PROPOSED DEMAND SIDE MANAGEMENT PLAN FOR GAZIFÈRE

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EXECUTIVE SUMMARY

The following discussion outlines a series of proposed Demand Side Management (DSM) initiatives for Gazifère. The discussion begins with a review of Gazifère's market and current energy efficiency efforts and then focuses on the recommended approach, the program specifications and the expected results. It concludes with a discussion of performance based incentive mechanisms.

The programs are intended to be realistic expressions of what is achievable in Gazifère's market. The approach taken involves relying as much as possible on the DSM planning efforts that have taken place in Ontario. This was seen as an effective way to develop appropriate programs while minimizing the up-front planning and development costs.

The proposed programs are expected to cost Gazifère $312,000 in Year 1 (both direct and indirect costs). The associated savings are approximately 623,000 m^3 per year. This is a highly cost-effective portfolio of programs. As well, the programs are designed to accommodate changes in the marketplace and to evolve as the utility evolves.

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1. BACKGROUND

Demand-side Management (DSM) plans as developed by utilities, governments or other agencies typically consist of a number of steps or components. The level of effort involved in each component is dependent upon a number of factors including data availability, marketplace characteristics and budgetary constraints. A full discussion of the design and development of a comprehensive DSM plan is provided in Appendix A.

The Plan presented here begins with a discussion of Gazifère's current levels of effort related to DSM and then presents the approach recommended for future program development. Program descriptions, costs and deliverables for each new program area are provided along with the rationale for the program.

Gazifère is a small utility with limited resources. As such, the basic intent of this planning exercise is to design a series of DSM programs that respect the spirit of a comprehensive approach as detailed in Appendix A without undertaking the significant costs associated with such an approach. The methodology is to rely on other utility experience for much of the supporting data and analysis, while using information specific to Gazifère for developing savings estimates for each market.

2. GAZIFÈRE'S MARKET

Any DSM programs that Gazifère undertakes must be done in the context of the current marketplace. Gazifère is a relatively small gas utility with all of its customers in the immediate Hull area. It supplies approximately 200 million cubic metres of gas annually. Of this, roughly

half is to three very large industrial customers, while the remainder is supplied to about 21,000 residential and 2,000 commercial customers. Much of this load is new load, having come on to the system in the past ten years. These facts affect the nature and scope of the energy efficiency programs the utility should consider. Specifically,

- All program efforts must acknowledge the relatively small size and market power of Gazifère. The utility should focus on its own set of customers first and participate with caution in large province-wide efforts.
- When feasible, the utility may wish to partner with strategic allies such as the federal and provincial governments or other utilities in the delivery of programs that advance the goals of the utility. Irrespective of any joint efforts, Gazifère will need to closely monitor events at both the federal and provincial levels as many new programs are currently being developed – some of which could be delivered to Gazifère customers. The new provincial energy agency's mandate in particular may impact the nature of the programs.
- The large customers represent an opportunity for tailored, customized projects. A large volume program that addresses the specific needs of these customers should be considered.
- Gazifère already has some well established delivery channels such as the rental and financing programs. These represent low cost and effective means of getting higher efficiency equipment into the market. They should continue to be used in any DSM program development.
- Many of Gazifère's residential customers are new homes. These homes are, by nature, much more efficient than older homes. As well, Gazifère has already delivered a variety of more efficient technologies to the marketplace (see Section 3). These facts mean that average loads have decreased noticeably over the past ten years. However, it also means that the

potential for energy efficiency improvements is now lower than what it was in the past. This has been the Ontario experience as well, and it has meant that the newest menus of energy efficiency programs tend to have less aggressive targets than the earliest programs.

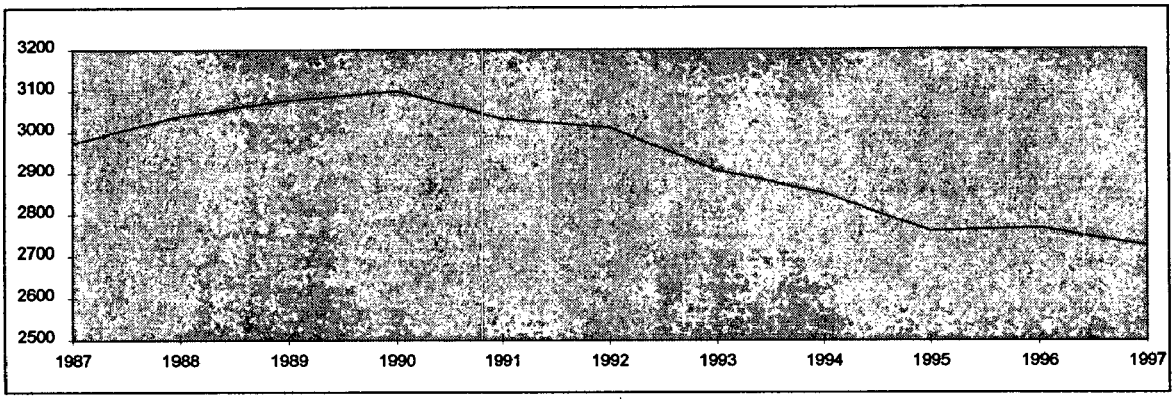
3. CURRENT MARKETPLACE FOR ENERGY EFFICIENCY

Any forecast of savings due to DSM must acknowledge both the current levels of technical efficiency in the market and any past or on-going utility/government energy efficiency initiatives. Often, this entails significant data collection and modelling exercises aimed at producing detailed forecasts of technical, economic and achievable potential savings estimates. For Gazifère's purposes, these exercises are not recommended at this time for two reasons: First, a large body of this information has already been compiled in Ontario and is available for use (see Section 4). Second, as part of its operating practices, Gazifère has developed a variety of data that supports an analysis of the marketplace.

Of particular interest is the average load data of the past ten years. Figure 1 shows the average residential load for the period 1987 to 1997. The increase in the first three years was driven largely by oil to gas conversions. After 1990, it is evident that a significant decrease in average residential consumption has occurred. This is due to the combined effects of a smaller and more efficient building stock (largely new) and the adoption of more efficient equipment/practices – most notably higher efficiency furnaces, tank temperature set-back and higher energy factor water heaters. In the case of furnaces, government regulation since 1992 has meant all new furnaces are mid-efficiency type or better. As well, since 1994 Gazifère has predominantly rented high efficiency condensing type furnaces. The changes in the furnace market combined

with Gazifère's initiatives aimed at lowering water heating demand[1] have made significant contributions to the overall efficiency of the housing stock with average load decreasing by approximately 10% since 1990.

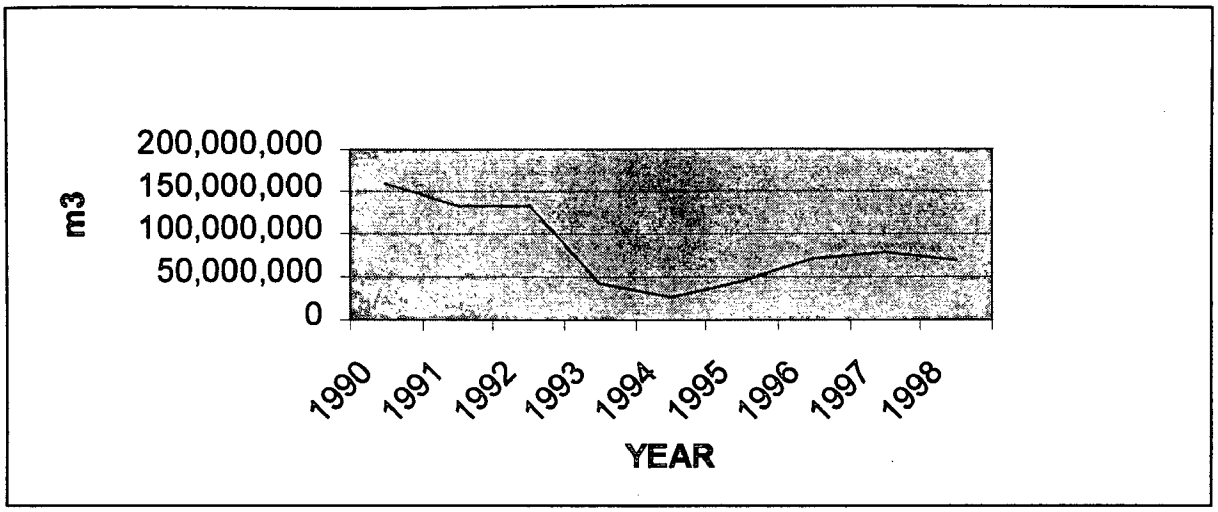
Figure 1. Residential Average Load



In the industrial sector, a similar pattern in average load has occurred. Figure 2 shows average industrial load over the same period. Clearly, a significant decrease in the average load for the industrial customers has occurred over the same period.

[1] Gazifère procures higher Energy Factor tanks for the rental program and lowers tank temperature settings during service calls.

Figure 2. Industrial Average Load



Note: Consumption of E.B. Eddy and Bowater only.

The fact that average load has decreased in both markets is important since it may limit the future potential reduction in average load that is possible due to energy efficiency improvements. In the case of the residential sector, this is likely the case as many customers already have energy efficient equipment. Further improvements to efficiency will be smaller and more costly.

As indicated, Gazifère is already active in a number of energy efficiency efforts. Table 1 summarizes the current menu of DSM type activities. These programs and efforts have been operated mainly for customer service reasons and as such, have not been deemed DSM by the utility. They are clearly DSM-type activities, however, and any programs conceived as part of this planning exercise must start with a recognition that significant energy efficiency improvements to the stock have already occurred. This will no doubt also affect the total potential improvement in the future.

Table 1. Current Energy Efficiency Programs

PROGRAM	TARGET SECTOR	DESCRIPTION
Rental Program: Water Heater Tank Procurement, Setback and Sizing	Residential and Commercial	Gazifère buys higher efficiency tanks (EF>.65 and ASHRAE 90.1 IES) for rental program and lowers tank temp setting during service calls. Proper sizing of tank based on load.
Rental Program: H.E. Furnaces	Residential	Predominantly high efficiency furnaces in rental program.
Maintenance and Inspection and Equipment Replacement	Residential and Commercial	Defective appliance upgrades to higher efficiency. Maintenance scheduled to maximize performance. Higher efficiency motors installed at failure. Set-back thermostats and proper filter usage recommended.
Customer Feedback	Residential and Commercial	High bill complaints and insufficient hot water calls are investigated with corrective actions recommended.

4. RECOMMENDED APPROACH

Appendix A presents a comprehensive methodology for the development of a DSM plan.

While this approach is rigorous, it is also time-consuming and expensive. As well, it largely ignores the well-developed body of expertise and documentation that has already been established in the field of DSM planning in Canada. Gazifère has the opportunity to short-cut much of the analysis presented in Appendix A by capitalizing on the recent planning efforts undertaken in Ontario by Union Gas and Enbridge Consumers Gas. These planning efforts represent the very best in planning approaches developed in Canada. Specifically, it is recommended that:

- Technologies identified by Enbridge Consumers Gas in their Year 2000 rate case[2] be accepted "as is" in the development of the Gazifère plan. A comprehensive list of technologies is provided in Appendix B. Per unit savings, costs, equipment life and Total Resource Cost Test results (pass or fail) are shown for each technology. Technologies that are cost effective from a societal perspective (Total Resource Cost Test) and meet the market needs of Gazifère have been included in one or more program designs.
- The generic program types and focus used in Ontario be adopted by Gazifère. Programs will be designed around sectors (residential, commercial, etc) and decision type (new, replacement and retrofit).
- Gazifère propose a portfolio of programs that are aimed specifically at an overall market transformation to higher efficiency. Market transformation represents the next generation of DSM programs wherein the traditional customer focused incentive programs are re-oriented towards an up-stream delivery channel focus.
- Gazifère propose a portfolio of programs that are consistent with the size of the market, add customer value and strive to minimize utility costs.
- Gazifère use a staged approach to the implementation of DSM whereby a selection of programs are initiated in Year 1 and allowed to develop over a two to three year time horizon. Some of these programs will be infrastructure support in nature and will not garner savings in the first year.
- Gazifère develop an electronic measurement and tracking tool which will accurately track numbers of participants, net savings and utility costs. This tool and the resulting data will

[2] "2000 Demand Side Management Plan" – RP-1999-0001 – as filed with the Ontario Energy Board.

provide the foundation for any evaluation activities the utility undertakes. It will also provide a "paper trail" of efforts and allow for justification of expenditures.

- Using the tracking information as a base, conduct research and analysis in support of the savings, cost and number of participants estimates (load impact evaluation) and monitor the effectiveness of the program delivery (process impact evaluation).

Note that by capitalizing on the significant experience in Ontario, Gazifère can minimize the up-front DSM planning effort but still be assured of proposing a well-rounded portfolio of cost effective DSM programs. The following discussion outlines a proposed portfolio of programs with a focus on first year participants, costs and savings. Year one is assumed to coincide with Gazifère's first full year of program activities. While a staged approach over a number of years is recommended for the development of the programs, subsequent year estimates have not been made due to the uncertain nature of many of the infrastructure support efforts.

5. PROPOSED PROGRAMS

The following discussion presents the proposed portfolio of programs. Program savings are estimated using the per unit natural gas savings provided in Appendix B, estimates of the number of participants based on current and expected Gazifère activities, and free rider estimates as appropriate. The per unit savings estimates represent annual savings. The free rider estimates are based on current sales data where available, program experience in Ontario and expert opinion.

Program costs are determined using a bottom-up approach that calculates both incentive cost and program delivery/support costs.

The net savings and cost estimates are provided in table form for each sector where savings are estimated – residential and commercial - and for the total portfolio.

5.1 Residential Sector

Residential Water Heating: Component 1. Tank Procurement.

The Company will continue its practice of procuring higher efficiency water heater tanks for use in the rental program. The tanks have a minimum energy factor (EF) rating that is three percentage points higher than the government standard. Gazifère procures 2,000 tanks annually for the rental program. Per unit savings are 49 m^3. Net savings for this component are thus estimated at 98,000 m^3 per year.

The incremental cost of procuring the higher efficiency tanks is built into the cost of the tanks and covered by the rental rates.

Residential Water Heating: Component 2. Water Heater Service Calls.

All residential calls related to water heater service requirements will receive a package of energy savings measures. These include: tank temperature setback, pipe insulation, faucet aerator and showerhead. The pipe insulation would be installed as part of the service call and the

showerhead and aerator left with the customer. Annual service calls are estimated at 1,500 and the per service call savings[3] are 160 m^3 per year. This yields an annual savings of 240,000 m^3.

The measures will be provided to customers at no charge. The entire cost of the package to Gazifère is estimated at $20 per customer. Assuming 1,500 service calls annually gives a total incentive cost to the utility of $30,000 per year. Program support costs related to operating the program include initiatives such as bill advertising. These costs are estimated at $5,000 per year. Total cost to the utility is thus $35,000. No accommodation of either user pay or assistance from the regional water authority (Outaouais Urban Community) is made in this program design, however either of these would lower the cost of this initiative. Partnering with the water authority in particular may be a very cost effective way of delivering the program.

Residential Space Heating: Component 1. High Efficiency Furnace Promotion.

The Company will promote high efficiency (condensing) furnaces in replacement and conversion opportunities through promotional materials and the use of incentives. The focus of the incentive effort will be two-fold: promotional materials for customers and incentives for channel partners. Dealers and contractors will receive a $200 incentive for high efficiency furnaces purchased in replacement and conversion opportunities.

While dealers and contractors are the key channel partners for delivering the program, the ability to rent the equipment from Gazifère is an important feature for successful implementation. In

3. Note that the savings estimate is not equal to the sum of the individual measures. Instead an estimate that accommodates the interactive effects of the four measures is specified.

the past, the rental program has played an important role as an avenue for customers to receive equipment. Continuing this capability will support the promotional efforts of the program.

High efficiency furnaces will penetrate the market via two avenues: (1) replacements of lower efficiency natural gas furnaces in the existing stock and (2) conversions from other fuels to natural gas.

In the replacement market, there are currently approximately 18,000 residential space heating customers in Gazifère's franchise area. Of these, approximately 5,400 are owned and rented by Gazifère. Since 1995, the rental program has focused on high efficiency furnaces and as such these units have an 87% share of new rentals and a 44% share overall equating to roughly 2,380 units. The remainder of the space heating market (ie. non-rentals) has a lower percentage of high efficiency furnaces. For this assessment, a 10% share is assumed (1,260 units). In combination, the market share estimates mean that there are approximately 3,640 high efficiency furnaces and 14,360 conventional and mid efficiency furnaces in the franchise. Assuming an equipment life of 20 years means that 720 (14,360/20) conventional and mid-efficiency furnaces are replaced annually. This is the target market for the furnace replacement program.

The target market represents the total potential for the furnace replacement program. Of this, the program can be expected to achieve approximately 50% of the total potential. This equates to 360 units. This is the achievable potential for the program. Note as well that a free rider estimate is specified for this program as there is already a naturally occurring penetration of high

efficiency furnaces. The free rider estimate is 30% which is based on current market share data.[4] The free rider estimate implies that 30% of participants would decide to install a high efficiency furnace in the absence of the program. These participants are not included in the quantification of program savings, however they are included in the calculation of total program costs as they do receive the incentive. The per unit natural gas savings are 679 m^3 per year. Combining the number of participant, free rider and per unit savings estimate gives a net annual savings of 171,108 m^3 in the replacement market.

For conversions from other fuels, the number of new space heating customers in the conversion market has averaged 400 per year over the past few years. Using the same assumptions as for the replacement market, it assumed that 50% will choose high efficiency furnaces under the program, with 30% of those being free riders. Thus 200 customers in the conversion market will choose high efficiency, 60 of which are free riders. Combining the number of participant, free rider and per unit savings estimate gives a net annual savings of 95,060 m^3 in the conversion market.

Utility costs for this component are estimated at $122,000. This is derived assuming an incentive of $200 per unit applied to all participants plus annual advertising and support costs of $10,000.

4. Average annual high efficiency furnace sales for the period 1996 through 1998 were 31% of total market.

Residential Space Heating: Component 2. Fireplace Efficiency Level Support

The Company will promote EcoLogo[5] fireplaces and will support federal and provincial agencies in the support of minimum efficiency ratings for natural gas fireplaces when appropriate. The Company will also collect the relevant data related to average efficiency levels for fireplaces in the franchise and the various equipment costs. Since these data have not yet been collected, it is premature to attempt to estimate the savings for the program. The costs for this program are considered minimal.

Total Residential Sector Results.

Table 2 provides details on the program results for the residential sector. Over 600,000 m^3 savings (net of free riders) are expected from this portfolio at an expected cost to Gazifère of $157,000 in Year 1. Incentives for high efficiency furnaces are the largest component of the total program costs.

Table 2. RESIDENTIAL SECTOR PROGRAMS

		# OF PARTIC	FREE RIDERS	SAVINGS PER PARTIC M^3	TOTAL NET SAVINGS M^3	INCENTIVES	DIRECT SUPPORT COSTS	TOTAL COSTS
WATER HEATING	COMP 1	2000	0	49	98,000	$ -	$ -	$ -
	COMP 2	1500	0	160	240,000	$ 30,000	$ 5,000	$ 35,000
SPACE HEATING	COMP 1	560	30%	679	266,168	$ 112,000	$ 10,000	$ 122,000
	COMP 2	0	0	0	-	$ -	$ -	$ -
TOTAL RESIDENTIAL		4060	N/A	N/A	604,168	$ 142,000	$ 15,000	$ 157,000

[5] EcoLogo is a national environmental labelling organization that is developing labelling standards based on environmental/energy efficiency considerations.

5.2 Commercial Sector

Commercial Water Heating: Component 1. Tank Procurement.

The Company will continue its practice of procuring higher efficiency tanks for use in commercial applications in the rental program. Many of the tanks are assumed to be residential tanks in commercial applications. As such, the per unit savings and costs are the same as those specified in the residential discussion. Gazifère currently procures approximately 100 tanks annually for the commercial rental program. Per unit savings are 49 m^3. Net savings for this component are thus estimated at 4,900 m^3 per year

This component also includes an accommodation for the rental of larger commercial tanks. The focus for this effort will be the continued procurement and rental of ASHRAE 90.1B commercial tanks which have a higher energy rating and lower heat loss than the standard commercial tank. A projection of 20 units in Year one reflects the relatively small number of customers which use these tanks. Per unit savings are 700 m^3 giving a total net savings of 14,000 m^3.

No incremental program costs for the commercial procurement effort are specified since this is the continuation of an existing procurement policy.

Commercial Space Heating: Component 1. Higher Efficiency Boilers.

The Company will promote the use of higher efficiency mid-range and condensing commercial boilers using both an incentive mechanism and general awareness campaigns aimed at commercial dealers and contractors. Incentives for higher efficiency commercial boilers will be

set at $0.05/m^3$ of savings up to a maximum of $2,000. It is expected that the average incentive will be $1,000. The incentive and awareness campaigns will focus on contractors and consulting engineers. Part of this effort will utilize a registry of qualified dealers who will be responsible for delivering the program.

Participation is expected to be minimal initially as the infrastructure needs at least a year to get established. First year activities thus are purely support costs. The cost of the registry and supporting awareness information is estimated at $5,000.

Total Commercial Sector Results.

Table 3 provides the program results and the total commercial sector activities. Savings are projected to be approximately 19,000 m^3 with total program costs of $5,000.

Table 3. COMMERCIAL SECTOR PROGRAMS

		# OF PARTIC	FREE RIDERS	SAVINGS PER PARTIC M^3	TOTAL NET SAVINGS M^3	INCENTIVES	DIRECT SUPPORT COSTS	TOTAL COSTS
WATER HEATING	COMP 1	100	0%	49	4,900	$ -	$ -	$ -
	COMP 1a	20	0%	700	14,000	$ -	$ -	$ -
SPACE HEATING	COMP 1	0	0%	0	-	$ -	$ 5,000	$ 5,000
TOTAL COMMERCIAL		180	N/A	N/A	18,900	$ -	$ 5,000	$ 5,000

5.3 Industrial/Commercial Custom Energy Management Services (CEMS).

Gazifère has a small number of large volume industrial customers. There are also a selection of larger commercial customers (termed fringe industrial) that can benefit from industrial style technologies and service offerings. Both of these customer types are the focus of the CEMS program. The program leverages services currently offered through third parties such as consulting engineers and energy services companies. Gazifère is responsible for the customer/third party introduction and initial project mediation. As well, Gazifère will provide partial funding of the initial audit. The third parties are responsible for delivering the energy efficient technologies and energy conservation measures. As part of the obligation of the third party receiving customer leads, they are responsible for reporting implemented savings back to the utility.

The program uses a comprehensive approach to the market wherein no specific measure or technology is initially promoted, but the mechanism to identify and promote higher efficiency opportunities is established. This then allows volumes from all implemented measures, regardless of technology, to be claimed towards the DSM program. The savings potential is identified through an up-front audit delivered by the engineering firm or energy services company.

Gazifère will support this initial audit component by paying one-third of the audit cost up to a maximum of $5,000. This commitment by the utility is intended to both alleviate customer perceived risk and ensure that the audit and any eventual energy efficiency retrofits are properly reported back to Gazifère. Note that both Union Gas and Enbridge Consumers Gas in Ontario

offer similar programs and have found that support of the audit is a very effective way of building interest in the savings potential for the customer. Most customers that have an audit performed do go on to implement at least some of the energy efficiency upgrades.

Freeridership and life expectancy of measures is considered on a case by case basis, dependent on customer knowledge, market factor conditions and technology installed.

Within the CEMS program, energy savings opportunities are evaluated within a number of potential areas. These include:

- Monitoring and Targeting (M&T) where a metering and tracking system is installed to educate energy users on conservation techniques.
- Boiler system evaluations including boiler audits and tune-ups.
- Heating equipment maintenance and replacement including rooftop units and make-up air systems.
- Process measures such as burner systems, dryers or compressed air.
- Waste heat recovery analysis (pinch technologies).

Experience in Ontario indicates that potential savings are significant in all of the above areas. As an example, the Steam Saver audit program offered by Enbridge Consumers Gas has identified average savings of 16% within a simple payback period of ~1.6 years. Savings at specific sites vary depending on the boiler application, quality of system design, and equipment condition.

As this program is primarily an infrastructure support effort initially, no savings have been estimated at this point. However, it is expected that ~10% of industrial gas consumption could be economically achievable within a 2-3 year sales cycle. The cost of initiating the program relates to two requirements. First, there will be introductory mailings, meeting costs and some small general expenses. Second, an external consultant will be needed to assist in developing both the list of key deliverables for the audit and the terms of reference for the identification of potential partners. Incremental costs for all of these efforts are estimated at $10,000. In Year 1, it is forecast that three customers will take advantage of the audit. The cost is estimated at $5,000 for each for a total cost of $15,000 in audit incentives. Total program costs are thus $25,000. With the successful development of the infrastructure, savings should begin by Year 2.

5.4 Residential/Commercial Construction: Infrastructure Support

Gazifère will undertake to support federal and provincial initiatives related to the implementation of better construction practices in the residential and commercial sectors. This component recognizes that significant improvements in construction practices in Quebec have already occurred – especially in the residential sector. However, there are still specific opportunities related to supporting higher building codes and training trades workers etc. This effort could also include facilitating or supporting the delivery of federal/provincial initiatives aimed at promoting energy efficiency in new construction. Specific programs that may apply include the federal Model National Energy Codes and the Commercial Building Incentive Programs.

As this is purely an infrastructure support program, no savings or cost estimates are specified in Year 1.

6. TOTAL BUDGET AND SAVINGS

Table 4 provides the total savings and direct costs for the entire portfolio of programs in Year 1, where Year 1 is assumed to begin in October 2000. Total first year direct costs [6] are expected to be $187,000 while savings are approximately 623,000 m^3 per year. Costs and savings for subsequent years have not been established pending results of the infrastructure support efforts. Note as well that some program related expenditures may occur in FY1999. These are not accounted for in this assessment.

Table 4. TOTAL PROGRAM RESULTS AND DIRECT COSTS

SECTOR	TOTAL NET SAVINGS (M^3)	INCENTIVES	DIRECT SUPPORT COSTS	TOTAL COSTS	COST PER M^3 SAVED
RESIDENTIAL	604,168	$ 142,000	$ 15,000	$ 157,000	$ .260
COMMERCIAL	18,900		$ 5,000	$ 5,000	$ .265
INDUSTRIAL		$ 15,000	$ 10,000	$ 25,000	
NEW CONSTR					
TOTAL	623,068	$ 157,000	$ 30,000	$ 187,000	$ .300

Table 5 provides the total budget for Year 1. It includes both the direct costs as per Table 4 and all indirect costs which include research related costs, overheads etc. The overhead cost represents one full time equivalent (FTE) employee. Other costs include research and external consulting costs. Total cost for all DSM activities in Year 1 is estimated at $312,000.

[6] Direct costs are for program implementation and incentives. They do not include overheads or supporting research costs.

Table 5. TOTAL DIRECT AND INDIRECT COSTS

	COST TYPE	YEAR 1 COST
1	Incentives	$157,000
2	Support Costs	$30,000
	Total Direct Costs (1,2)	$187,000
3	Research	$25,000
4	Overheads	$100,000
	Total Costs (1,2,3,4)	$312,000

Referring to Table 4, the cost per m^3 savings value provides a useful indicator for comparative purposes. It is an index of total direct costs divided by total first year savings. Table 6 provides the costs and projected savings for the first DSM plans filed by Union Gas and Enbridge Consumers Gas by major program area. It also shows the cost per m^3 saved index. As can be seen, Gazifère's index falls between the two large Ontario utilities. More important however is the trend that has occurred in Ontario where the index has dropped significantly as the utilities gained experience with their programming activities. It is expected that Gazifère's index would begin to drop as program experience is gained. Note as well that both Ontario utilities have very low industrial indices as compared to the other sectors. This is typical since industrial programs usually deliver significant savings at minimal cost to the utility. Gazifère can expect similar results once its industrial program is operationalized.

Table 6. Other Utility Programs

	GAZIFÈRE			ENBRIDGE CONSUMERS GAS 1995 PLAN			UNION GAS 1997 PLAN		
SECTOR	SAVINGS (M^3)	TOTAL COSTS	COST PER M^3 SAVED	SAVINGS (M^3)	TOTAL COSTS	COST PER M^3 SAVED	SAVINGS (M^3)	TOTAL COSTS	COST PER M^3 SAVED
RESIDENTIAL	604,168	$ 157,000	$ 0.260	803,000	$ 1,044,000	$ 1.300	3,232,000	$ 1,050,000	$ 0.325
COMMERCIAL	18,900	$ 5,000	$ 0.265	294,000	$ 360,000	$ 1,224	624,000	$ 800,000	$ 1.283
INDUSTRIAL		$ 25,000		891,000	$ 1,247,000	$ 1.400	7,395,000	$ 500,000	$ .068
AGRICULTURE							32,000	$ 50,000	$ 1.55
TOTAL	623,068	$ 187,000	$ 0.300	1,988,000	$ 2,651,000	$ 1.334	11,283,000	$ 2,400,000	$ 0.213

Total costs are direct costs, excluding overheads.

7. NEXT STEPS

- Operationalizing this Plan – The need to develop an implementation/business plan. Staff commitments, training needs, marketing data and literature and infrastructure support requirements need to be confirmed and built into the business plan. As indicated, it is expected that one full time equivalent (FTE) resource will be needed in Year 1 as well as some specialized consulting services in some program areas – notably industrial. Gazifère may wish to allocate a number of people initially to get the programs started. Resources could then be cut back as the programs are established. Note that it is important that programs be developed and delivered in all areas in the same time frame. This helps to establish the energy efficiency message in the marketplace and also builds synergy between the various programs. The synergistic effects are especially important since many of the delivery agents operate in more than one market.
- Develop monitoring and evaluation plans and tools. The short term requirement is for a tracking tool which allows for monthly reporting of number of customers, net savings, incentive and support costs. This tool can be as simple as a spreadsheet which is manually updated or a more sophisticated automated system.

- Build on the current programs and develop new programs. Beyond Year 1, Gazifère will need to fine-tune the existing menu of programs based on their initial successes and may also need to put in place new program components. In particular, the infrastructure support efforts have higher uncertainty than the other program components and careful monitoring of market reaction to the programs will be required.

8. PERFORMANCE BASED INCENTIVES

The use of Shared Savings Incentive Mechanisms (SSM) to promote energy efficiency at utilities is becoming more common in Canada and the U.S. The basic rationale is that energy efficiency represents a new business undertaking for utilities which does not contribute to profits. This concept is underscored by traditional regulatory practices which generally link the earnings of a utility to its total sales. Because energy efficiency decreases load, the fundamental orientation of conventional regulatory practice penalizes energy efficiency investments. Shared savings incentives to reward utility DSM activities were first proposed in the U.S. in 1988 as a way to address this regulatory bias. They are intended to compensate the utility for the extra costs and efforts associated with operating DSM programs. Note that a separate mechanism – the Lost-Revenue Adjustment Mechanism or LRAM is often used in conjunction with the SSM to compensate specifically for the lost revenues. As such the LRAM is mainly intended to reduce or eliminate one of the major disincentives to DSM, but it does not necessarily provide a positive incentive to promote DSM.

The basic idea with an SSM is that the benefits of cost effective energy efficiency improvements promoted by the utility can be shared among the customers participating in the utility program,

all utility ratepayers, and the utility. For the participants, the energy (natural gas) bill is lowered. For the utility ratepayers, the costs of providing natural gas are reduced as compared to the utility doing nothing to promote energy efficiency. For the utility, a fraction of the net savings to all ratepayers is retained as earnings. There are a variety of models used to determine the exact amount of the SSM and the selection of the approach is usually made in the context of the utility's specific circumstances. In Ontario, both Union Gas and Enbridge Consumers Gas in Ontario have proposed the use of SSMs to the Ontario Energy Board.

Studies conducted by the American Council for an Energy Efficient Economy[7] indicate that for energy efficiency efforts, utilities that make use of an SSM generally out-perform utilities that do not have an SSM. There are a variety of reasons for this, however the main impact likely relates to the allocation of corporate resources to the energy efficiency activities. Energy efficiency activities compete with other corporate resources and if DSM activities are seen to be profitable, they are more likely to receive appropriate consideration in the context of the other activities. In addition, DSM activities are a non-traditional activity for the utility which require significant resources and effort.

Recent evidence in Ontario suggests that support for the SSM concept will come from the majority of parties in the stakeholder process. Both industry and environmental advocates see the use of the SSM as a way of both rewarding the utility for legitimate DSM activities and ensuring that there is an economic argument for those activities. While it is acknowledged that the gas utilities continue to operate in a regulated environment, it is also accepted that that

[7] Regulatory Incentives for Demand-Side Management, Chapter 12. American Council for an Energy Efficient Economy. May, 1992.

environment is increasingly competitive and there needs to be a "business case" developed for all activities. The SSM supports the development of the business case for DSM.

The adoption of an SSM is important to the utility, customers and the regulatory authority. It gives the appropriate signals to all parties regarding the commitment to energy efficiency.

APPENDIX A

DSM PROGRAM DEVELOPMENT

DSM PROGRAM DEVELOPMENT

DSM program design, development and implementation has evolved significantly since the first efforts undertaken by U.S. electric utilities. In Ontario, the major natural gas utilities – Enbridge Consumers Gas and Union Gas have been delivering energy efficiency programs for a number of years. Both utilities have developed and filed comprehensive DSM plans with the regulatory authority – the Ontario Energy Board (OEB). These plans represent the state-of-the-art with respect to DSM planning. The process in Ontario has identified a number of key objectives and components for any DSM plan. These are discussed in detail below.

1. DSM Principles and Objectives

The following is a list of principles and objectives currently used by the gas utilities in Ontario to assist in selecting and prioritizing individual DSM initiatives.

1.1 DSM Principles

- Facilitate the efficient use of gas by customers in each market segment by developing and delivering customer-valued DSM programs.
- Foster and support DSM innovation and experimentation, new technologies and methodologies.
- Aspire towards permanent market transformation where customer attitudes and actions place a priority on energy efficiency.
- Ensure that the DSM efforts do not result in undue rate impacts on customers.

- Employ a user pay principle subject where cost recovery will not unduly restrict program participation.

1.2 DSM Objectives

- Develop and implement a societal cost effective portfolio of DSM programs that reduces natural gas consumption. These programs will:
    - fulfill customer needs,
    - identify and address market barriers,
    - to the degree possible and practical, ensure that lost opportunities are captured;
    - allocate to, and appropriately recover, DSM program costs and revenue impacts from the individual rate classes.
- Conduct effective monitoring and evaluation for each program to provide measurable feedback on customer participation and satisfaction, program delivery mechanisms, load impacts, and emissions reductions.
- Build upon existing market expertise to reduce duplication of effort by utilizing the opportunities to partner with other stakeholders.
- Ensure open dialogue with interested or affected parties through a formal consultative process.

2. Framework for the Development of a Portfolio of DSM Programs

There are a number of components required to develop a defensible plan. The following sections highlight the typical approach used in many jurisdictions. The level of effort

will vary dependent upon data availability, market characteristics and budgetary constraints, however, most plans are generally developed using this format.

2.1 Select Screening Methodology

DSM programs and the measures they promote are expected to be cost effective. The most commonly used set of tests used by utilities to screen DSM initiatives are those developed in the 1980's by the California Energy Commission. Of these, the "Societal Cost Test" which measures the costs and benefits of DSM from a societal perspective is the hurdle test for DSM programs currently offered by the gas utilities in Ontario.[1] In this test, the benefits are expressed in terms of the avoided cost of natural gas. The costs consist of incremental equipment cost and utility program costs. The test as applied in Ontario also allows for the use of monetary values for emissions reductions as an added benefit, and both Enbridge Consumers Gas and Union Gas make use of this feature.

As a second-level screen, the utilities consider the "Rate-payer Impact Measure Test" (RIM). This test measures the affect on rates of the implementation of a DSM initiative. While this is not a hurdle test, the expectation is that the results of this test for the portfolio of programs will not be considered "undue".[2]

There are a variety of software tools that are used in the cost effectiveness analysis of DSM programs. Enbridge Consumers Gas and Union Gas both use the same Excel based spreadsheet model which allows for the expression of streams of costs and benefits in a single Net Present Value (NPV) number.

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[1] For a full discussion, see the "Standard Practice for Cost-Benefit Analysis of Conservation and Load Management Programs", California Energy Commission, 1987.

[2] While "undue" has not been clearly defined, it is generally understood that rate impacts should be less than 1%.

2.2 Develop Avoided Costs

Avoided or marginal cost(s) represent the benefits from the implementation of a DSM program. They are usually expressed in terms of forecast streams of expenditures that the utility undertakes to supply incremental natural gas. As such, they consist of throughput purchases, storage costs and investments in facilities and equipment (including construction) associated with the delivery of an incremental supply of natural gas.

2.3 Develop Relevant Market Data and Information

Certain market data is required to support the development of the planning projections and assumptions. This includes information regarding the number and type of customers, the nature of their facilities and equipment, and projections of how these are expected to change over time. Typically, gas utilities have reasonably good data on number of customers by class and numbers of specific types of technologies (water heaters, furnaces etc.). Less certain are the data related to other specific loads (commercial boilers, for example) and the forecasts of the various components. It is necessary to make certain assumptions for the missing data and develop forecasts where appropriate.

2.4 Develop List of Cost Effective Technologies to be Included in Programs

Ultimately, the portfolio of programs will rely on specific equipment to deliver the energy efficiency savings. As indicated, all technologies are expected to be cost effective from the societal perspective. A list of technologies that meet this criterion is required to feed the eventual program designs. Certain specific information is required for each

technology considered. This information represents the basics for cost effectiveness analysis. For both the existing (base case) technology and the energy efficient technology, the requirements are:

- annual usage,
- installed cost,
- expected equipment life.

Based on this information, estimates of incremental cost and savings are used in conjunction with the avoided costs to determine the cost effectiveness for each technology considered. Those that are cost effective are then considered for inclusion in a program or programs.

Both Enbridge Consumers Gas and Union Gas have developed well-documented lists of energy efficient technologies covering a variety of residential, commercial and industrial equipment types. This information resides in the public domain and represents an excellent foundation for Gazifere's efforts in this area.

2.5 Develop and Screen Potential Programs and Select Candidate Programs

For our purposes, "program" is defined as a set of cost effective DSM measures, using a number of delivery channels to encourage decision makers to make energy efficiency investment choices. This means that the screening process for programs is based on a composite of the included measures, the forecasted penetration of those measures, their freeridership value, and all direct program costs. Overhead costs and other indirect expenditures are included at the aggregate level. Together these provide for an analysis of the total costs and benefits for the delivery of DSM activities in total.

In this process, the selection of candidate programs is more accurately described as a selection of the level of effort among programs and the emphasis given to program elements. This process is usually an iterative one that includes a variety of more qualitative considerations such as timing, resource constraints, market characteristics and competitive forces. The goal is to have a defensible set of programs that meet the criteria defined at the outset.

2.6 Develop Monitoring and Evaluation (M&E) Strategies

M&E is undertaken for a number of reasons. The Regulator needs to ensure that program expectations are tracked and evaluated. There may be both Lost Revenue Adjustment Mechanisms (LRAM) or Shared Savings Mechanisms (SSM) that the Regulator adopts. Both require rigourous tracking and evaluation. The utility also needs to ensure that its programs are delivered cost effectively and meet shareholder expectations. Evaluation can also assist in fine-tuning program designs as the programs are rolled out.

M&E plans usually include two general types of evaluation: impact and process. Impact evaluations focus on the actual impacts of the programs – number of participants, savings and costs. Impact evaluations require that these data are collected in a consistent and documented manner. Most utilities develop an electronic tracking system to support this exercise. For LRAM variance reporting, the data is normally updated monthly. Process evaluations focus on how well the various delivery mechanisms operated and are more qualitative in nature. Process evaluations often rely on surveys, focus group research etc. to collect the required information.

While there is a significant amount of previous experience from other utilities to draw on, M&E plans are very specific to the franchise. Experience in Ontario also indicates that they need to be developed as part of the planning stage, not as an afterthought. Research requirements are often easy to identify in a planning scenario but become less so when the focus shifts to implementation.

2.7 Intervenor and Regulatory Review

The consultative process is an important facet of securing regulatory acceptance. The Ontario experience clearly shows that involvement of the various intervenors at the earliest stages of the DSM Plan is critical for the development of a Plan that all the various parties agree to.

APPENDIX B

TECHNOLOGY DATA AND SCREENING RESULTS

RESIDENTIAL NEW CONSTRUCTION MEASURES

End-Use	Efficient Technology	Base Technology	Description	Gas Savings (m^3/yr)	Incremental Cost ($)	Equipment Life (Yrs)	Benefit/Cost Ratio > 1 TRC
Water Heating	Condensing Gas Water Heater	Power Vent Water Heater	86% energy factor	200	$ 1,000.00	15	No
Water Heating	Direct Vent Water Heater	Power Vent Water Heater	Direct Venting with outdoor air	50	$ 100.00	15	No
Water Heating	Grey Water Heat Recovery	No Heat Recovery	Heat exchanger on outlet water recovers heat	240	$ 500.00	15	No
Water Heating	High Efficiency Water Heater	Standard Water Heater	Procurement Standard - 65% energy factor	49	$ 14.83	15	Yes
Water Heating	Horizontal clotheswasher	Conventional Clotheswasher	Front loading clothes washer, uses 58% less water (40% less hot water)	70	$ 400.00	15	No
Water Heating	Hot Water Recirculation	No Recirculation	System uses timers and controls for "on-demand" water	224	$ 500.00	15	No
Water Heating	Pipe Insulation - Full wrap	Existing Pipe - No Wrap	Wrap full length of water pipe to reduce heat loss	34	$ 63.00	20	No
Water Heating	Pipe Insulation - One metre	Existing Pipe - No Wrap	Wrap one metre of water pipe to reduce heat loss	11	$ 3.50	20	Yes
Water Heating	Pipe Insulation - Two metres	Existing Pipe - No Wrap	Wrap two metres of water pipe to reduce heat loss	17	$ 4.00	20	Yes
Water Heating	Set point Reduction	Standard Water Heater	Lowers tank temperature from 140 F to 130 F	100	$ -	15	Yes
Water Heating	Solar Assisted Water Heater	Standard Water Heater	Solar assisted water heating with natural gas back up	400	$ 2,200.00	15	No
Water Heating	Tankless Water Heater	Standard Water Heater	95% energy factor - no storage tank	120	$ 1,300.00	15	No
Water Heating	Ultra High Efficiency Water Heater	Standard Water Heater	Premium Tank - 67% energy factor	51	$ 50.00	15	Yes
Water Heating	Water Heater with Heat Trap	Standard Water Heater	Reduces migration of heat into pipes	17	$ 20.00	15	Yes

RESIDENTIAL NEW CONSTRUCTION MEASURES

End-Use	Efficient Technology	Base Technology	Description	Gas Savings (m^3/yr)	Incremental Cost ($)	Equipment Life (Yrs)	Benefit/Cost Ratio > 1 TRC
Space Heating Space Cooling	Attic Insulation (R-40)	(R-30)	Increase amount of insulation in the attic beyond building code	50	$ 150.00	30	No
Space Heating	Basement Upgrade Package	OBC Home	Basement Upgrade Package including wall & under slab insulation	400	$ 700.00	25	Yes
Space Heating Water Heating	Combination Water/Space Heating Unit	H.E. Furnace & P.V. Tank	Water Heater with Air Handler	204	$ 200.00	15	No
Space Heating Space Cooling	Comprehensive Air Sealing	Standard Air Sealing	Comprehensive duct and sill plate sealing for air leakage and HVAC design and balancing	600	$ 1,200.00	15	No
Space Heating	Gas Heat Pump	High Efficiency Furnace	Performance rating of 1.3	450	$ 8,000.00	19	No
Space Heating	High Efficiency Furnace	Mid Efficiency Furnace	Condensing Gas Furnace	416	$ 700.00	19	No
Space Heating Space Cooling	Heat recovery ventilator (HRV)	No HRV	Recovers heat loss in ventilation - used to pre-heat intake air	220	$ 500.00	20	No
Space Heating Space Cooling	Low E Windows (R-3)	Standard Windows (R-2)	165 sq ft upgrading of window or all windows in a typical sized home	105	$ 250.00	25	Yes
Space Heating Space Cooling	Low E Windows (R-3)	Standard Windows (R-2)	250 sq ft upgrading of window or all windows in a custom home	159	$ 320.00	25	Yes
Space Heating Space Cooling	Triple Pane plus Low E Windows	Standard Windows (R-2)	250 sq ft upgrading of window or all windows in a custom home	300	$ 3,000.00	25	No
Space Heating Space Cooling	Programmable Thermostat	Standard Thermostat	Lowers heating and cooling requirement when home is un-occupied	160	$ 25.00	20	Yes
Space Heating Space Cooling	R2000 Home	OBC Home	Performance Standard - 40% savings on heating load	800	$ 2,000.00	30	Yes
Clothes Drying	Moisture Sensor	No Moisture Sensor	Shuts off dryer when clothes are dry	10	$ 30.00	15	No

RESIDENTIAL EXISTING HOMES MEASURES

End-Use	Efficient Technology	Base Technology	Description	Gas Savings (m³/yr)	Incremental Cost ($)	Equipment Life (Yrs)	Benefit/Cost Ratio > 1 TRC
Water Heating	Condensing Gas Water Heater	Standard Water Heater	86% energy factor	219	$ 1,000.00	15	No
Water Heating	Direct Vent Water Heater	Power Vent Water Heater	Direct Venting with outdoor air	50	$ 100.00	15	No
Water Heating	Faucet Aerators	Existing faucet	Install aerators that reduce water flow	17	$ 2.50	8	Yes
Water Heating	Grey Water Heat Recovery	No Heat Recovery	Heat exchanger on outlet water recovers heat	240	$ 500.00	15	No
Water Heating	High Efficiency Water Heater	Standard Water Heater	Procurement Standard - 65% energy factor before volume adjustment	49	$ -	15	Yes
Water Heating	Horizontal clotheswasher	Conventional Clotheswasher	Front loading clothes washer, uses 58% less water (40% less hot water)	70	$ 400.00	15	No
Water Heating	Hot Water Recirculation	No Recirculation	System uses timers and controls for "on-demand" water	224	$ 500.00	15	No
Water Heating	Low Flow Showerhead	Existing Showerhead	Install showerheads that reduce water flow	93	$ 10.00	11	Yes
Water Heating	Pipe Insulation - Full wrap	Existing Pipe - No Wrap	Wrap full length of water pipe to reduce heat loss	34	$ 63.00	20	No
Water Heating	Pipe Insulation - One metre	Existing Pipe - No Wrap	Wrap one metre of water pipe to reduce heat loss	11	$ 3.50	20	Yes
Water Heating	Pipe Insulation - Two metres	Existing Pipe - No Wrap	Wrap two metres of water pipe to reduce heat loss	17	$ 4.00	20	Yes
Water Heating	Set Point Reduction	Standard Water Heater	Lowers tank temperature from 140 F to 130 F.	100	$ -	15	Yes
Water Heating	Solar Assisted Water Heater	Standard Water Heater	Solar assisted water heater with natural gas back up	400	$ 2,200.00	15	No
Water Heating	Tankless Water Heater	Standard Water Heater	95% energy factor - no storage tank	120	$ 1,300.00	15	No
Water Heating	Ultra High Efficiency Water Heater	Standard Water Heater	Premium Tank - 67% energy factor	51	$ 50.00	15	Yes
Water Heating	Water Heater with Heat Trap	Standard Water Heater	Reduces migration of heat into pipes.	17	$ 20.00	15	Yes
Water Heating	Water Heater Blanket	Standard Water Heater	Wrap water heater (Selected pre 1990 tanks only)	54	$ 40.00	10	Yes

RESIDENTIAL EXISTING HOMES MEASURES

End-Use	Efficient Technology	Base Technology	Description	Gas Savings (m³/yr)	Incremental Cost ($)	Equipment Life (Yrs)	Benefit/Cost Ratio > 1 TRC
Space Heating Space Cooling	Attic Insulation (R-40)	R-32	Increase the amount of insulation in the attic during upgrade	65	$ 186.00	25	No
Space Heating	Basement Air Sealing	No air sealing	Contractor installed air sealing of sill plates and utility openings	200	$ 300.00	25	Yes
Space Heating	Basement Insulation (R-12)	R-0	Install full height insulation in un-finished basement	400	$ 1,100.00	25	No
Space Heating Water Heating	Combination Water/Space Heating Unit	H.E. Furnace & P.V. Water Heater	Water Heater with Air Handler	204	$ 200.00	15	Yes
Space Heating Space Cooling	Do It Yourself Draft Proofing	Standard Thermal Envelope	Improve thermal envelop through caulking & weatherstripping	80	$ 100.00	10	Yes
Space Heating Space Cooling	Floor Insulation (R-28)	R-4	Install insulation under floors to reduce heat loss (main floor only)	180	$ 340.00	25	Yes
Space Heating Space Cooling	Heat recovery ventilator (HRV)	No HRV	Recovers heat loss in ventilation - used to pre-heat in-take air	275	$ 700.00	20	No
Space Heating	High Efficiency Boiler	Standard Eff. Boiler	Condensing Boiler	675	$ 1,500.00	20	No
Space Heating	High Efficiency Furnace	Mid Efficient Furnace	Condensing Furnace	679	$ 1,314.00	18	Yes
Space Heating	Mid efficiency boiler - early replacement of Rental Conversion Burner	RCB unit	Mid efficiency unit (approx 83% AFUE)	1093	$ 386.00	10	Yes
Space Heating Space Cooling	Low E Windows (R-3)	Standard Windows (R-2)	60 sq ft upgrading of window or 4 windows in a typical size home	66	$ -	25	Yes
Space Heating Space Cooling	Programmable Thermostat	Standard Thermostat	Lowers heating and cooling requirement when home is un-occupied	212	$ 70.00	20	Yes
Space Heating	Rad Reflectors	No Rad Reflectors	Insulate behind rad to reduce heat loss	150	$ 275.00	15	No
Space Heating Space Cooling	Thermal Door	Wood Door	Higher insulation value than wood door	83	$ 50.00	25	Yes
Space Heating Space Cooling	Wall Insulation (R-12)	R-0	Install rigid insulation during siding retrofit	500	$ 1,300.00	25	No
Space Heating Space Cooling	Whole-house weatherization	Standard Thermal Envelope	Contractor installed comprehensive weatherization	600	$ 1,200.00	25	Yes
Clothes Drying	Moisture Sensor	No moisture sensor	Shuts off dryer when clothes are dry	10	$ 30.00	14	No

SMALL COMMERCIAL NEW CONSTRUCTION MEASURES

End-Use	Efficient Technology	Base Technology	Description	Gas Savings (m^3/yr)	Incremental Cost ($)	Equipment Life (Yrs)	Benefit/Cost Ratio > 1 TRC
Water Heating	ASHRAE 90.1 Water Heater in Restaurant	Power Vent Water Heater	5% efficiency improvement over conventional tank	150	$ 400.00	10	No
Water Heating	Condensing Gas Water Heater in Restaurant	Power Vent Water Heater	86% energy factor	800	$ 2,000.00	10	No
Water Heating	Direct Vent Water Heater	Power Vent Water Heater	Direct Venting with outdoor air	50	$ 100.00	15	No
Water Heating	Grey Water Heat Recovery in Restaurant	No Heat Recovery	Heat exchanger on outlet water recovers heat	960	$ 1,000.00	10	No
Water Heating	High Efficiency Water Heater	Standard Water Heater	Procurement Standard - 65% energy factor	49	$ 14.83	15	Yes
Water Heating	Pipe Insulation - Full wrap	Existing Pipe - No Wrap	Wrap full length of water pipe to reduce heat loss	34	$ 63.00	20	No
Water Heating	Pipe Insulation - One metre	Existing Pipe - No Wrap	Wrap one metre of water pipe to reduce heat loss	11	$ 3.50	20	Yes
Water Heating	Pipe Insulation - Two metres	Existing Pipe - No Wrap	Wrap two metres of water pipe to reduce heat loss	17	$ 4.00	20	Yes
Water Heating	Set point Reduction	Standard Water Heater	Lowers tank temperature from 140 F to 130 F	100	$ -	15	Yes
Water Heating	Solar Assisted Water Heater for Swimming Pool	Standard Water Heater	Solar assisted water heating with natural gas back up	1200	$ 2,200.00	15	No
Water Heating	Tankless Water Heater	Standard Water Heater	95% energy factor - no storage tank	120	$ 1,300.00	15	No
Water Heating	Ultra High Efficiency Water Heater	Standard Water Heater	Premium Tank - 67% energy factor	51	$ 50.00	15	Yes
Water Heating	Water Heater with Heat Trap	Standard Water Heater	Reduces migration of heat into pipes	17	$ 20.00	15	Yes

SMALL COMMERCIAL NEW CONSTRUCTION MEASURES

End-Use	Efficient Technology	Base Technology	Description	Gas Savings (m³/yr)	Incremental Cost ($)	Equipment Life (Yrs)	Benefit/Cost Ratio > 1 TRC
Space Heating Space Cooling	Attic Insulation (R-40)	(R-30)	Increase amount of insulation in the attic beyond building code	50	$ 150.00	30	No
Space Heating Space Cooling	C2000 Construction	ASHRAE 90.1 Construction	Comprehensive thermal shell and high efficiency heating/cooling system	900	$ 500.00	25	Yes
Space Heating Water Heating	Combination Water/Space Heating Unit in Restaurant	H.E. Furnace & P.V. Tank	Water Heater with Air Handler	816	$ 600.00	10	Yes
Space Heating	Gas Heat Pump	High Efficiency Furnace	Performance rating of 1.3	450	$ 8,000.00	19	No
Space Heating	High Efficiency Furnace	Mid Efficiency Furnace	Condensing Furnace	416	$ 700.00	19	Yes
Space Heating	High Efficiency Boiler - condensing	Standard Atmospheric Boiler	Condensing boiler	750	$ 1,000.00	30	Yes
Space Heating	Mid Efficiency Boiler	Standard Atmospheric Boiler	Mid efficiency unit (approx 83% AFUE)	500	$ 600.00	30	Yes
Space Heating Space Cooling	Heat recovery ventilator (HRV)	No HRV	Recovers heat loss in ventilation - used to pre-heat intake air	220	$ 500.00	20	No
Space Heating Space Cooling	Low E Windows (R-3)	Standard Windows (R-2)	250 sq ft upgrading of window or all windows in a typical commercial building	159	$ 320.00	25	Yes
Space Heating Space Cooling	Triple Pane plus Low E Windows	Standard Windows (R-2)	250 sq ft upgrading of window or all windows in a typical commercial building	300	$ 3,000.00	25	No
Space Heating Space Cooling	Programmable Thermostat	Standard Thermostat	Lowers heating and cooling requirement when building is un-occupied	160	$ 25.00	20	Yes

LARGE COMMERCIAL NEW CONSTRUCTION MEASURES

End-Use	Efficient Technology	Base Technology	Description	Gas Savings (m^3/yr)	Incremental Cost ($)	Equipment Life (Yrs)	Benefit/Cost Ratio > 1 TRC
Water Heating	ASHRAE 90.1 Water Heater in Large Application	Power Vent Water Heater	5% efficiency improvement over conventional tank	700	$ 450.00	10	Yes
Water Heating	Boiler Load Control	Standard boiler no control	Customized system saves 30% on 100,000 m3 per year	30000	$ 10,000.00	15	Yes
Water Heating	High Efficiency Water Heater - 83%	Standard Water Heater	83% AFUE with 14,000 m3 per year	2880	$ 4,000.00	20	Yes
Water Heating	High Efficiency Water Heater - 94%	Standard Water Heater	94% AFUE with 14,000 m3 per year	4320	$ 14,000.00	20	No
Water Heating	Water Heater Load Control	Standard Water Heater	Customized system saves 30% on 14,000 m3 per year	4320	$ 5,000.00	15	Yes
Space Heating Space Cooling	Building Controls	Existing Controls	Electronic control system in 50,000 sq ft building	20000	$ 30,000.00	20	Yes
Space Heating Space Cooling	Building Controls	Existing Controls	Electronic control system in 200,000 sq ft building	60000	$ 150,000.00	20	No
Space Heating Space Cooling	C2000 Construction	ASHRAE 90.1 Construction	Comprehensive thermal shell and high efficiency heating/cooling system	55000	$ 25,000.00	25	Yes
Space Heating	High Efficiency Boiler - condensing	Standard Atmospheric Boiler	Condensing boiler with AFUE in excess of 93%	30000	$ 32,500.00	30	Yes
Space Heating	Mid Efficiency Boiler	Standard Atmospheric Boiler	Boiler with AFUE in excess of 82%	26000	$ 20,000.00	30	Yes
Space Heating	Modulating Boiler	Standard Atmospheric Boiler	Higher operating efficiency	25000	$ 8,000.00	30	Yes

SMALL COMMERCIAL EXISTING BUILDINGS MEASURES

End-Use	Efficient Technology	Base Technology	Description	Gas Savings (m^3/yr)	Incremental Cost ($)	Equipment Life (Yrs)	Benefit/Cost Ratio > 1 TRC
Water Heating	ASHRAE 90.1 Water Heater in Restaurant	Power Vent Water Heater	5% efficiency improvement over conventional tank	150	$ 400.00	10	No
Water Heating	Condensing Gas Water Heater in Restaurant	Power Vent Water Heater	86% energy factor	800	$ 2,000.00	10	No
Water Heating	Direct Vent Water Heater	Power Vent Water Heater	Direct Venting with outdoor air	50	$ 100.00	15	No
Water Heating	Grey Water Heat Recovery in Restaurant	No Heat Recovery	Heat exchanger on outlet water recovers heat	960	$ 1,000.00	10	No
Water Heating	High Efficiency Water Heater	Standard Water Heater	Procurement Standard - 65% energy factor	49	$ 14.83	15	Yes
Water Heating	Horizontal clotheswasher in Laundramat (high use)	Conventional Clotheswasher	Front loading clothes washer, uses 58% less water (40% less hot water)	279	$ 400.00	10	No
Water Heating	Pipe Insulation - Full wrap	Existing Pipe - No Wrap	Wrap full length of water pipe to reduce heat loss	34	$ 63.00	20	No
Water Heating	Pipe Insulation - One metre	Existing Pipe - No Wrap	Wrap one metre of water pipe to reduce heat loss	11	$ 3.50	20	Yes
Water Heating	Pipe Insulation - Two metres	Existing Pipe - No Wrap	Wrap two metres of water pipe to reduce heat loss	17	$ 4.00	20	Yes
Water Heating	Set point Reduction	Standard Water Heater	Lowers tank temperature from 140 F to 130 F	100	$ -	15	Yes
Water Heating	Solar Assisted Water Heater for Swimming Pool	Standard Water Heater	Solar assisted water heating with natural gas back up	1200	$ 2,200.00	15	No
Water Heating	Ultra High Efficiency Water Heater	Standard Water Heater	Premium Tank - 67% energy factor	51	$ 50.00	15	Yes
Water Heating	Water Heater with Heat Trap	Standard Water Heater	Reduces migration of heat into pipes	17	$ 20.00	15	Yes

SMALL COMMERCIAL EXISTING BUILDINGS MEASURES

End-Use	Efficient Technology	Base Technology	Description	Gas Savings (m^3/yr)	Incremental Cost ($)	Equipment Life (Yrs)	Benefit/Cost Ratio > 1 TRC
Space Heating Space Cooling	Attic Insulation (R-40)	(R-30)	Increase amount of insulation in attic during upgrade	65	$ 186.00	30	No
Space Heating Water Heating	Combination Water/Space Heating Unit in Restaurant	H.E. Furnace & P.V. Tank	Water Heater with Air Handler	816	$ 600.00	10	Yes
Space Heating	Gas Heat Pump	High Efficiency Furnace	Performance rating of 1.3	450	$ 8,000.00	19	No
Space Heating	High Efficiency Furnace	Mid Efficiency Furnace	Condensing Furnace	416	$ 700.00	19	Yes
Space Heating	High Efficiency Boiler - condensing	Standard Atmospheric Boiler	Condensing boiler	750	$ 1,000.00	30	Yes
Space Heating	Mid Efficiency Boiler	Standard Atmospheric Boiler	Mid efficiency unit (approx 83% AFUE)	500	$ 600.00	30	Yes
Space Heating Space Cooling	Heat recovery ventilator (HRV)	No HRV	Recovers heat loss in ventilation - used to pre-heat intake air	275	$ 700.00	20	No
Space Heating Space Cooling	Low E Windows (R-3)	Standard Windows (R-2)	250 sq ft upgrading of window or all windows in a typical commercial building	159	$ 320.00	25	Yes
Space Heating Space Cooling	Triple Pane plus Low E Windows	Standard Windows (R-2)	250 sq ft upgrading of window or all windows in a typical commercial building	300	$ 3,000.00	25	No
Space Heating Space Cooling	Programmable Thermostat	Standard Thermostat	Lowers heating and cooling requirement when building is un-occupied	212	$ 25.00	20	Yes

LARGE COMMERCIAL EXISTING BUILDINGS MEASURES

End-Use	Efficient Technology	Base Technology	Description	Gas Savings (m^3/yr)	Incremental Cost ($)	Equipment Life (Yrs)	Benefit/Cost Ratio > 1 TRC
Water Heating	ASHRAE 90.1 Water Heater in Large Application	Power Vent Water Heater	5% efficiency improvement over conventional tank	700	$ 450.00	10	Yes
Water Heating	Boiler Load Control	Standard boiler no control	Customized system saves 30% on 100,000 m3 per year	30000	$ 10,000.00	15	Yes
Water Heating	High Efficiency Water Heater - 83%	Standard Water Heater	83% AFUE with 14,000 m3 per year	2880	$ 4,000.00	20	Yes
Water Heating	High Efficiency Water Heater - 94%	Standard Water Heater	94% AFUE with 14,000 m3 per year	4320	$ 14,000.00	20	No
Water Heating	Water Heater Load Control	Standard Water Heater	Customized system saves 30% on 14,000 m3 per year	4320	$ 5,000.00	15	Yes
Space Heating Space Cooling	Building Controls	Existing Controls	Electronic control system in 50,000 sq ft building	20000	$ 30,000.00	20	Yes
Space Heating Space Cooling	Building Controls	Existing Controls	Electronic control system in 200,000 sq ft building	60000	$ 150,000.00	20	No
Space Heating	High Efficiency Boiler - condensing	Standard Atmospheric Boiler	Condensing boiler with AFUE in excess of 93%	30000	$ 32,500.00	30	Yes
Space Heating	Mid Efficiency Boiler	Standard Atmospheric Boiler	Boiler with AFUE in excess of 82%	26000	$ 20,000.00	30	Yes
Space Heating	Modulating Boiler	Standard Atmospheric Boiler	Higher operating efficiency	25000	$ 8,000.00	30	Yes

MICHAEL RICHARD SINGLETON

PROFESSIONAL EXPERIENCE

1995 - Present — President, Future Thoughts Consulting
Member of the Global Energy Services Consortium (GES)
Toronto, Ontario

- Provision of energy services to utilities, government agencies and industry in the areas of resource planning, conservation and environmental assessments and financial evaluations.

- Currently providing support services to the Energy Efficiency Programs Departments at Enbridge Consumers Gas and Union Gas Ltd. Services include technology assessments, cost effectiveness analysis, emissions reduction quantification, strategic planning, training seminars and regulatory interaction.

Projects Completed

- Union Gas Ltd. 1998 Evaluation Report. Official filing to the Ontario Energy Board. A detailed evaluation of all of Union Gas' 1998 Demand Side management activities. The evaluation incorporated an examination of the savings and costs as well as a review of all research undertaken in support of both process and impact evaluation activities. In association with Union Gas staff. May, 1999.

- Societal impact assessment of the 1999 Union Gas Natural Gas Vehicle Plan and the 1999 Distribution Plan. These assessments included detailed quantification of emissions impacts, avoided costs and cost effectiveness for a variety of competing fuel types and supply strategies.

- Principle author of the Foundation Paper on the Commercial/Institutional Sector in Canada. Prepared for Natural Resources Canada. November, 1998. This paper lays out a detailed strategy for assessing energy efficiency opportunities in the Commercial/Institutional sector in Canada in support of Canada's greenhouse gas emissions reductions commitment.

- Union Gas Ltd. Demand Side Management Plan. Official filing to the Ontario Energy Board. A 5-year energy efficiency marketing plan covering all sectors of the market. Included detailed projections of impacts, cost-effectiveness analysis and resource requirements. In association with Union Gas staff. July, 1998.

- The 1999 Demand-Side Management Summary - Consumers' Gas Company Ltd. Official filing to the Ontario Energy Board. A 5-year energy efficiency marketing plan covering all sectors of the market. Included detailed projections of impacts, cost-effectiveness analysis and resource requirements. In association with Consumers Gas staff and Tellus Institute. January, 1998.

- Commercial sector energy calibration of the ATLAS End-Use energy demand model for Consumers Gas. Development of all calibration data including floorspace, fuel share and energy utilization indices. December, 1997.

- Development of diversification strategy and alternative opportunity assessments for Consumersfirst Ltd. Included market and profitability analysis of specific commercial opportunities. In association with the Global Energy Services Consortium. March, 1998.

- Development of Toronto Hydro's CO_2 Emissions Reductions Methodology and Results. Included the provision of a detailed modeling framework to track, calculate and report CO_2 emissions reductions resulting from all Toronto Hydro energy management activities. Prepared for the CO_2 Committee, Toronto Hydro. April, 1997.

- Proposed Arrangements for the Establishment of a Green Fund at Toronto Hydro. Prepared for the CO_2 Committee, Toronto Hydro. In association with Margaree Consultants Inc. January, 1997.

- 1997 Centra/Union Demand Side Management Plan. Official filing to the Ontario Energy Board. A 5-year energy efficiency marketing plan covering all sectors of the market. Included detailed projections of impacts, cost-effectiveness analysis and resource requirements. In association with SRC Canada. August, 1996.

- Strategies for the Reduction of CO_2 Emissions for Toronto Hydro. Prepared for the CO_2 Committee, Toronto Hydro. In association with Margaree Consultants Inc. April, 1996.

EDUCATION

1979 - 1983	Honours BA - Economics, York University, Toronto, ON. Major Courses: Advanced Economic Theory, Regional Economics, Macro-economics, Micro-economics, Industrial Organization, Statistics.
1987	Qualitative & Probability Analysis, University of California, Berkeley, CA.
1992	DSM Program Evaluation Training Seminar, Barakat & Chamberlin Inc.
1993	Local Integrated Resource Planning Seminar, Barakat & Chamberlin Inc.
1997	Effective Consultant Skills Seminar, Strategic Management Resources Inc.