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Residential Electrical Efficiency Data Review

FINAL REPORT

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REPORT

Executive Summary

The Electrical Efficiency and Conservation (EEC) project team of the Clean Air Strategic Alliance (CASA) has been tasked with recommending an electrical efficiency target(s) for the province of Alberta. Part of that recommendation needs to include the justification for the target. The purpose of this study is to compile information regarding past residential energy efficiency incentive programs in Canada, focusing on electrical efficiency, to be used by the EEC team in target setting. The results of this task are presented below, along with an assessment of the maximum potential for electrical efficiency in the sector given best available technologies.

During the course of the research, three main limitations to the scope of the study were identified:

1. Market transformation is typically the primary goal of any energy efficiency program. There are a number of mechanisms that can be used to achieve market transformation including social marketing, regulations and new technologies. Incentive programs, the focus of this research, are just one component of social marketing. When implementing electrical efficiency programs, it will be important to consider how all of these mechanisms may contribute to the efforts of market transformation.
2. There is a direct relationship between electrical efficiency and the efficiencies of other energy types, such as natural gas. It is important to consider this relationship when implementing any programs directed at improving electrical efficiency.
3. Past energy efficiency programs have not addressed electricity use in all product categories. Significant potential for electricity savings was identified for the following product categories, which may warrant further investigation: fuel switching for clothes dryers and ranges, and efficiency programs for electronics and small appliances.

The results of the analysis show that the overall potential for electricity reduction in Alberta's residential sector is estimated to be a maximum of a 1970 GWh (26% of sectoral consumption) if all of the lighting and appliances are replaced with new, Energy Star or best practice models. An additional 1480 GWh (19% of sectoral consumption) reduction is potentially available if all secondary refrigerators are decommissioned and not replaced, and all electric clothes dryers and ranges are switched to natural gas.

Estimates of the potential for direct participation in energy efficiency programs in Alberta were based on the performance of past electrical energy programs within Canada, scaled by target population. Through this comparison it was determined that approximately 48 GWh per year in direct energy savings could be realistically achieved through a refrigerator buy-back program, 17 GWh per year through an Energy Star appliance rebate program, 92 GWh per year through a CFL give-away, and 4.5 GWh per year for a furnace motor upgrade program. Most of the energy savings are for electricity, however, there is some savings in water heating through Energy Star clothes washers and dishwashers. The estimated cost for a total energy reduction of 161 GWh per year based on these programs is $37 million, which would be applied over several years. This equates to approximately 2.1% of the total residential electricity consumption in Alberta, and annual savings of $11 million for consumers.

Based on the maximum potential identified for electrical efficiency in Alberta, it may be possible to achieve an additional, estimated 150 GWh in electricity savings through fuel switching and programs addressing consumer electronics.

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1. Background & Purpose

The Electrical Efficiency and Conservation (EEC) project team of the Clean Air Strategic Alliance (CASA) has been tasked with recommending an electrical efficiency target(s) for the province of Alberta. Part of that recommendation needs to include the justification for the target. At this time, the EEC team has decided to focus their efforts on a target(s) for the residential sector in order to both simplify the task at hand and to provide a model for other sectors to be addressed.

Electrically efficient appliances[1] and lighting can be used to deliver services to the residential sector while reducing the amount of electricity consumed when compared with conventional products. This has the effect of reducing costs, the environmental impact of electricity supply, and the demand for electrical infrastructure. The efficiency of electricity use is also directly linked with the use of other energy sources, such as natural gas, which needs to be considered in any analysis of electrical efficiency.

Often, electrically efficient appliances initially cost more for consumers to purchase, but save more than this added cost over a period of time. Electrical efficiency programs are generally geared at overcoming this capital cost barrier by increasing consumer awareness of the benefits of electrically efficient products. To guarantee the adoption of more efficient products, regulation is used to mandate certain electrical efficiency standards. The ultimate goal of each is a transformation to a marketplace with higher efficiency products.

In attempting to establish a potential electrical efficiency target for the residential sector in Alberta, the EEC team is interested in collecting information on existing or previous residential energy efficiency programs or initiatives that have been tested and implemented at municipal, provincial/territorial and national levels. This includes information on the programs, their costs and results, and the current and potential penetration of energy efficient products. The EEC team would also like to receive some guidance on how the information collected could be used to set a target for Alberta.

This report begins by outlining several potential approaches to target setting in Section 2. It is followed by investigating the maximum potential for electrical efficiency in the residential sector in Section 3. This is done by calculating the electricity savings that could be achieved if the appliance and lighting stock in the province was completely converted to high efficiency products. Section 4 summarizes the results of electrical efficiency programs in other provinces and territories, and estimates the potential for these programs if delivered in Alberta. Section 5 provides a summary of the results of the work completed and suggests how it can be used to set a target for the residential sector in Alberta.

1.1 Approaches for Market Transformation

Ultimately, the goal of setting electrical efficiency targets is to spur a market transformation to more efficient products, services and behaviors. There are multiple means to achieving market transformations. Government regulation, be it municipal, provincial or federal, can be used to mandate minimum efficiency standards; social marketing of efficiency can also be used; and the introduction of new technologies is a third option. It is common for each of these to be used in conjunction with the others to create long term market transformation.

[1] Appliances investigated include refrigerators, freezers, washing machines, clothes dryers and ranges.

Regulation can be used by governments to force a market transformation, whether it's through product standards or another mechanism. In order to enact new legislation, it often requires public support for it to be approved by lawmakers, and for it to be successfully applied and enforced. Regulation can be applied early or late within a market transformation depending on various factors.

Social marketing attempts to create public change through awareness building. There is no guarantee the change will occur, but a series of approaches or tools can be used to engage the public in the desired change: *Prompts, Norms, Communication, Incentives, and Commitment.* Also, a social marketing campaign should involve careful planning that identifies barriers and benefits to the market change, and works to remove barriers, if it wishes to be successful.

- *Prompts:* Visual or auditory aids as reminders to action.
- *Norms:* Building visible community norms reinforce behavior.
- *Communication:* Properly targeted and developed communication supplements any social marketing campaign.
- *Incentives:* Properly designed incentives can have a substantial impact on choice and behavior.
- *Commitment:* In most cases, people who have initially agreed to a small request or action are more likely to agree to or participate in a larger request or action.

Social marketing is often used to raise awareness of the issue and generate public support for change. This has the effect of creating consumer demand for new products and services to be offered. Regulation can be used at any point within the transformation, whether early or late, but usually after some level of market penetration has been achieved. Early regulation can have an immediate and profound affect on the market if it is enforced effectively, usually at a lower institutional cost than attempting to create the same level of change through social marketing. Late regulation typically affects to complete the market transformation once a certain portion of it has occurred through social marketing in order to catch the "stragglers". Various combinations of social marketing and regulation can be used to affect a complete transformation of the market from one type of service, product or behavior to another.

The development of new technology can also be a catalyst to market change. A market transformation can be created without this component (through social marketing and / or regulation), but a better technology can be an effective way to transform the market in conjunction with other mechanisms, or sometimes on its own. One example is the emergence of LED holiday lights. LED lights are up to 95% more efficient than conventional holiday lighting and are virtually unbreakable, thus it is potentially a better product for consumers. These lights have been in high demand since their introduction and as more units are produced and sold, the cost of manufacturing often drops, thus increasing their attractiveness to the consumer.

This report focuses on a review of the *incentives* provided in Canadian jurisdictions to promote electrical efficiency. As has been demonstrated, incentive programs are one tool that can be used when attempting to create market transformations. Incentive programs can be somewhat more predictable and attractive to consumers than voluntary measures.

2. Approaches to Target Setting

When setting a target for a particular sector in the province, the target needs to be well defined and measurable.

2.1 Defining the Target

The definition of a target for the residential sector requires at least three key parts: 1. a description of what is being targeted, 2. a timeframe and 3. the magnitude of the target.

2.1.1 Target Description

Electrical efficiency for the residential sector can be defined several ways. Table 2.1 offers several suggested definitions as well as comments on the advantages and disadvantages of each definition.

Table 2.1 Options for Describing an Electrical Efficiency Target for Alberta

Description	Advantages	Disadvantages
1. Decrease in overall sectoral electricity consumption (kWh)	• Focuses on overall sectoral impact.	• Influenced by growth in population.
2. Decrease in average individual electricity consumption (kWh / person)	• Not influenced by population growth.	• Could result in an overall increase in electricity consumption. • Benefits from increases in household density.
3. Decrease in average household electricity consumption (kWh / household)	• Not influenced by the number of dwellings constructed.	• Could result in an overall increase in electricity consumption. • Benefits from decreases in household density.
4. Decrease in average electricity consumption by residential floor space (kWh / m^2)	• Not influenced by the size of houses.	• Could result in an overall increase in electricity consumption. • Does not address the issue of the size of houses.
5. Decrease in average electricity consumption for in-stock or new appliances and lighting (kWh / product)	• Not influenced by the number of appliances purchased.	• Could result in an overall increase in electricity consumption. • Requires measurement of efficiencies of in-stock appliances or actual sales.

Figures 2.1 and 2.2 shows the past trends (from 1990 to 2000) and future projections (2001 to 2010) for the various target options, as well as other relevant indicators. The future trends are not indicated for appliances as these are somewhat more uncertain than the other indicators.

These figures are based on data from the Office of Energy Efficiency (OEE) Energy Use Database and Statistics Canada.

Figure 2.1 Trends in Electricity Consumption within the Residential Sector in Alberta (projections used for 2001 to 2010)

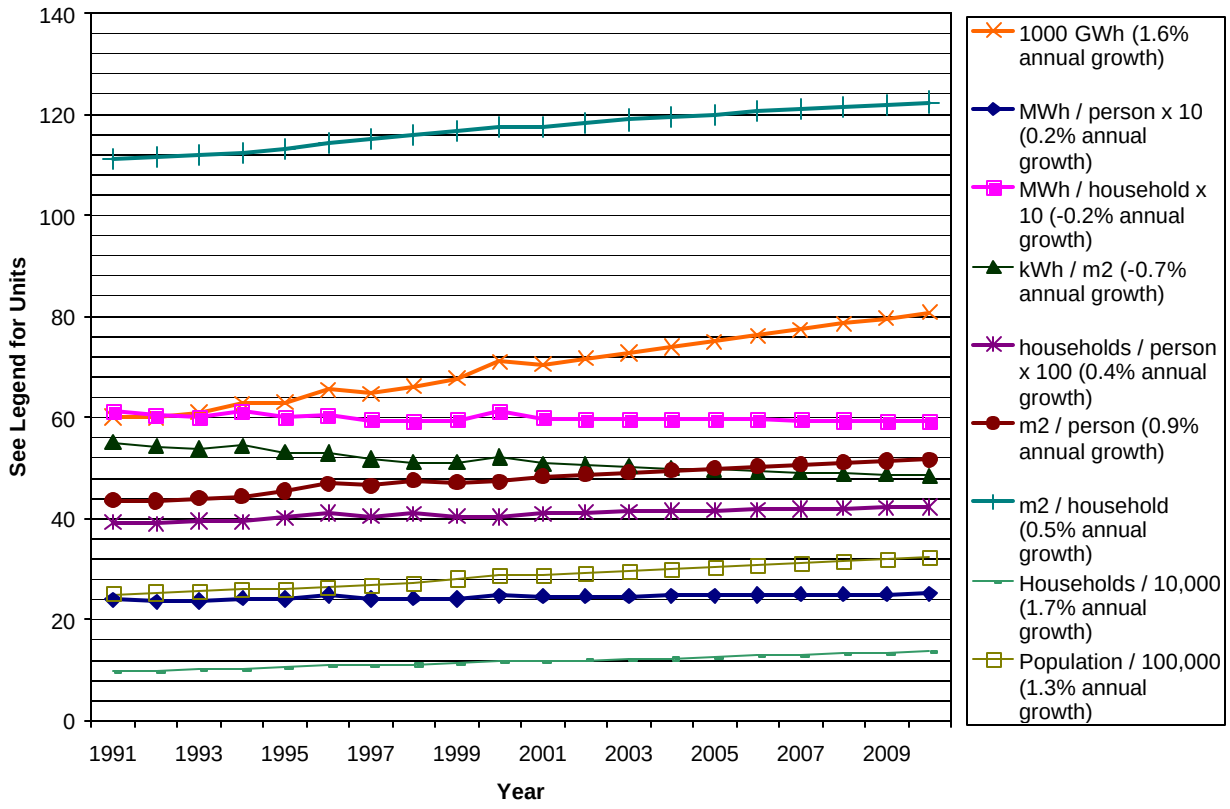


Figure 2.1 shows that historically, overall electricity consumption (GWh) and electricity consumption per unit of floor space (kWh/m^2) change significantly over time. If either of these indicators are used for target setting, it will be important to consider the current trends in order to account for what is considered to be business-as-usual (ie. likely to occur without any energy efficiency programs), moreso than for the other indicators.

The trends in appliance energy consumption, particularly refrigerators and freezers, have also changed significantly over time, as shown in Figure 2.2[2]. These trends will also need to be considered if attempting to set a target based on the average energy consumption per appliance. It should be noted that the electricity consumption for clothes washers and dishwashers does not include any energy used to heat the water used in these appliances.

Figure 2.4 shows the larger overall trends within the residential sector. While the efficiency of appliances is improving, the number of appliances is increasing (shown in Figure 2.3), thus the appliance electricity consumption per household has decreased only moderately. Meanwhile, electricity consumption for lighting and space heating has increased.

[2] Includes both electrical and natural gas appliances.

Figure 2.2 Trends in Appliance Energy Consumption in Alberta

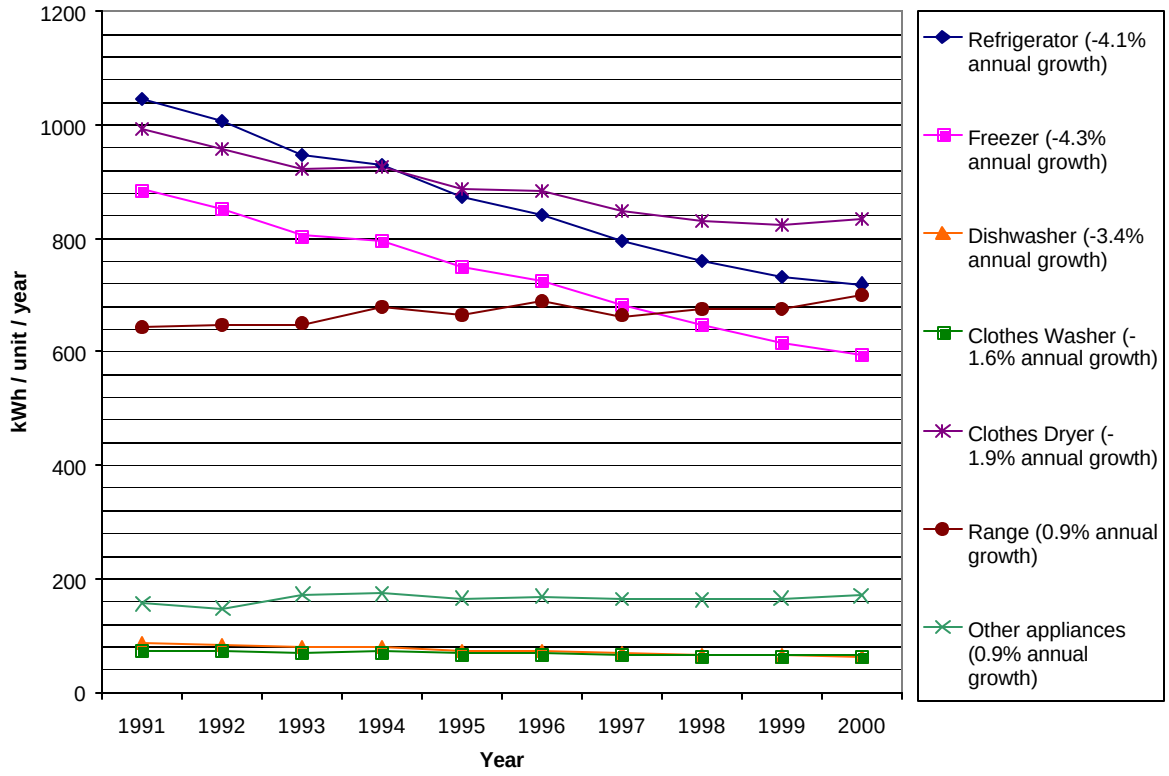


Figure 2.3 Trends in Appliance Ownership in Alberta

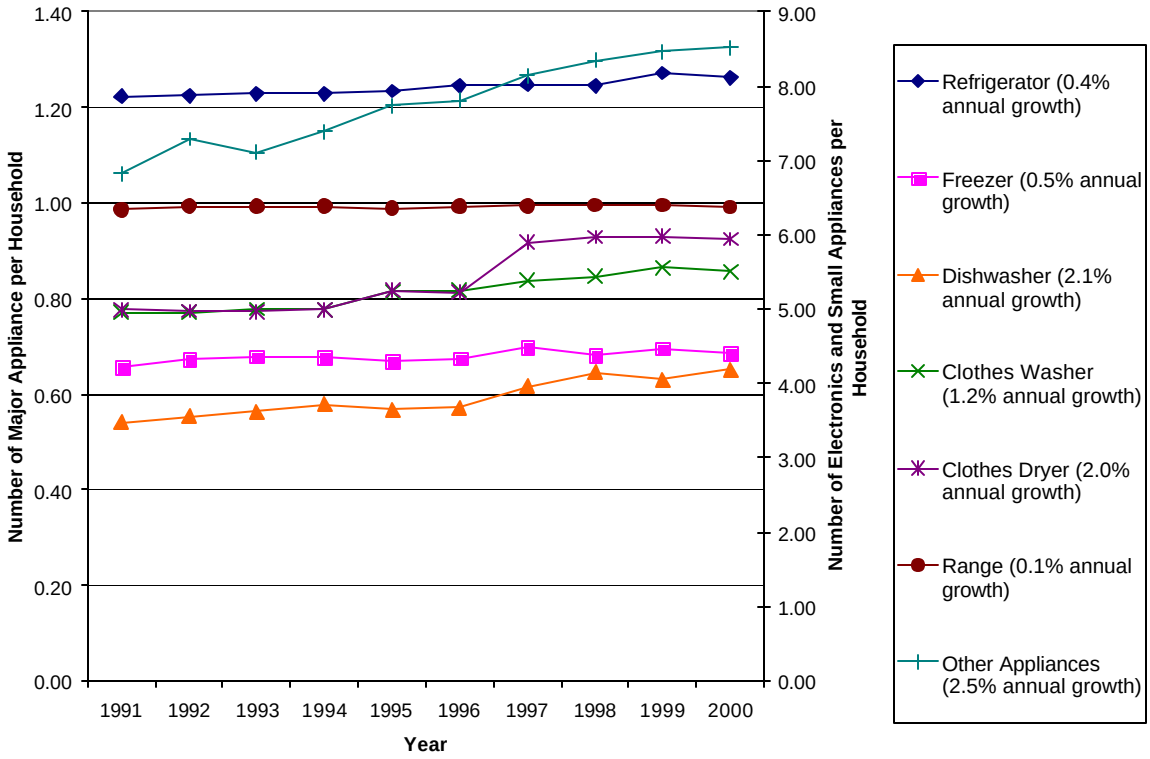
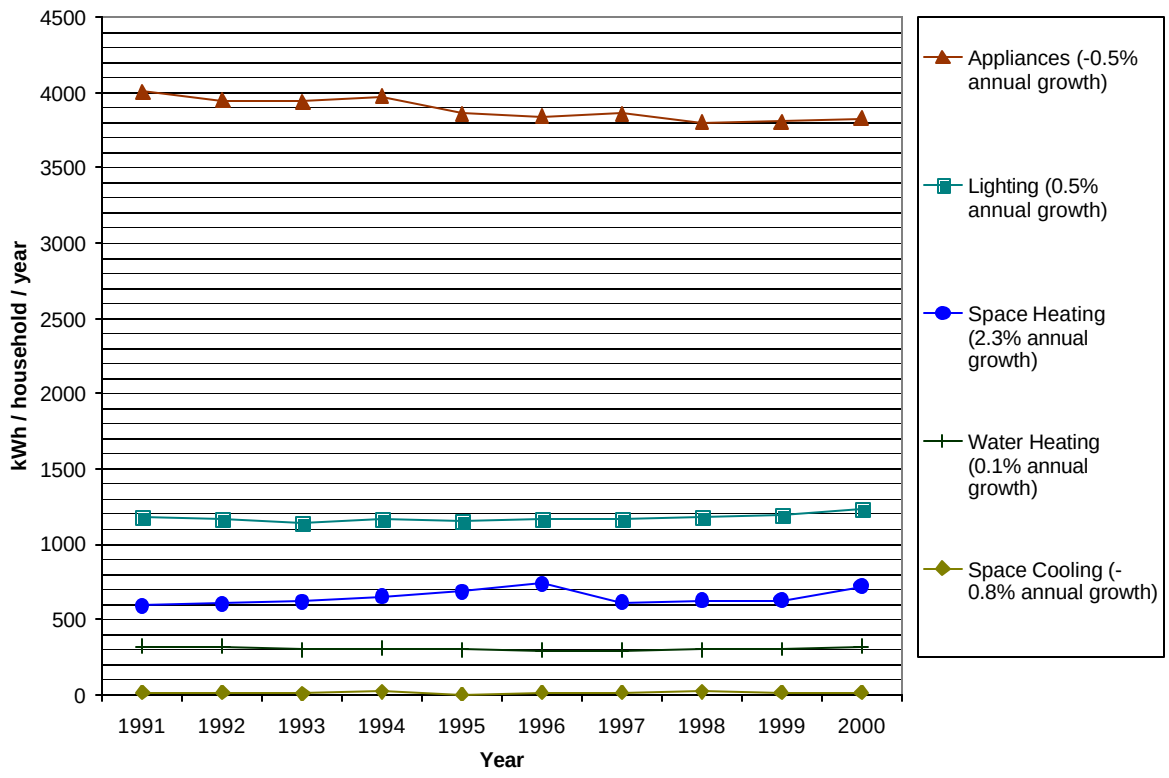


Figure 2.3 Trends in Household Electricity Consumption in Alberta Grouped by End-Use



2.1.2 Target Timeframe

The second component of the definition is a timeframe. It will be important to indicate what timeframe the target is being established for with both a target year and a reference year. The target year is when the change is intended to be achieved by. The reference year is the year that performance will be measured against.

Taking into account the time to design and implement electrical efficiency programs for the province, three to five years may be required for the established targets to be met. Therefore, the target could be established using 2005 as the reference year and either 2008 or 2010 as the year targeted for the efficiency improvements to be in effect.

2.1.3 Methodology for Setting the Target Magnitude

The third component of the target definition is the magnitude of the target. This section discusses the methodology for establishing the magnitude of the sectoral target. Sections 3 to 5 introduces and discusses the data that could be used to set the magnitude of the target.

In order to set a provincial target for a particular sector based on the potential of individual programs, it is necessary to develop a methodology for compiling the appropriate information together. First, the various methods of achieving a target were identified. These are:

1. Replicating electrical efficiency programs previously delivered in Canada (with both direct and in-direct results)
2. Creating new electrical efficiency programs (with both direct and in-direct results)
3. Introducing new electrical efficiency regulations

The electrical efficiency programs previously delivered in Canada, and most likely those that would be subsequently developed often include one or more of the following approaches to social marketing: communication, prompts and incentives.[3] These programs have the result of creating changes in behaviour, some of which are directly measurable, others which are not.

A directly measurable result, for example, is when someone directly participates in the program, and their participation is recorded. An in-direct result occurs when someone is exposed to the program, but any change in action is not measured directly by the program. Typically, these types of programs are good at measuring their direct impact, but it is quite difficult to measure in-direct impacts, and therefore it is often not attempted. Challenges with measuring the full impact of a given program provides definite limitations to how effective it is to set a provincial target based on the expected performance of programs.

Setting a target based on regulations is somewhat simpler than basing the target on social marketing programs. For a given regulation, such as mandating Energy Star refrigerators, it is relatively easy to predict its impacts on electricity consumption once a breakdown of the current product sales is obtained.

Another factor to consider when setting the magnitude of a target is business-as-usual changes in electrical efficiency. For example, the efficiency of the in-use appliance stock naturally increases as older appliances are replaced with new ones. Any targets for electrical efficiency should be set to go beyond improvements that are already expected to occur without any additional action. Of course, there are always many factors influencing electrical efficiency, both upward and downward. It can be quite difficult to predict the business-as-usual electrical efficiency without thorough analysis and accurate data for recent years.

[3] The programs presented in Section 4 include only those programs in Canada that have incentives as a key component. Research into programs that are solely communications or prompts was not undertaken due to the limited amount of quantified results typically reported for these types of programs.

2.2 Measurement

It is important to set the method of measuring performance against a target at the same time that the target is set to ensure that the target will be measurable.

The methods of measuring improvements in electrical efficiency for the residential sector in Alberta are limited to the available data. Presently, only a handful of methods of measuring the performance of electrical efficiency initiatives have been identified:

1. The Office of Energy Efficiency's Energy Use Database
   Potential use of data: The Energy Use Database could be used to track the estimated electricity consumption for Alberta's residential sector.

   Quality of data: This database is the most thorough compilation of energy use in Alberta that has been identified. The drawbacks of this database include the time lag in reporting. As of April 2005, the database reports data up to 2002, however there are indications that both the 2002 and 2001 data is preliminary at this stage.

2. The direct results from programs or regulations
   Potential use of data: Program or regulatory results could be used to track their direct impact on decreasing electricity consumption in the residential sector.

   Quality of data: Programs or regulations that are implemented within Alberta are almost certain to contain a method of measuring and reporting their direct results. In-direct results of the program, however, are often difficult to quantify and usually not included within the program's mandate.

3. Sales data on appliances and lighting from retailers or distributors
   Potential use of data: Trends within the sales of new appliances and lighting could provide indications of any market transformations that occur over the period of time in question.

   Quality of data: This information has proved difficult to obtain in the past, particularly at a provincial level.

4. Survey of electrical appliances and lighting
   Potential use of data: A survey of Alberta households could be used to identify changes in purchasing and operating behavior.

   Quality of data: Would best be implemented using survey at multiple points in time to provide an indication of changes over time. There is a certain level of judgment introduced by survey respondents. The costs and processes involved in surveys may make them difficult to carry out.

5. Survey of electricity retailers
   Potential use of data: Same as OEE data.

   Quality of data: Anticipated to be of similar quality to OEE data, but possibly with faster data compilation and reporting. The speed at which this could be accomplished should be investigated further if this is an option of interest.

3. Maximum Potential of Electrical Efficiency

One of the indicators that can be used to set a sectoral target is to first investigate the maximum potential for electrical efficiency. This is based on the premise that if all appliances and lighting were upgraded to new, high efficiency devices, the residential sector would be at its current maximum potential. This theoretical scenario is then used in Section 5 to provide context to the discussion of what a reasonable target for Alberta could be.

Note that the estimates for numbers of existing appliances and average electricity consumption are based on data from the National Energy Use Database produced by the Office of Energy Efficiency.

Refrigerators

At present, there are an estimated 1.5 million refrigerators in Alberta, or 1.28 per household. At an average consumption of 656 kWh per year, this represents an estimated total consumption of 985 GWh of electricity in 2005.

In 2001, the average electrical consumption of a new refrigerator was 559 kWh per year. This is assumed to be approximately the same for 2005. Energy Star eligible refrigerators need to be 15% more efficient than the minimum standard[4]. Based on this standard, it is assumed that the average Energy Star refrigerator is 15% more efficient than the average refrigerator sold (ie. Energy Star refrigerators consume 475 kWh per year on average). To determine the maximum potential for refrigerator electrical efficiency, it is assumed that 100% of the current stock is converted to Energy Star compliant models. The result is a reduction in electricity consumption of 394 GWh per year.

In 2005, it is forecasted that Alberta households have, on average, 1.28 refrigerators. If the theoretical maximum were extended such that all households had only one refrigerator (ie. All second refrigerators were removed and not replaced) and that it was Energy Star compliant, this would result in savings of 550 GWh per year.

Freezers

At present there are an estimated 839,000 freezers in Alberta. At an average consumption of 487 kWh per year, this represents an estimated total consumption of 404 GWh per year.

In 2001, the average consumption for new models shipped was 337 kWh per year. It is assumed that this is approximately the same in 2005. Energy Star compliant freezers must be at least 10% more efficient than standard models[5]. Based on this standard, it is assumed that the average Energy Star freezer is 10% more efficient than the average refrigerator sold (ie. Energy Star freezers consume 303 kWh per year on average).

To determine the maximum potential for freezer electrical efficiency, it is assumed that 100% of current stock is converted to Energy Star compliant models. The result is a reduction in electricity consumption of 149 GWh per year.

[4] Energy Star website. www.energystar.gc.ca. Accessed May 24, 2005.
[5] Ibid.

Clothes Washers

At present there are an estimated 1.05 million clothes washers in Alberta, with an average consumption of 64.9 kWh per year. This represents a total estimated consumption of 65.9 GWh.

New, Energy Star clothes washers can be more than 3 times as efficient as the existing stock.[6] Assuming the energy savings occur equally for electricity and water heating, the resulting savings by replacing all existing clothes washers with high efficiency models is 44 GWh per year.

Dishwasher

At present, there is an estimated stock of 794,000 dishwashers in Alberta. The estimated consumption of each unit is 59.4 kWh per year, or 45 GWh for the entire stock in the province.

New, Energy Star dishwashers can consume more than 60% less energy than the existing stock.[7] Assuming the energy savings occur equally for electricity and water heating, the resulting savings by replacing all existing dishwashers with high efficiency models is 27 GWh per year.

Clothes Dryer

At present clothes dryers consume an estimated 833 GWh in the province of Alberta.

Best-practice electric clothes dryers[8] can consume up to 15% less electricity than the existing stock.[9] The resulting savings by replacing all existing electric clothes dryers with high efficiency models is 125 GWh per year.

Alternatively, by replacing all electric clothes dryers with natural gas dryers, it is estimated that nearly all of the 833 GWh of electricity consumed by clothes dryers can be eliminated. This switch would result in having a net positive impact on greenhouse gas emissions, reducing the emissions associated with electricity production by an estimated 76% when compared with the emissions of natural gas combustion[10].

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[6] Bhargava, A., et. al. 2004. "Study on the Electrical Efficiency of Alberta's Economic Sectors." Canadian Energy Research Institute. Calgary, AB. Prepared for Clean Air Strategic Alliance.

[7] Ibid.

[8] As defined by the Office of the Energy Efficiency and Renewable Energy of the US Department of Energy. Source: http://www.consumerenergycenter.org/homeandwork/homes/inside/appliances/dryers.html#electric

[9] Bhargava, A., et. al. 2004. "Study on the Electrical Efficiency of Alberta's Economic Sectors." Canadian Energy Research Institute. Calgary, AB. Prepared for Clean Air Strategic Alliance.

[10] Assumes an average emission factor of 884t CO_2eq / GWh of electricity generated, and transmission and distribution losses of 11.6%.

Ranges

At present, ranges consume an estimated 649 GWh in the province of Alberta.

The most efficient electric range in the Canadian marketplace consumes approximately 5% less electricity than the average electric range in the existing stock.[11] The resulting savings by replacing all existing electric ranges with the most efficient model currently available is 32 GWh per year.

Alternatively, by replacing all electric ranges with natural ranges, it is estimated that most of the 649 GWh of electricity consumed by electric ranges can be eliminated. This switch would result in having a net positive impact on greenhouse gas emissions, again reducing the emissions associated with electricity production by an estimated 76% when compared with the emissions of natural gas combustion.

Lighting

Current electricity consumption in the province of Alberta attributable to lighting is 1537 GWh. Compact fluorescent lightbulbs (CFL) are between 67% and 75% more efficient than incandescent lightbulbs, but currently make up only 10% of the market. If 90% of the residential lighting market is improved in efficiency by 71%, the resulting estimated savings are 982 GWh.

Furnace Fan Motors

It is estimated that there are currently 552 GWh be consumed by furnace fan motors in the Alberta residential sector each year.

A variable speed or electronically controlled motor is estimated to require approximately 60% of the electricity as conventional fan motors (conventional motor: 933 W vs. VSM: 560W).[12] If all fan motors in the province were converted from a conventional motor to a VSM, the annual electricity savings are estimated to be 221 GWh.

[11] Bhargava, A., et. al. 2004. “Study on the Electrical Efficiency of Alberta’s Economic Sectors.” Canadian Energy Research Institute. Calgary, AB. Prepared for Clean Air Strategic Alliance.

[12] Personal Communication. David Miller. Jem Energy. Phone: (403) 860-6361.

4. Past Electrical Efficiency Incentive Programs

In order to establish an electrical efficiency target for the residential sector, the EEC project team has designed a process to review the performance of electrical efficiency incentive programs in Canada and to estimate the potential impact of these programs if they were delivered in Alberta.

Table 4.1 contains a list of all the electrical efficiency incentive programs in recent years identified for Canada. As well, the programs which have been included in the analysis are indicated. Those that have been excluded from the analysis were excluded because a complete set of performance data were not available (e.g. data regarding program costs and electricity savings).

Table 4.1 Electrical Efficiency Incentive Programs in Canada

Program Provider	Program Name	Included in Analysis?
Appliances		
BC Hydro	Refrigerator Buy-Back	Yes
	Energy Star Appliance Program	No, complete data not available
Yukon Economic Development	Fridge Exchange Program	Yes
Gov't of Ontario	Energy Star Sales Tax Exemption	Yes
Gov't of Saskatchewan	Energy Star Program	Yes
Hydro Quebec	Energy Star	No, new program
Manitoba Hydro	Energy Star – New Home Program	No, complete data not available
Lighting		
BC hydro	CFL Vouchers	Yes
	Holiday lights mail-in rebates	No, complete data not available
Hydro Quebec	CFL Promotion	No, new program
Manitoba Hydro	CFL Program	No, complete data not available
	Holiday Lighting	No, complete data not available
	Wisdom in Saving Energy (WISE)	No, complete data not available
Heat Recovery Ventilators		
NF Power	HRV - part of Electric Heating Program	No, complete data not available
Furnace Motors (as part of a larger furnace program)		
Climate Change Central	Furnace replacement	Yes
Enbridge Gas – New Brunswick	High efficiency heating systems program	No, complete data not available
Terasen	2003 Energy Star Heating System Upgrade Offer	Yes
Union Gas	2003 & 2004 energy star furnace programs	No, complete data not available

Data was also collected for a residential Energy Star program in New York State. This provides some context for what is occurring in jurisdictions outside of Canada.

The following tables list the details of each of the electrical efficiency incentive programs where adequate amount of data was obtained. They also include an estimate of the potential impact of a similar program in Alberta. This estimate was completed by simply scaling all program costs and results by the size of the target population. A more accurate estimate could be undertaken

with a more thorough investigation of the past programs and / or market research information for Alberta. Further investigation of the past programs would require additional information to be collected, which may or may not be available.

It should be noted that the cost per kWh value has been calculated in a fairly simple manner in order to provide a general comparison to the cost of other programs and the cost of generating electricity. A much greater detail of analysis that considers the net affects of the program with both participants and non-participants over time could be completed to provide a more accurate representation of the unitized program costs. However, this was beyond the scope of this study.

Table 4.2 Refrigerator Buy-back Program

	BC Hydro Program[13]	Translated to Alberta
General Description	The program provides utility customers with an environmentally-sound means of disposing of "second" refrigerators, alleviating restricted landfill capacity, the uncontrolled release of chlorofluorocarbons into the atmosphere, and inefficient electricity use. BC Hydro offers $30 for customers who would allow the utility to come and take the old refrigerator, which must be in working condition and between 10-24 cubic feet, away.	A similar program is considered for Alberta with electricity retailers, government or non-government organizations administering the program.
Target Population	BC Hydro Customers (1.4 million households)	All of Alberta (1.26 million households)
Program Participation	63,000 refrigerators	56,700 refrigerators
Annual Electricity Reduction	53 GWh (847 kWh / appliance / year & 63,000 participants)	48 GWh (0.64% of estimated sector consumption in 2005)
Total Cost	$7.4 million (75% of 2yr. program cost) (75% incentives, pick-up and disposal; 25% advertising)	$6.7 million
Program Length	1.5 of 2 years reported on	1.5 years
Estimated Free Riders	25%	25%
Consumer Costs	No cost	
Consumer Annual Savings (@ $0.07/kWh)	$3.7 million	$3.3 million
Program Cost per kWh Over 10 years of Electricity Savings	$0.014 / kWh	$0.014 / kWh
Impacts of Fuel Switching	N/A	N/A
Potential Improvements	None cited.	
Potential Partnerships	Refrigerator recyclers and retailers. Appliance manufacturers. Natural Resources Canada.	

[13] Personal Communication. Patrick Mathot, Residential Marketing Manager, BC Hydro, Patrick.Mathot@bchydro.bc.ca

Table 4.3 Refrigerator Exchange Program

	Yukon Economic Development Program[14]	Translated to Alberta
General Description	This pilot project offered a $200 incentive to consumers in diesel communities to replace an old working fridge with a new Energy Star labeled fridge. Free delivery and removal of old refrigerators was offered to all residents. A $20 incentive to sales staff for all Energy Star appliances was also offered.	A similar program is considered for Alberta with electricity retailers, government or non-government organizations administering the program.
Target Population	All of the Yukon (11,000 households)	All of Alberta (1.26 million households)
Program Participation	184 refrigerators exchanged	21,000 refrigerators
Annual Electricity Reduction	168 MWh	19 GWh*
Total Cost	$96,000 (project coordination and administration, promotion and advertising, coupons)	$11 million*
Program Length	April 2002 - March 2004	2 years
Estimated Free Riders		
Consumer Costs	Incremental cost of Energy Star fridge minus incentives	
Consumer Annual Savings (@ $0.07/kWh)	$12,000	$1.4 million*
Program Cost per kWh Over 10 years of Savings	$0.057 / kWh	$0.057 / kWh*
Market Transformation Indications	As a result of the Fridge Exchange, Energy Star labeled appliances are readily available in the Yukon, where previously some suppliers couldn't get much selection and others, none at all. Retailers who knew little about the EnerGuide labeling system and the benefits and ongoing savings through energy efficiency are now well-informed about EnerGuide and Energy Star, and are actively promoting the role of energy savings in selling energy efficiency to their customers.	Availability and awareness of Energy Star appliances is already somewhat established in Alberta, although the program will likely increase the awareness.
Impacts of Fuel Switching	N/A	N/A
Potential Improvements	None cited.	
Potential Partnerships	Refrigerator recyclers and retailers. Appliance manufacturers. Natural Resources Canada.	

* The estimated program performance in Alberta is considered to have high uncertainty. This is due to the fact that the appliance market in the Yukon is considered to be significantly different than the one in Alberta.

[14] Personal Communication. Susan Rousseau, Administrative Assistant ESC/YDC, Ph: 867-393-7063, Fax: 867-393-7061, Email: administration@nrgsc.yk.ca

Table 4.4 Energy Star Appliance Rebate I

	Government of Ontario Program[15,16]	Translated to Alberta
General Description	The Ontario government provided a retail sales tax (8%) rebate to purchasers of new energy-efficient household appliances. Rebates were available for Energy Star qualified: • refrigerators, dishwashers, and clothes washers sold on or after November 26, 2002 and on or before July 31, 2004, and • freezers sold on or after January 1, 2003 and on or before July 31, 2004.	A similar program is considered for Alberta. A mail-in rebate equivalent to 8% of the product price is assumed as there is no retail sales tax in Alberta.
Target Population	All of Ontario (4.65 million households)	All of Alberta (1.26 million households)
Program Participation	340,000 rebates Refrigerators - 133,000 (39%) Washing machines - 92,000 (27%) Dishwashers - 105,000 (31%) Freezers - 11,000 (3%)	92,000 rebates
Annual Energy Reduction[17]	74 GWh	20 GWh
Total Cost	$38 million (rebates only) Average value of RST rebate: Refrigerators - $134 Washing machines - $120 Dishwashers - $87 Freezers - $60	$10 million
Program Length	November 26, 2002 to July 31, 2004 (January 1, 2003 to July 31, 2004 for freezers).	20 months
Estimated Free Riders	Not tracked	
Consumer Costs	Incremental cost of an Energy Star appliance minus rebate	
Consumer Annual Savings (@ $0.07/kWh)	$5.2 million	$1.4 million
Program Cost per kWh Over 10 years of Savings	$0.051 / kWh	$0.051 / kWh
Impacts of Fuel Switching	N/A	N/A
Potential Improvements	For this type of a program in Alberta, the rebate needs to be based on something other than provincial sales tax.	
Potential Partnerships	Appliance retailers and manufacturers. Natural Resources Canada.	

[15] Personal Communication. Chris Goethel. Ministry of Finance, Government of Ontario. Phone: (416) 327-0275 Email: chris.goethel@fin.gov.on.ca

[16] Personal Communication. Elizabeth Cole. Ministry of Finance, Government of Ontatio. Phone: (416) 327-0273 Email: elizabeth.cole@fin.gov.on.ca

[17] Includes energy savings from reduction in hot water use for clothes washers and dishwashers.

Table 4.5 Energy Star Appliance Rebate II

	Government of Saskatchewan Program[18,19]	Translated to Alberta
General Description	Provincial Sales Tax rebate for the purchase or long-term lease of Energy Star qualified refrigerators, dishwashers, clothes washers and freezers.	A similar program is considered for Alberta. A mail-in rebate equivalent to 7% of the product price is assumed as there is no retail sales tax in Alberta.
Target Population	All of Saskatchewan (0.39 million households)	All of Alberta (1.26 million households)
Program Participation	17,325 rebates Clothes washers - 5,443 Dishwashers - 6,628 Freezers - 1, 042 Refrigerators - 6,925	56,000 rebates
Annual Energy Reduction[20]	4.4 GWh	14.2 GWh
Total Cost	$1.25 million (rebates) + estimated $110,000 for staffing = $1.41 million for 17 months Average rebate: $72.11	$4.1 million
Program Length	October 2003 to Present (data provided up to Feb. 25, 2005)	17 months
Estimated Free Riders	Not tracked	
Consumer Costs	Incremental cost of an Energy Star appliance minus rebate	
Consumer Annual Savings (@ $0.07/kWh)	$310,000	$990,000
Program Cost per kWh Over 10 years of Savings	$0.029 / kWh	$0.029 / kWh
Impacts of Fuel Switching	N/A	N/A
Potential Improvements	For this type of a program in Alberta, the rebate needs to be based on something other than provincial sales tax.	
Potential Partnerships	Appliance retailers and manufacturers. Natural Resources Canada.	

[18] Personal Communication. Grant McVicar. Office of Energy Conservation. Saskatchewan Research Council. Phone: (306) 787-6033 Email: mcvicar@src.sk.ca

[19] Personal Communication. Mike Halayka. Government of Saskatchewan. Phone: (306) 787-8514 Email: mhalayka@finance.gov.sk.ca

[20] Includes energy savings from reduction in hot water use for clothes washers and dishwashers.

Table 4.6 Energy Star Products and Marketing

	New York[21]	Translated to Alberta
General Description	A market transformation program that partners with retailers to provide training, sales tools, promotional opportunities, and cooperative advertising incentives. It includes periodic special promotions (eg. lighting catalogue, 2 for 1 bulb offer, clothes washer and heat pump water heater incentives). Targeted appliances: refrigerators, dishwashers, clothes washers, room air conditioners, through the wall air conditioners, freezers, dehumidifiers, ceiling fans, screw in compact fluorescent lights, hardwired/portable CFL fixtures, home electronics and windows. Part of a larger Energy Smart Program funded through a System Benefit Charge.	A similar program is considered for Alberta.
Target Population	All of New York state (6.5 million households)	All of Alberta (1.26 million households)
Program Participation	340,000 rebates Refrigerators - 133,000 (39%) Washing machines - 92,000 (27%) Dishwashers - 105,000 (31%) Freezers - 11,000 (3%)	66,000 rebates
Annual Energy Reduction[23]	122 GWh from direct participation	23.6 GWh
Total Cost	USD$45.9 million	CAD$11.6 million
Program Length	Results obtained for June 1998 to December 2003	5.5 years
Estimated Free Riders	123 GWh net savings (considers free riders, free drivers, standards, level of energy service and natural change effects)	23.8 GWh net savings
Consumer Costs	Incremental cost of an Energy Star appliance minus any rebate	
Consumer Annual Savings (@ CAD$0.07 / kWh)	CAD$8.54 million	CAD$1.66 million
Program Cost per kWh Over 10 years of Savings	USD$0.038 / kWh	CAD$0.049 / kWh
Market Transformation Indications	Consumer mail survey understanding of Energy Star increased from 35% in 1999 to 47% in 2003.	
Impacts of Fuel Switching	N/A	N/A
Potential Improvements	None cited	
Potential Partnerships	Appliance retailers and manufacturers. Natural Resources Canada.	

[21] http://www.nyserda.org/Energy_Information/04vol2pt1-sbc.pdf

[22] 2004 average Canadian dollar (CAD) / United States Dollar (USD) exchange rate of 1.3015. Source: Bank of Canada. www.bankofcanada.ca/en/exchange-look.htm. Accessed May 23, 2005.

[23] Includes energy savings from reduction in hot water use for clothes washers and dishwashers.

Table 4.7 CFL Give-Away Program

	BC Hydro Program[24]	Translated to Alberta
General Description	BC Hydro gave away CFL bulbs to each of their customers through voucher redemption and supplementary offers from manufacturers and retailers.	A similar program is considered for Alberta with electricity retailers, government or non-government organizations administering the program.
Target Population	BC Hydro Customers (1.4 million households)	All of Alberta (1.26 million households)
Program Participation	1.32 million CFLs (plus 560,000 from participating retailers and manufacturers)	1.19 million CFLs
Annual Electricity Reduction	102 GWh (75 kWh / bulb / yr)	92 GWh (1.23% of estimated sector consumption in 2005)
Total Cost	$26 million • 50% voucher costs • 15% labour and administration • 35% advertising	$23 million
Program Length	02-05 (last summer 04) Oct. 2003 – Mar. 2004	6 months
Estimated Free Riders	21%	21%
Consumer Costs	No cost	
Consumer Annual Savings (@ $0.07/kWh)	$7.1 million	$6.4 million
Program Cost per kWh Over 7 years of Savings	$0.025 / kWh	$0.025 / kWh
Market Transformation Indications	The initiative increased awareness of CFLs from 80% (baseline) to 88% eight months to one year after the program ended.	
Impacts of Fuel Switching	N/A	N/A
Potential Improvements	• Integrate CFL give-away with other activities. Eg. displays / info booths at stores; buy 2, get 1 free; etc. This is intended to generate greater behavioural change than a single initiative. • Monitor sales information as well as changes in awareness	
Potential Partnerships	• CFL retailers and manufacturers • Natural Resources Canada	

[24] Personal Communication. Patrick Mathot, Residential Marketing Manager, BC Hydro, Patrick.Mathot@bchydro.bc.ca

Table 4.8 Furnace Motor Upgrade Program

	Climate Change Central Furnace Replacement Program[25]	Translated to a New Alberta Program*
General Description	The project was designed to inform consumers about energy efficient heating choices and encourage consumers to purchase energy efficient furnaces ($200 mail-in rebate plus $100 manufacturer rebate), including efficient electric motors (additional $100 mail-in rebate), resulting in an increase of the percentage of high efficiency furnaces in Alberta homes.	
Target Population	All of Alberta	
Program Participation	4,072 Alberta residents received rebates 3,115 residents received rebates for furnaces with variable speed motors	
Annual Electricity Reduction	1.7 GWh (3115 units @ 552 kWh / yr) (0.02% of estimated sector consumption in 2005)	
Total Cost	Estimated $369,000 for promotion of efficient electric motors (25% of total program costs based on size of incentives for motors vs. furnaces) (rebates 86%, marketing 8%, service charges 1%, wages 4%, admin 1%, contingency 3%)	
Program Length	71 days	
Estimated Free Riders	1/3 of purchases	
Consumer Costs	Incremental cost of a efficient furnace motor minus incentives	
Consumer Annual Savings (@ $0.07/kWh)	$120,000	
Program Cost per kWh Over 10 years of Savings	$0.022 / kWh	
Market Transformation Indications	Reports confirm that this program has substantially increased consumer interest in Energy Star qualified furnaces.	
Impacts of Fuel Switching	N/A	
Potential Improvements	• Direct mail-out timing to be alligned with the program launch. • Contractor information package to be distributed in advance of the program launch. • Clearer information inputs in the Application form. • The criteria for approving/rejecting "special cases" to be standardized and codified.	
Potential Partnerships	11 manufacturers, major local retailers and furnace contractors, NRCan, Heating, Refrigeration and Air Conditioning Institute of Canada	

* A new program for Alberta is assumed to have the same performance as the previous program.

[25] Personal Communication. Simon Knight, Climate Change Central. Ph: 780-408-4581, Email: sknight@climatechangecentral.com

Table 4.9 Furnace Upgrade Offer

	Terasen Gas[26,27]	Translated to Alberta
General Description	The program offered financial incentives to customers purchasing and installing a new high efficiency gas furnace or boiler in their home. Participants were eligible for a $300 rebate on their gas bill. Another $150 rebate was available if the new furnace had a high-efficiency variable speed furnace fan motor (VSM). Customers could also take advantage of up to $600 in additional upgrade offers from affiliated manufacturers and suppliers. A 0% financing option was also offered in place of the rebate. (up to $4,000, payable over 24 months).	A similar program is considered for Alberta.
Target Population	852,000 customers	All of Alberta (1.18 million natural gas heating units)
Program Participation	Total number of participants - 2,704 1617 participants installed furnaces with VSM	2240 VSM participants
Annual Electricity Reduction	0.89 GWh	1.24 GWh
Total Cost	$15,000 plus incentives VSM portion: $5000 plus $243,000 in incentives	$340,000
Program Length	September 1, 2003 to December 15, 2003	3.5 months
Estimated Free Riders	Majority of VSM participants were considered free riders	
Consumer Costs	Incremental cost of variable speed motor minus incentive	
Consumer Annual Savings (@ $0.07/kWh)	$62,000	$90,000
Program Cost per kWh Over 10 years of Savings	$0.028 / kWh	$0.028 / kWh
Impacts of Fuel Switching	N/A	N/A
Potential Improvements	None cited.	
Potential Partnerships	Electric utilities and NRCan funded the VSM portion of the incentive. Appliance manufacturers. Lending institutions.	

[26] Personal Communication. Mark Hartman, Terasen Gas. Ph: 604.592.7603 Fx: 604.592.7670 Email: Mark.Hartman@terasengas.com

[27] Terasen Gas. 2004. "2003 Terasen Gas / Energy Star Heating Upgrade Offer - Final Report."

5. Summary

The purpose of this study was to compile information regarding past residential energy efficiency incentive programs in Canada, focusing on electrical efficiency. The results of this task are presented below, along with an assessment of the maximum theoretical potential for electrical efficiency in the sector given best available technologies.

The authors acknowledge that the scope of work is fairly narrow in the fact that it only looks at electrical efficiencies and programs which offer direct financial incentives.

There is a direct relationship between electrical efficiency and the efficiencies of other energy types, as demonstrated in appliances such as furnaces and washing machines, which in Alberta typically use multiple energy sources, and dryers and ranges, which have the option to be fuelled by a number of energy sources. It is important to consider this relationship further when implementing any programs directed at improving electrical efficiency.

As described in the introduction, market transformation can come about through a number of mechanisms including social marketing, regulations and new technologies. Incentive programs, the focus of this research, are just one component of social marketing. When implementing electrical efficiency programs, it will be important to consider how all of these mechanisms may contribute to the efforts of market transformation.

Maximum Potential of Electrical Efficiency

If all of the lighting and appliances within Alberta's residential sector were replaced with new, Energy Star or best practice models, the estimated reduction in the sector's annual electricity consumption would be 1970 GWh or 26% of the total sectoral consumption estimated for 2005. If this is combined with the decommissioning of all secondary refrigerators (i.e. they are not replaced) and replacing all electric clothes dryers and ranges with natural gas appliances, the annual electricity savings are estimated to be 3460 GWh or 45% of the total sectoral consumption estimated for 2005. The breakdown of estimated efficiency improvements for each appliance type is summarized in Table 5.1.

Table 5.1 Summary of Maximum Potential for Electricity Reductions in Alberta

End-Use	Current Annual Electricity Consumption	Maximum Reduction in Annual Electricity Consumption
Lighting	1537 GWh	982
Refrigerators	985 GWh	394 GWh (replace all fridges) 550 GWh (replace primary fridges, decommission secondary fridges)
Freezers	404 GWh	149 GWh
Clothes Washers	66 GWh	44 GWh
Dishwashers	45 GWh	27 GWh
Clothes Dryers	833 GWh	125 GWh (replace with efficient electric dryers) 833 GWh (replace with natural gas dryers)
Ranges	649 GWh	32 GWh (replace with efficient electric ranges) 649 GWh (replace with natural gas ranges)
Other Appliances[28]	1882 GWh	Not investigated
Space Heating	896 GWh	221 GWh (replace all furnace fan motors with high efficiency motors)
Water Heating	377 GWh	Not investigated
Space Cooling	19 GWh	Not investigated
Total	7694 GWh	Low: 1911 GWh (21% of total) High: 3830 GWh (44% of total)

[28] Includes televisions, video cassette recorders, digital video disc players, radio, computers, toasters, etc.

Past Electrical Efficiency Incentive Programs

Table 5.2 summarizes the incentive programs that were presented in Section 4.

Table 5.2 Summary of Potential Incentive Programs for Alberta[29]

Direct Annual Energy Savings	Consumer Annual Savings (@ $0.07/kWh)	Program Cost	Program Length	Program Cost per kWh	Annual GHG Emission Reduction[30]
Refrigerator Buy-Back Program (based on BC Hydro program)					
48 GWh	$3.3 million	$6.7 million	1.5 years	$0.014 / kWh (@ 10 years of savings)	57 kt CO_2eq
Refrigerator Exchange Program (based on Yukon Economic Development program)					
19 GWh	$1.4 million	$11 million	2 years	$0.057 / kWh (@ 10 years of savings)	19 kt CO_2eq
Energy Star Appliance Rebate I (based on Government of Ontario program)					
20 GWh	$1.4 million	$10 million	20 months	$0.051 / kWh (@ 10 years of savings)	20 kt CO_2eq
Energy Star Appliance Rebate II (based on Government of Saskatchewan program)					
14 GWh	$0.99 million	$4.1 million	17 months	$0.029 / kWh (@ 10 years of savings)	14 kt CO_2eq
CFL Give-Away Program (based on BC Hydro program)					
92 GWh	$6.4 million	$23 million	6 months	$0.025 / kWh (@ 7 years of savings)	91 kt CO_2eq
Furnace Motor Upgrade Program (based on Climate Change Central Program)					
1.7 GWh	$0.12 million	$0.37 million	71 days	$0.022 / kWh (@ 10 years of savings)	1.7 kt CO_2eq
Furnace Upgrade Offer (based on Terasen Gas program)					
1.2 GWh	$0.09 million	$0.34 million	3.5 months	$0.028 / kWh (@ 10 years of savings)	1.2 kt CO_2eq
Energy Star Products and Marketing (based on New York program)					
23 GWh	$1.7 million	$11.6 million	5.5 years	$0.049 / kWh (@ 10 years of savings)	23 kt CO_2eq

[29] Based on actual results of previous programs delivered in North America.

[30] Assumes an average emission factor of 884t CO_2eq / GWh of electricity generated, and transmission and distribution losses of 11.6%.

Overall Conclusions

The results of the two analyses performed demonstrate that there is considerable opportunity for improving the electrical efficiency of Alberta's residential sector, and that there are a number of jurisdictions that have proven how this can be initiated. From the programs reviewed, it can be seen that the electrical efficiency initiatives in Canada have focused in four main areas: 1) decommissioning of old refrigerators, 2) promotion of Energy Star appliances, 3) promotion of compact fluorescent light bulbs, and 4) promotion of variable speed furnace motors in conjunction with high efficiency furnace promotions. Through the research performed, other electrical efficiency areas that show significant opportunities for electricity reduction were identified. These include switching to natural gas clothes dryers and ranges, and for further investigating electricity efficiency opportunities with consumer electronics and small appliances.

Refrigerator Decommissioning

The decommissioning of old refrigerators in Alberta is estimated to have the potential to reduce electricity consumption by a maximum of 394 GWh per year, if those refrigerators are replaced with Energy Star models. Another 156 GWh per year of savings are possible if the estimated 420,000 secondary refrigerators in Alberta are decommissioned without being replaced. Translating a BC Hydro Refrigerator Buy-Back Program to Alberta demonstrates that there is the potential to realistically achieve 48 GWh (9% of the maximum potential) of this electrical reduction potential through the direct impact of a $6.7 million, 1.5 year program. If the electrical savings from this program are assumed to be effective over at least 10 years, the cost of the program equates to $0.014 per kWh with the electricity savings to the consumer becoming equivalent to the program costs in just over 2 years (assuming the price of electricity is $0.07 per kWh).

A similar program was instituted by Yukon Economic Development, in order to promote the exchange of old refrigerators with new, Energy Star models. Translating this program to Alberta also demonstrates the significant potential for electricity reduction with this type of initiative as it is estimated to have the potential for 19 GWh of direct savings in Alberta. The costs of the program, however, are not considered to be as applicable to the Alberta context as programs in other jurisdictions given the relatively immature market for Energy Star products that existed in the Yukon, the wide differences in program size (due to differences in population within the two regions), and it is assumed, relatively high costs for product transportation.

Energy Star Appliances

The promotion of Energy Star appliances, including refrigerators, freezers, clothes washers and dishwashers, is estimated to have the potential to reduce energy consumption in Alberta's residential sector of up to a maximum of 614 GWh. This assumes that all of the existing stock of appliances is replaced with new, Energy Star models. Two recent Energy Star appliance rebate programs in Canada have demonstrated the ability for these types of programs to deliver direct energy reductions that are equivalent to between 14 GWh and 20 GWh for Alberta (2% to 3% of the maximum potential). The programs reported energy savings for both electricity and the energy needed for water heating for clothes washers and dishwashers. The costs for these two programs ranged between $0.029 / kWh and $0.051 / kWh (based on 10 years of electricity savings). The differences in the costs of these programs, given that both programs offered retail sales tax as a rebate to the consumer, is attributed mainly to the fact that appliances purchased

in Ontario were more expensive, on average, than those purchased in Saskatchewan. The 1% difference in sales tax contributed a smaller amount to this difference.

Compact Fluorescent Light Bulbs

The promotion of compact fluorescent light bulbs in the Alberta residential sector is estimated to have the potential to reduce electricity consumption by 982 GWh per year. This assumes that the non-compact fluorescent portion of the marketplace (90% of the marketplace) improves in efficiency by approximately 70% by converting to compact fluorescents. BC Hydro has demonstrated that Alberta could realistically expect to achieve a direct electricity reduction of 92 GWh (9% of the maximum potential) through a CFL give-away promotion. The cost of this 6 month program is estimated to be $23 million, or $0.025 / kWh over the 7 year life of the bulbs. The savings achieved by consumers exceeds the total expenditures of the program in just over 3.5 years (assuming the price of electricity is $0.07 per kWh).

Furnace Motors

There have been many programs across Canada in recent years to promote high efficiency furnaces, with an additional incentive for variable speed motors. Not all programs had specific incentives for these motors, or reported on the results of the motor component separately. It was possible, however, to segregate the electrical savings from the natural gas savings for two of the programs: Terasen Gas in B.C. and Climate Change Central in Alberta. Both of these programs achieved similar results, direct savings 1.2 GWh to 1.7 GWh of electricity per year (translated to an Alberta context) at a program cost of less than $400,000 or $0.022 / kWh to $0.028 / kWh (electricity savings assumed over 10 years). Both of these programs were run over the course of several months in 2004. The Terasen Gas program has been run for several consecutive years, with increasing participation each year. Similar results could be expected for subsequent programs in Alberta. The maximum potential for high efficiency furnace motors is estimated to be 221 GWh for the Alberta residential sector.

Clothes Dryers and Ranges

None of the programs from other jurisdictions addressed electrical efficiency in clothes dryers or ranges, as these appliances do not have the same degree of potential for electrical efficiency improvements as the other appliances previously discussed, and do not have Energy Star models associated with them. There is, however, a significant opportunity for reducing electricity consumption in these appliances by switching to natural gas versions. The result would be a province wide reduction of electricity consumption of approximately 833 GWh and 649 GWh for clothes dryers and ranges respectively. Given Alberta's electricity mix, the impact on direct greenhouse gas emissions is estimated to be 76% or a maximum of 1.8 Mt CO_2eq. annually. Given the significant potential for environmental benefits, further investigation of an appliance fuel-switching promotion is likely warranted.

Consumer Electronics and Small Appliances

There is also a significant amount of electricity consumed by electronics and small appliances ('Other Appliances' category from Table 5.1). These products were not investigated in detail due to the variety of products offered in this category. There are, however, Energy Star models for many types of consumer electronics, and therefore, there is an opportunity for these appliances to be targeted within an electrical efficiency program. There are also opportunities to become involved in the development of new standards for electronics and small appliances as these

products are receiving increased attention from standards organizations internationally due to their high cumulative electricity consumption. New standards with regard to stand-by or phantom loads are currently under development.

Social Marketing with Industry Involvement

One of the programs investigated included marketing and promotion of a broad range of Energy Star products in cooperation with retailers and manufacturers. The program, out of New York, included the following products: refrigerators, dishwashers, clothes washers, room air conditioners, through the wall air conditioners, freezers, dehumidifiers, ceiling fans, screw in compact fluorescent lights, hardwired/portable CFL fixtures, home electronics and windows. This program took a comprehensive approach to market transformation through partnerships with retailers to provide training, sales tools, promotional opportunities, and cooperative advertising incentives. For example, the cooperative advertising leveraged $30 million in advertising from retailers and manufacturers from $10 million in program investments. If the results of this program are translated to an Alberta context, it is estimated that this approach is capable of achieving 23 GWh in direct electricity savings for an $11.6 million program investment over 5.5 years. It is interesting to note that the net savings from the program (accounting for free drivers, free riders, state or federal energy efficiency standards, changes in the level of energy service, and natural change effects) is estimated to be nearly identical to the direct savings. This demonstrates the value of a multifaceted social marketing approach to ensuring impacts occur beyond direct participation and contribute towards a larger market transformation.

An Alberta example of a social marketing program based on partnerships with industry is the Built Green Alberta program. Built Green Alberta is a voluntary program whose primary purpose is to encourage homebuilders to use technologies, products and practices that will:

- Provide greater energy efficiency and reduce pollution
- Provide healthier indoor air
- Reduce water usage
- Preserve natural resources
- Improve durability and reduce maintenance

The Calgary Region Home Builders Association (CRHBA) has partnered with the Southern Alberta Institute of Technology (SAIT) to develop and deliver the program. In its first year within Calgary, the program had approximately 800 homes participate (about 10% of the total new housing market in Calgary) with Jayman Master Builder committing to have every house they build as part of the program. This type of program is another example of the opportunity to leverage resources from the private sector to work towards market transformation.

Summary

In summary, the overall potential for electricity reduction in Alberta's residential sector is estimated to be a maximum of a 1970 GWh (26% of sectoral consumption) if product replacement is the primary method considered, with an additional 1480 GWh (19% of sectoral consumption) reduction potentially available if secondary refrigerators are eliminated and a switch to natural gas clothes dryers and ranges is achieved. Based on past electrical efficiency programs within Canada, it was determined that approximately 48 GWh in direct energy savings could be realistically achieved through a refrigerator buy-back program, 17 GWh through an Energy Star appliance rebate program, 92 GWh through a CFL give-away, and 4.5 GWh through a furnace motor upgrade program run for 3 years. The estimated cost for a total

electricity reduction of 161 GWh per year based on these programs is $37 million, which would be applied over several years. This amounts to an electricity reduction of approximately 2.1% of the total residential consumption in Alberta.

Target Setting

Setting a residential electricity efficiency target for Alberta could be approached through several methods. The method discussed below is based on the results obtained regarding past programs in other jurisdictions.

As indicated above, the results from past programs in other jurisdictions have indicated the potential to achieve about 161 GWh per year in direct energy savings (2.1% of sectoral consumption) through the implementation of Energy Star efficiency programs over several years. This amount could be used as the basis for setting a target for the direct impact to be realized in Alberta from the application of electrical efficiency programs. These programs are estimated to cost $37 million and result in annual savings for consumers of $11 million.

This target could be expanded to include the efficiency opportunities presented through fuel switching and consumer electronics. If it is assumed that the potential for impacting these areas is similar to the potential realized for Energy Star appliances and lighting (ie. 10% of the maximum potential or 5% of the total consumption), then another 150 GWh direct reduction may be possible. Further research is required in this area to further refine the magnitude of electricity reduction opportunities potentially available.

Based on the research completed, there is a relatively limited range of targets that can be recommended, and those that are recommended are focused primarily on achieving certain levels of direct participation within similar efficiency programs. Opportunities do exist, however, to go beyond the scope of the programs presented here in setting and pursuing a residential electrical efficiency target for Alberta. Initiatives in this area can explore opportunities for electricity savings in products not previously addressed, such as clothes dryers, ranges, electronics and small appliances. Efficiency efforts can address more than just electricity – targeting programs to address other fuels, such as natural gas as there is a direct relationship between the use of these energy types within the residential sector. Coordinated social marketing programs, private sector involvement, the introduction of new regulations, and the development of new technologies can also be used.

Glossary

CASA – Clean Air Strategic Alliance

CFL – Compact fluorescent light bulbs

EEC – Electrical Efficiency and Conservation

Energy Star – International standard for an energy efficient product

Free Drivers – Impact of an energy efficiency program beyond direct participation. E.g. when consumer choices are influenced in spite of not directly participating in the program.

Free Riders – Participants in an energy efficiency program that would have likely made the same choices in the absence of the program.

LED – Light emitting diodes

NRCan – Natural Resources Canada

OEE – Office of Energy Efficiency (a part of Natural Resources Canada)

VSM – Variable speed motor (also known as an electronically controlled motor [ECM])