The Future of Energy Use in Medicine Hat

Engaging Individuals and Businesses

BACKGROUND REPORT

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BACKGROUND REPORT - The Future of Energy Use in Medicine Hat: Engaging Individuals and Businesses

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About the Pembina Institute

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The Future of Energy Use in Medicine Hat

Engaging Individuals and Businesses

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1. Introduction

In 2008, the City of Medicine Hat began providing rebates for energy efficient upgrades and renewable energy installations to its utility customers. The HAT Smart program, as it is known, has since become the most successful municipally offered program of its kind in the province.

As the current HAT Smart rebate programs mature, the City of Medicine Hat is looking to explore what future HAT Smart programming could look like. The purpose of this report is to identify and assess potential programming options for the City of Medicine Hat in engaging its residential and non-residential utility customers to reduce energy consumption and adopt renewable energy technologies.

1.1 Background and Environmental Targets

Currently, the energy needs for the City of Medicine Hat are almost exclusively met by locally produced natural gas as the City produces and distributes natural gas and generates electricity using natural gas as a fuel. Consequently, Medicine Hat residents enjoy some of the lowest energy prices and property taxes in Canada. As the existing natural gas fields decline, the City will need to add new sources of energy and income. As a strategy to address the decline in current gas supplies, Medicine Hat could benefit from both reducing the amount of energy it consumes, as well as diversifying the supply of its energy, notably towards renewable sources.

The City has also released a Community Environmental Roadmap, which sets targets for energy efficiency and conservation, as well as renewable energy generation. As part of this Roadmap, the City has set targets for:

- 25% of residential energy provided from renewable sources by 2025, and
- 20% reduction in residential natural gas and electricity consumption by 2020.

1.2 Report Outline

This report begins with an inventory of energy use within Medicine Hat, and by Medicine Hat utility customers (includes customers within Redcliff and the area immediately surrounding Medicine Hat). The energy inventory helps to identify key areas of energy use. It also provides a baseline that can be used to identify changes to energy use patterns.

The energy inventory is followed by a summary of the previous HAT Smart programming. This provides a good review of what has worked previously and the value that has been achieved through past programming.

The next section of the report identifies various options for future programming or engagement of utility customers. These options are then discussed to help identify opportunities that best meet the needs of the City.

2. Energy Inventory

2.1 Introduction

The City of Medicine Hat has a dual role when it comes to energy. As a municipal government, the City has an interest in the energy use, expenditures and emissions within its municipal boundaries. As a provider of natural gas and electricity to Medicine Hat and the surrounding area (including the Town of Redcliff), the City also has an interest in the energy use, expenditures and emissions within its customer base.

Due to this dual role, energy use, expenditures and GHG emissions within the city of Medicine Hat boundaries are first summarized, while the remainder of the more detailed energy inventory focuses on the entire customer base both within and outside of Medicine Hat. The reason for this focus is the fact that the HAT Smart program is offered to residential utility customers across the entire customer base as it is primarily funded through consumption charges among this same customer base. The HAT Smart commercial program, on the other hand, is limited to organizations within Medicine Hat as it is funded through City Council's Energy Dividend.

2.2 Medicine Hat: Energy Use, Expenditures and GHG Emissions in 2009

The report begins with an inventory of energy use within Medicine Hat.[1] The energy inventory helps to identify key areas of energy use. It also provides a baseline that can be used to identify changes to energy use patterns.

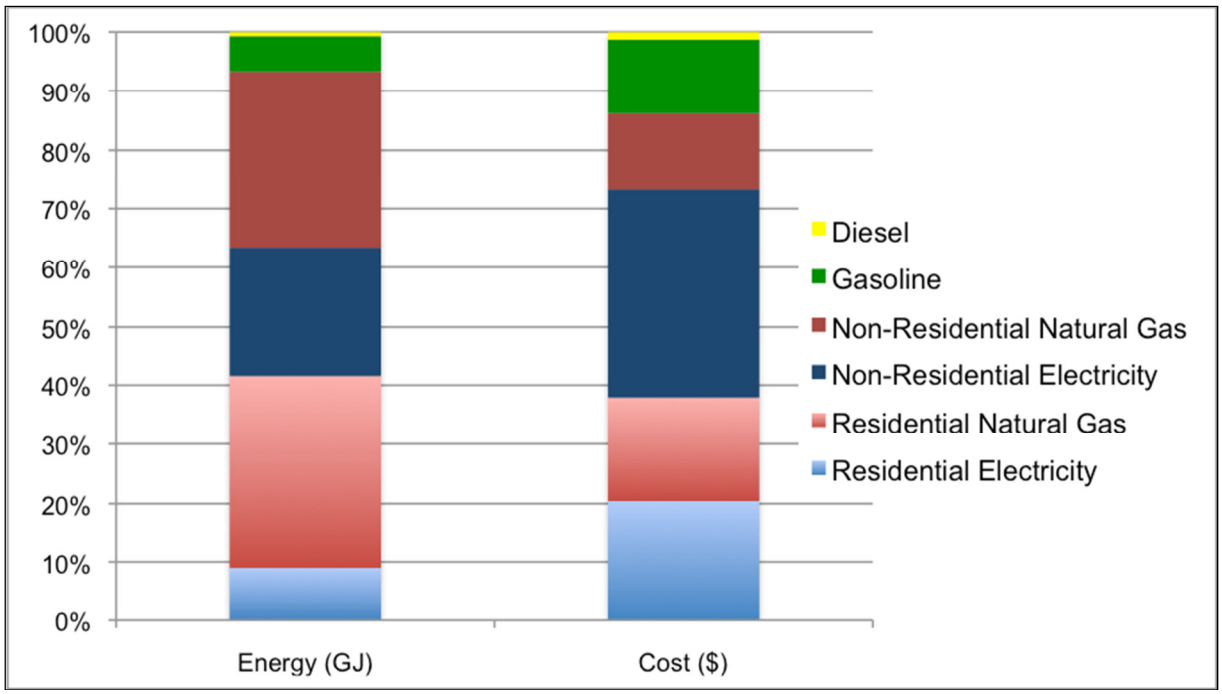


Figure 1: Medicine Hat 2009 Energy Use and Costs[2]

Figure 1 shows a summary of energy use and costs in Medicine Hat for 2009. Energy from natural gas makes up the greatest proportion of energy used in the city with 32% of total energy attributed to natural gas use in the residential sector, and 30% attributed to non-residential uses. Electricity use in the non-residential sector accounts for 22% of energy used in the city, while residential electricity accounts for 9%. Energy used for transportation is a small proportion of the total energy in the city as gasoline is estimated to account for about 6% of total energy and diesel accounts for about 1%. Additional information on the breakdown of energy use by building type, year and month is available in the background report.

Energy used in Medicine Hat has a significant cost as over $89 million each year are spent on electricity, natural gas, gasoline and diesel. With 56% of the total expenditures, electricity makes up the greatest proportion, as shown in Figure 1 with natural gas considerably lower at 30%. Though gasoline and diesel both contribute to relatively small amounts of total energy

[1] While this summary report covers just energy use in Medicine Hat, the background report also summarizes energy use for all utility customers including customers in Redcliff and the area surrounding Medicine Hat.

[2] Note: The energy inventory does not include the energy consumed by large industrial facilities located in Medicine Hat.

consumed, the energy used for transportation is estimated to account for 14% of the energy expenditures in the community.

The differences between energy use and costs result from the higher cost of electricity compared to natural gas. Electricity is over four times more expensive that gas on an energy basis. This is because it is not possible to convert all of the energy in natural gas to electricity when it is burned at a power plant. Once the high pressure energy is used up, the low pressure energy isn't able to spin an electricity generator any longer. This low pressure energy is often released as waste heat from power plants.

The average homeowner in Medicine Hat spends approximately $874 per year on natural gas and approximately $883 per year on electricity.

2.3 Medicine Hat Utility Sales

Medicine Hat supplies natural gas and electricity to customers within Medicine Hat, the Town of Redcliff and adjacent rural areas. Figure 2 illustrates the proportion of 2009 utility sales broken out by rate class and fuel type.

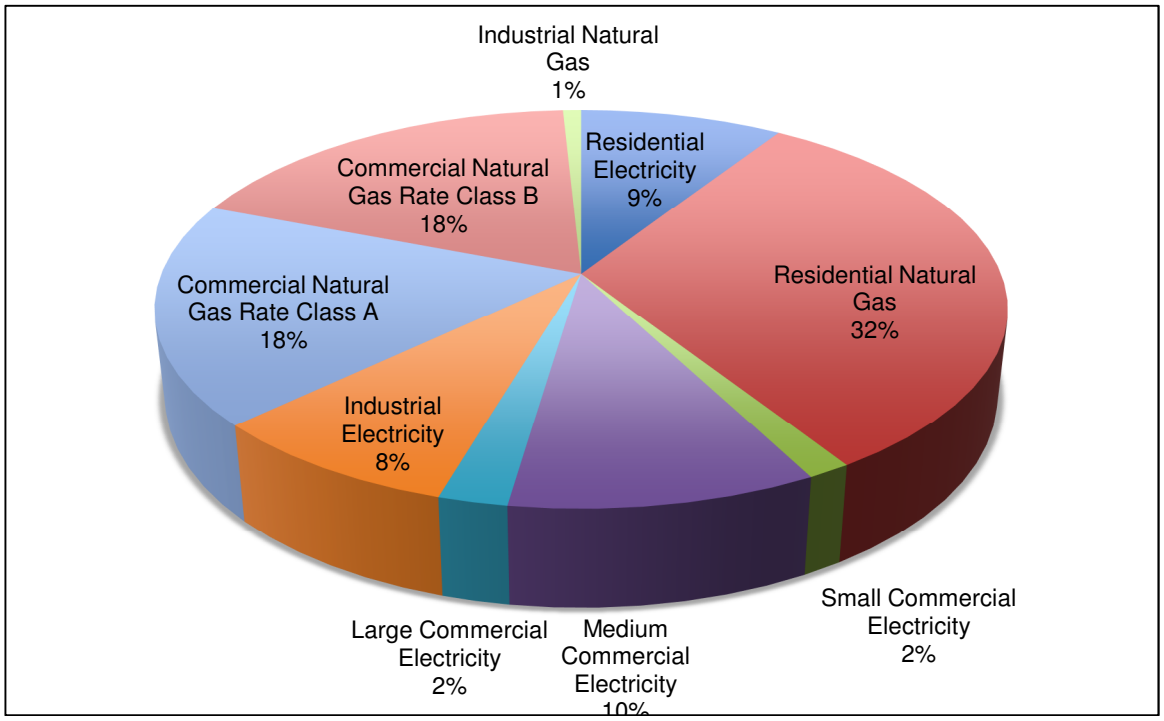


Figure 2: 2009 Utility Sales - Medicine Hat and Redcliff Consumption by Energy Type and Sector

Natural gas makes up the greatest amount of energy sales, with the residential sector consisting of 32% of the total energy sales, and the commercial rate classes A and B[3] each consisting of

[3] Rate Classes A and B are decided based on the total volume of natural gas consumed by the customer. Rate Class A is for General Service customers that use less than 5,000GJ in one year, whereas Rate Class B is for a Large Use General Service for customers that use more than 5,000GJ in one year.

18% total sales. 10% of total energy sales are attributed to electricity for the medium commercial rate class, while large and small commercial rate classes for electricity are each 2% of the total.

The historical data for the Medicine Hat utility sales from 2002 to 2009 is illustrated in Figure 3. Consumption for Medicine Hat, Redcliff and the rural areas serviced by the utility is combined and broken down by sector and energy type. A detailed breakdown of the commercial sector into small, medium and large categories for electricity consumption, and for rate classes A and B for natural gas consumption were available only for the years 2007, 2008 and 2009.

From 2002 to 2009, total energy consumed has fluctuated from an annual high of approximately 8.56 million GJ in 2009.

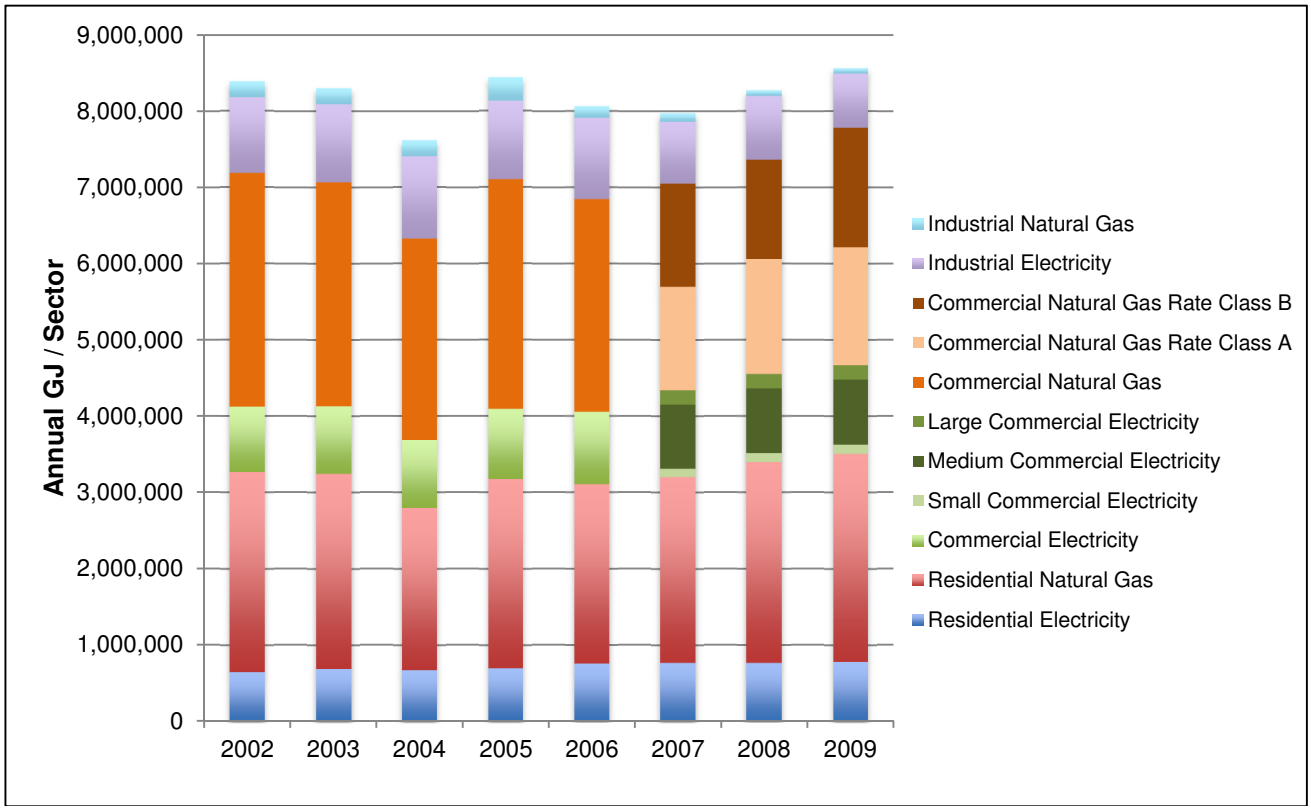


Figure 3: Total Combined Energy Consumption by Type and Sector 2002-2009

2.3.1 Electricity Consumption

Figure 4 shows the total electricity provided by the utility, and consumed by each major rate class. The residential, medium commercial and industrial sectors use the greatest amounts of electricity each year. Annual consumption for each rate class is consistent from 2007 to 2009 with the exception of the industrial class, which saw a 15% decrease in electricity consumption from 2008 to 2009.

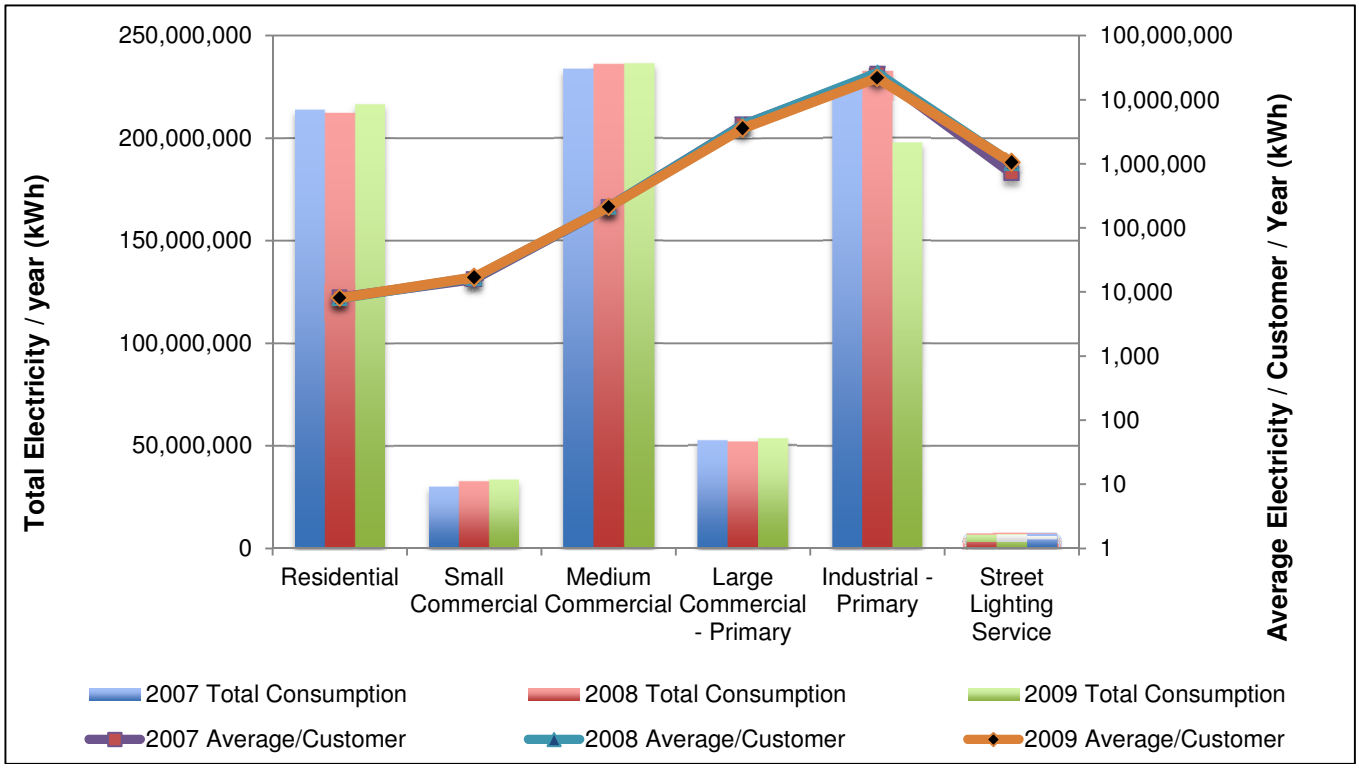


Figure 4: Total Electricity and Consumption per Customer, by Rate Class

2.3.2 Natural Gas Consumption

Figure 5 shows the annual natural gas consumption totals and per customer, again divided by rate class. The residential rate class consumes the greatest total amount of natural gas each year; in 2009 the sector used a total of 2.7 million GJ. The consumption of the commercial rate classes A and B are comparable, with approximately 1.5 million GJ consumed by each in 2009. The industrial rate class has the lowest total consumption but by far the highest per customer average, indicating a small number of users that consume large amounts of natural gas.

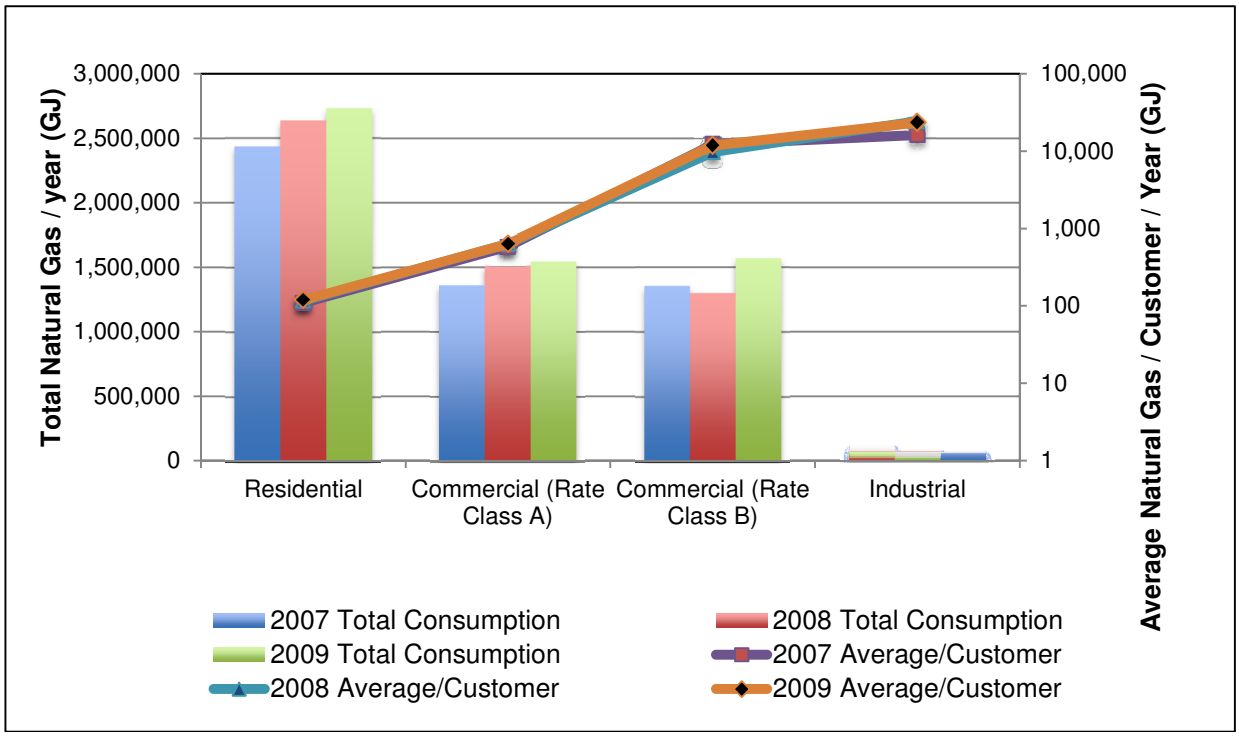
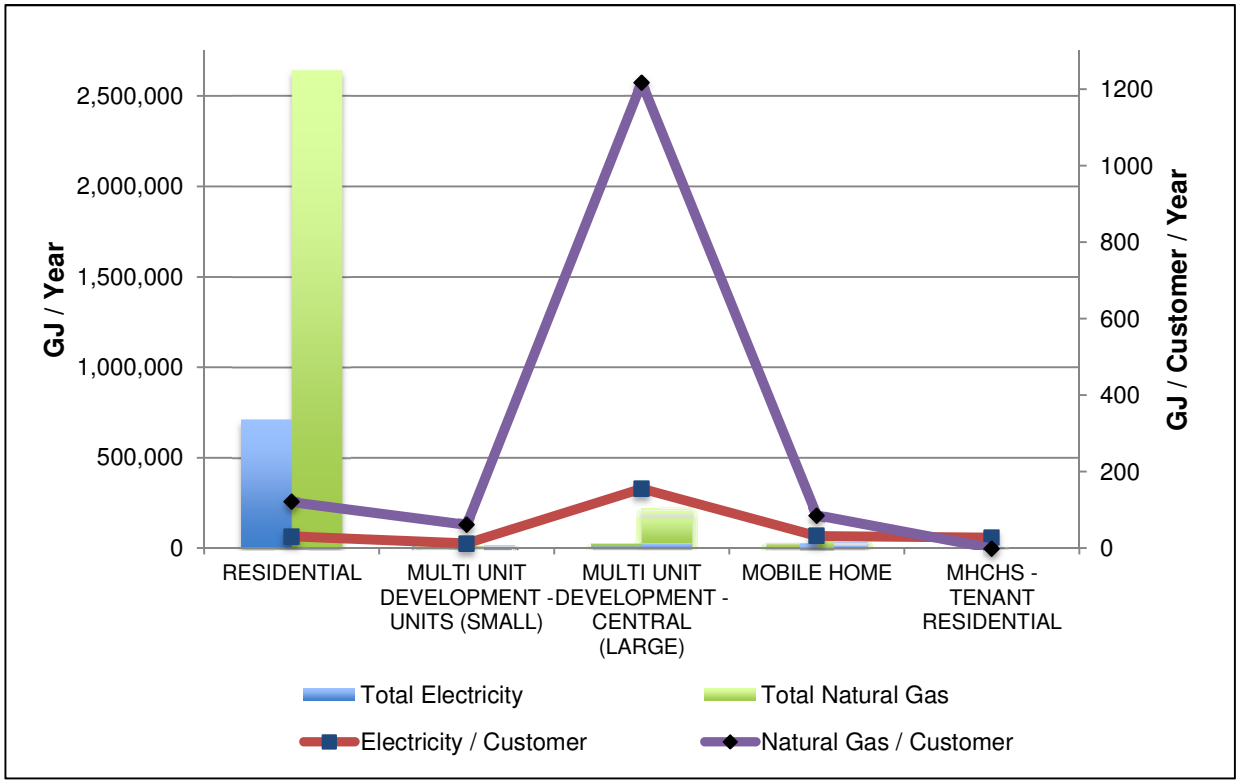


Figure 5: 2007- 2009 Total Natural Gas and Consumption per Customer, by Rate Class

2.4 Personal Energy Use / The Residential Sector

Personal energy used by Medicine Hat customers is consumed in a variety of housing types. Figure 6 shows the 2009 residential total and per customer electricity and natural gas consumption by location type. Single detached houses make up the majority of the electricity and natural gas used in the residential sector. The per customer energy use is much higher for the residential single detached houses, with an average of 120 GJ of natural gas and 31 GJ of electricity consumed in 2009. In contrast, the small multi unit development has an average per customer consumption of 60 GJ of natural gas and 12 GJ of electricity.



*MHCHS – refers to Medicine Hat Community Housing Society

Figure 6: 2009 Residential Electricity and Natural Gas Consumption, by Location Type

Figure 7 and Figure 8 illustrate the residential electricity and natural gas consumption of customers serviced by Medicine Hat by month for the years 2007 to 2009. Electricity consumption is greatest during July and August, due to the higher use of air conditioners that run on electricity. Consumption peaked in the summer of 2007, which corresponds to the high number of cooling degree days, as shown in Figure 9. Natural Gas consumption is greatest during the winter months, particularly January, February and December. This use is attributed to cold winters during which residents utilize greater amounts of natural gas to operate furnaces for heating. Natural gas consumption was slightly greater in the winter of 2009, which corresponds to the higher number of heating degree days, as shown in Figure 10.

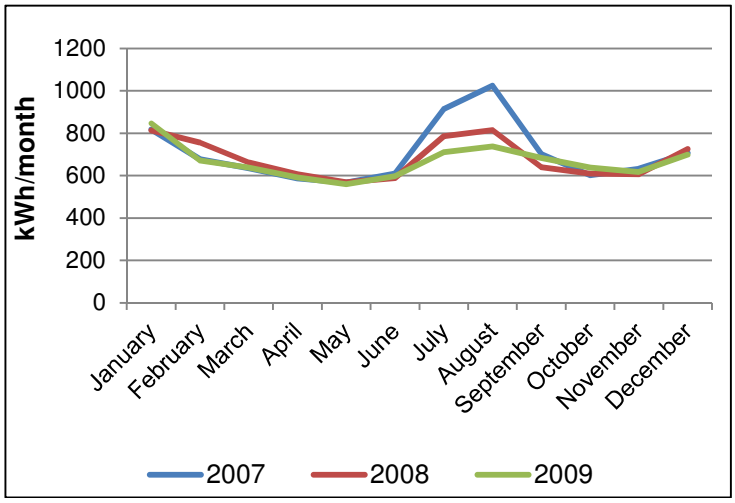


Figure 7: Average Monthly Residential Electricity Consumption: 2007-2009

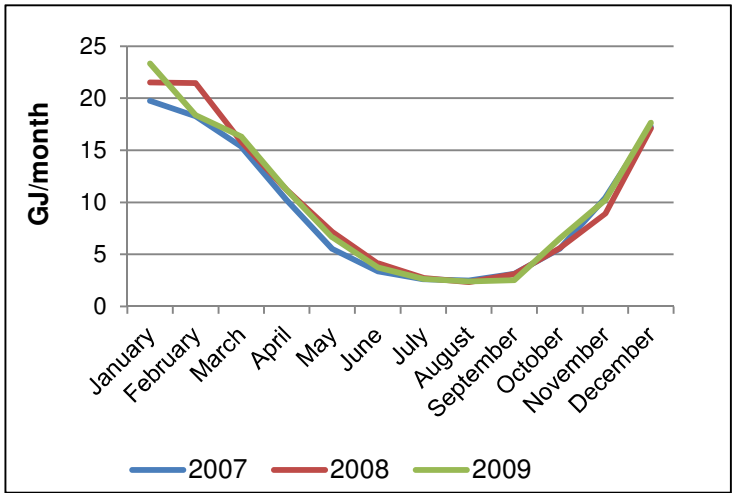


Figure 8: Average Monthly Residential Natural Gas Consumption: 2007-2009

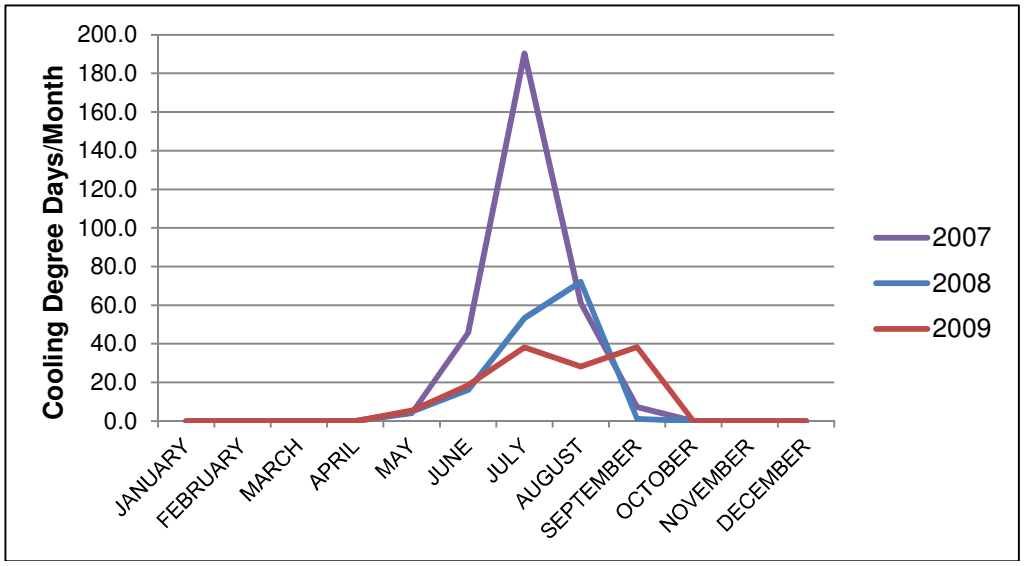


Figure 9: 2007-2009 Cooling Degree Days, by Month

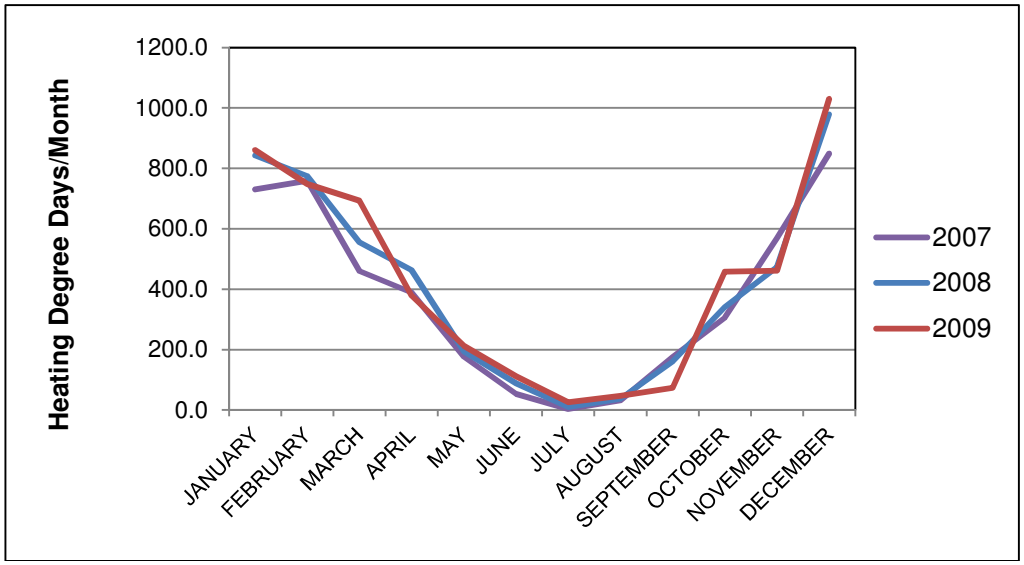


Figure 10: 2007-2009 Heating Degree Days, by Month

Figure 11 compares the residential per customer natural gas and electricity consumption for Medicine Hat and Redcliff from 2002 to 2009. Per customer electricity use is slightly higher in Redcliff compared to Medicine Hat. Both Medicine Hat and Redcliff electricity use are influenced by the cooling degree days as shown in Figure 12. Higher numbers of cooling degree days in 2003, 2006 and 2007, corresponds to a higher per customer use of electricity. In general, natural gas use is higher during years with colder winters, as indicated by higher numbers of heating degree days, which is also shown in Figure 12.

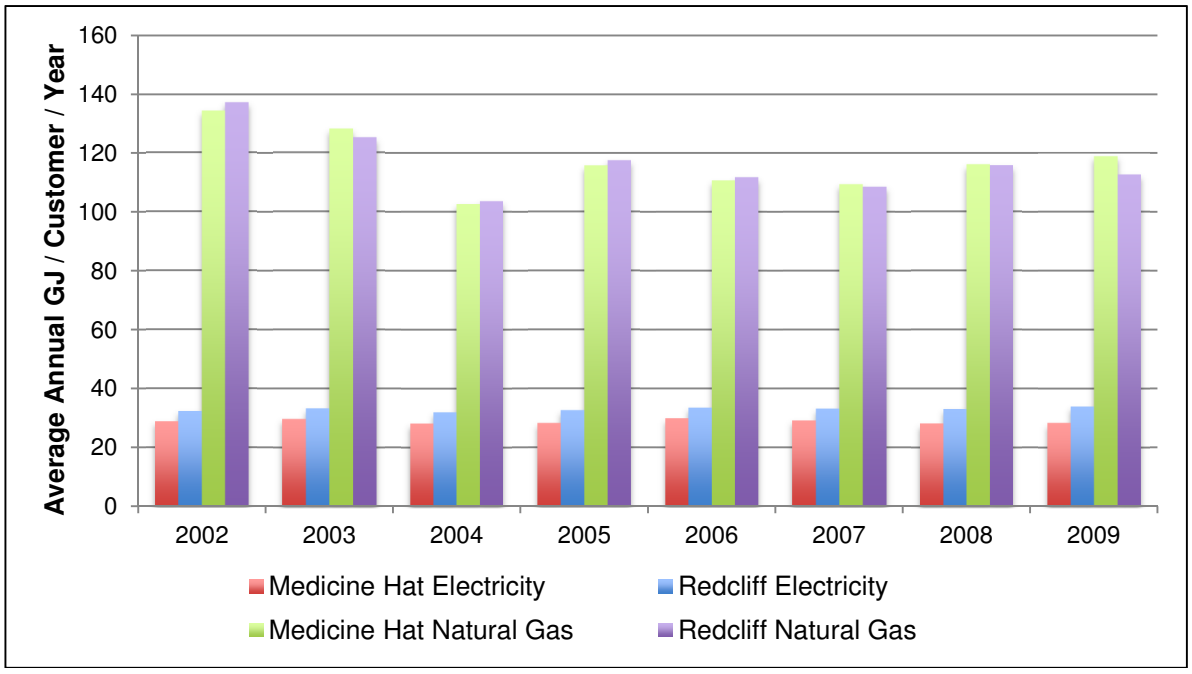


Figure 11: Medicine Hat vs. Redcliff - Average Annual Residential per Customer Consumption - Electricity and Natural Gas

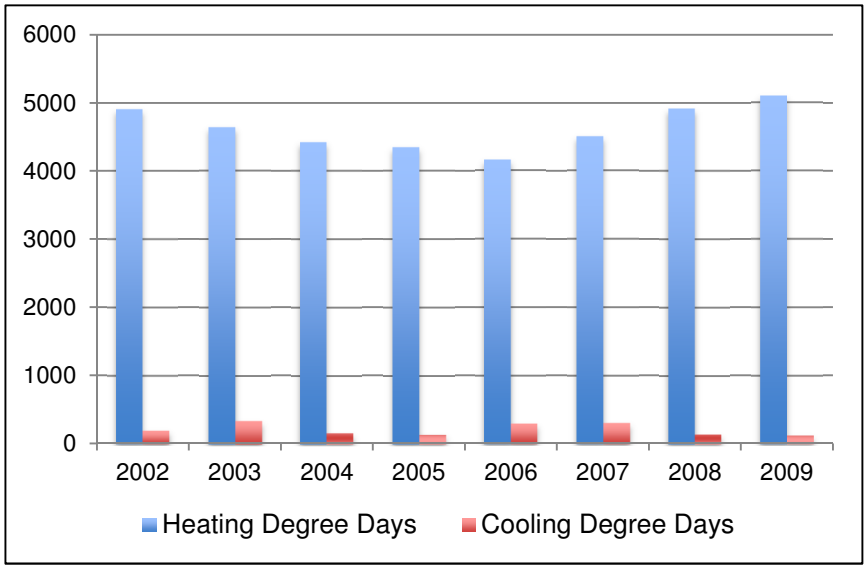


Figure 12: 2002-2009 Annual Heating and Cooling Degree Days

2.5 Energy Used by Businesses: The Non Residential Sector Serviced by Medicine Hat

The non residential sector serviced by Medicine Hat consists of commercial and industrial buildings and greenhouses, city departments, and schools or university buildings. The total and per customer natural gas and electricity consumption for each of these location types in 2009 is shown in Figure 13. The commercial and greenhouse classes have significant energy consumption, particularly in the form of natural gas. In 2009, average electricity consumption per customer is 551 GJ. Natural gas consumption is much more varied between location types. The greenhouse locations have by far the greatest consumption per customer, with an average of 10,920 GJ consumed in 2009.

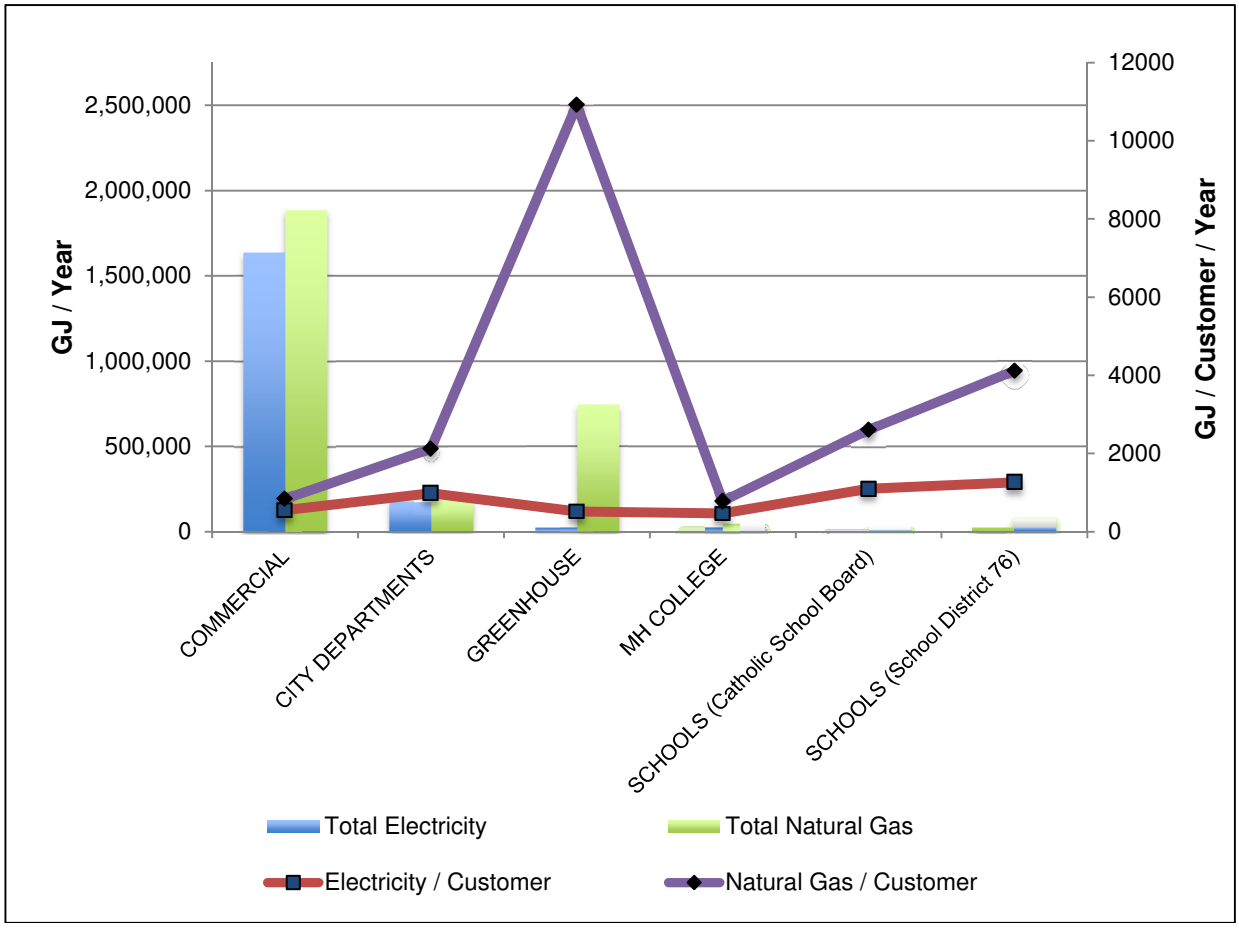


Figure 13: Non Residential Total and Per Customer Electricity and Natural Gas Consumption, by Location

Figure 14 shows the electricity consumption of customers in the medium commercial rate class by month for the years 2007 to 2009. Similar to the residential sector, electricity consumption is greatest during July and August. Consumption peaked in the summer of 2007, which corresponds to the high number of cooling degree days, as shown in Figure 9. Figure 15 shows the natural gas consumption of customers in Rate Class A. Energy use is greatest during the winter months of January, February and December. Natural gas consumption was slightly higher in the winter of 2009, which corresponds to the higher number of heating degree days, as shown in Figure 10.[4]

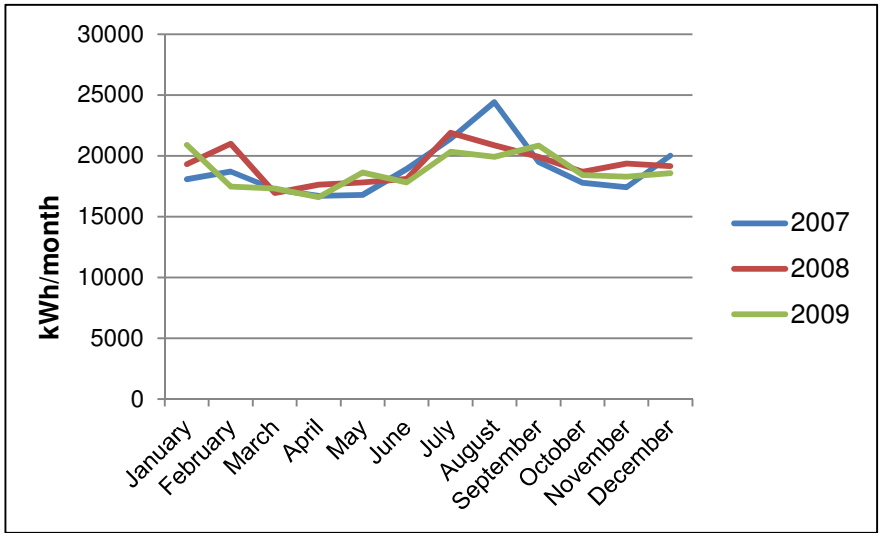


Figure 14: Average Monthly Medium Commercial Electricity Consumption

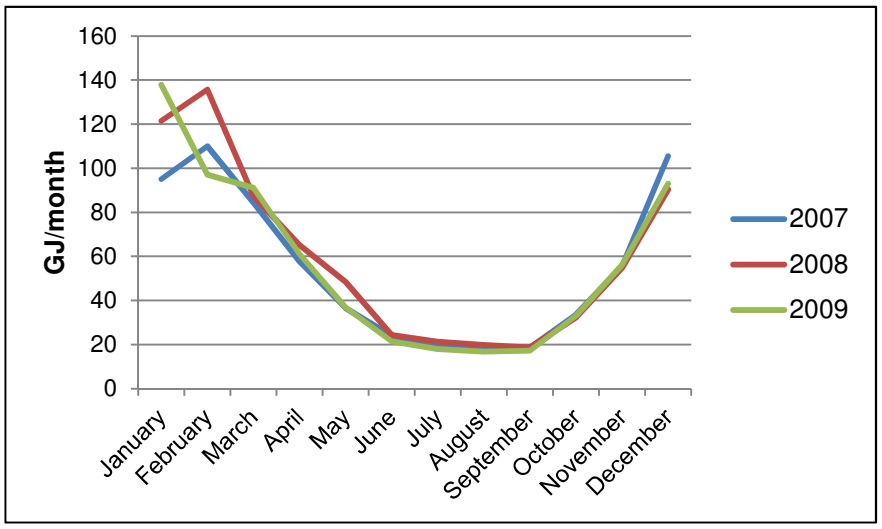


Figure 15: Average monthly Commercial (Rate Class A) Natural Gas Consumption

[4] The electricity consumption by month for the small and large commercial rate classes follow the same general pattern as that of the medium commercial, and natural gas consumption by month for rate class B follows the same pattern as for rate class A.

3. HAT Smart – Program Evaluation

3.1 Introduction

HAT Smart promotes a wide variety of programs related to energy conservation, efficiency and renewable energy for residents and businesses in Medicine Hat and the surrounding regions serviced by the utility. The programs were implemented following the 2008 Community Environmental Roadmap, which laid out performance measures and targets for future energy use in Medicine Hat. HAT Smart is a response to the performance targets by helping residents and businesses reduce their energy footprint through a variety of educational programs, energy assessments, and rebates for energy efficiency and renewable equipment.

The residential HAT Smart program began in 2008 by offering incentives for residents to complete energy assessments and replace old appliances. The residential program expanded to also include incentives for new home construction and renewable energy. The commercial program began in early 2010 and offers incentives for energy assessments, energy efficiency upgrades, and renewable energy installations.

The total HAT Smart budget for residential and commercial programs is approximately $2 million, with approximately $1 million allocated for each sector. The following sections offer detailed assessments of both the residential and commercial HAT Smart programs. Total program uptake, cost and level of energy reductions are presented. The analysis also assesses the cost of each program and incentive compared to the amount of energy reduced.

The analysis provides an important snapshot of the relative success about each element of the residential and commercial HAT Smart programs, and offers insight for future HAT Smart program design.

3.2 Residential Programs

3.2.1 Program Context

The current HAT Smart program for residential homes includes incentives for residents to complete energy assessments, replace old electric and natural gas appliances, and improve the air sealing and insulation of their homes. Renewable energy incentives for the residential sector include rebates for solar hot water heaters and solar electric systems (photovoltaics). In several instances, the HAT Smart Program incentives have complemented energy incentive programs run by the Federal and Provincial governments. In this way, participants in the program have benefited from multiple sources of funding to offset the costs of the new technology. Table 1

lists the residential programs provided by the City of Medicine Hat, and indicates complementary programs run by other levels of government.

Table 1: Current HAT Smart Residential Incentive Programs

Program Type	Technology or Product	Level of Incentive	Provincial / Federal* Program
Conservation and Efficiency	Energy Assessments	$100	$200 (Provincial)
	A/C Central Air	$200	$250 (Federal)
	Air Sealing and Insulation	$300	$430 (Federal)
	Clothes Washer	$75	$100 (Provincial)
	Furnace (Gas 92% / Gas 94% + DC Motor)	$400	$375-(Federal) + $400 (Provincial)
	Furnace – Gas 92% + DC motor	$400	$625-(Federal) + $500 (Provincial)
	Furnace – Gas 94% + DC motor	$400	$790-(Federal) + $500 (Provincial)
Renewable Energy	Solar Hot Water Heater	$3000	$1250 (Federal)
	Solar Electric (PV) System	$6000	n/a

* The Federal ecoENERGY rebate program ended in March 2010. The rebate values listed only apply if an energy assessment was competed prior to March 2010.

3.2.2 Residential Program Evaluation

As shown in Figure 16, funding allocated from late 2008 to date for energy efficiency and conservation make up over half of the current HAT Smart program expenses. Energy assessments consist of 21% of total program expenses, while renewable energy expenses consist of 25% of the total cost. Incentives for efficient new home construction make up a small proportion of total expenditures; however, the program only began in February 2010, and therefore has been available for a much shorter time than the other programs.

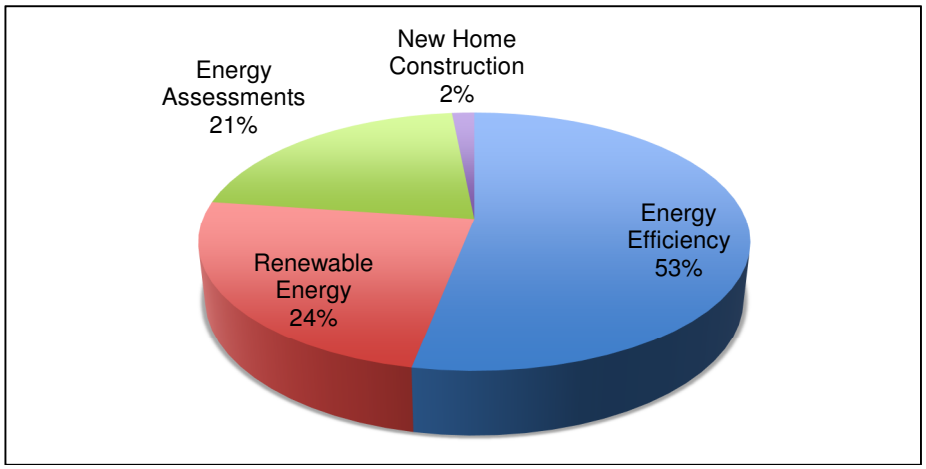


Figure 16: Total Residential Incentives by Program Category (based on $ expended)

Figure 17 shows the total expenses for the residential program categories.[5] The furnace rebate program has the highest cost; up to the end of the second quarter in 2010, the City had spent $204,600 on a total of 508 items. The energy assessments have the next highest total cost ($184,300) but by far the highest uptake with 1843 completed as these are mandatory for all program participants. The solar hot water and electric systems have a relatively high total cost but a much smaller number of participants.

As of Sept 17, 2010, there were 5 new home incentives provided since the start of new home incentives in February 2010: 1 for EnerGuide 80 ($1,500) and 4 for EnerGuide 82 ($3,000).

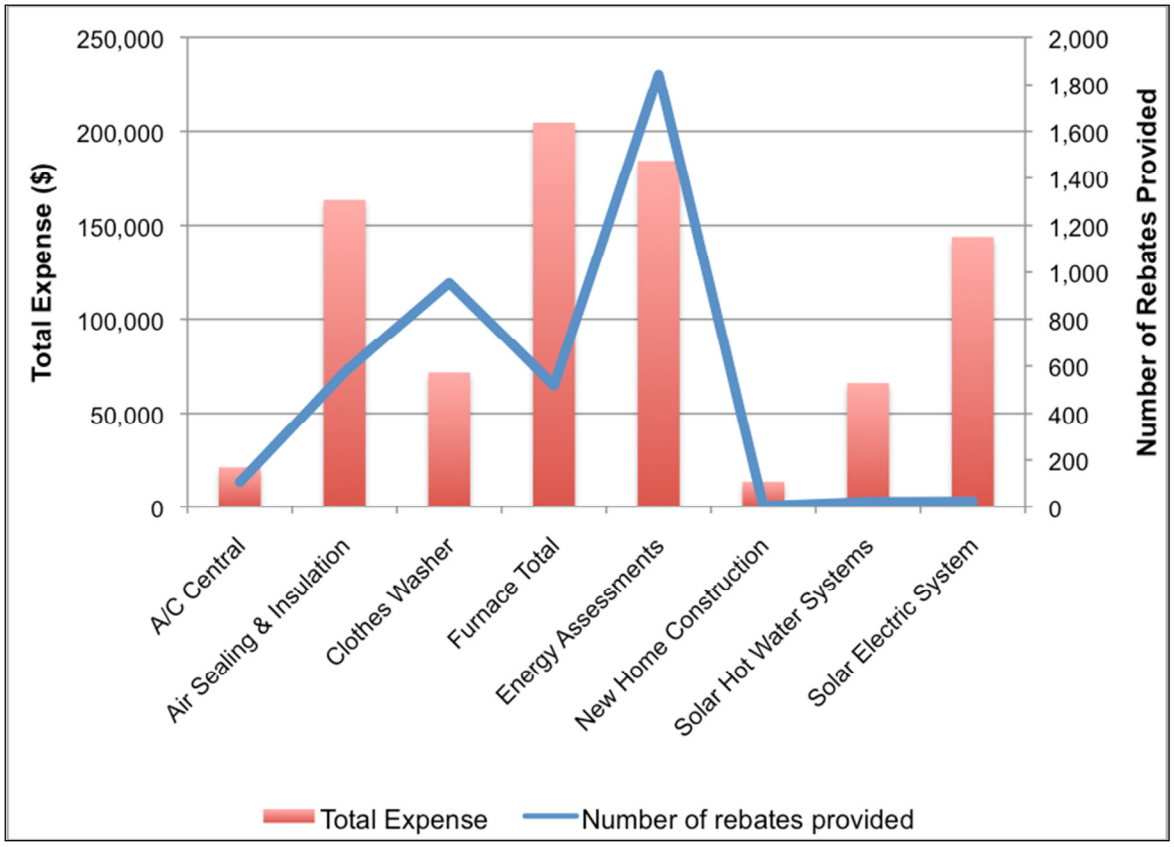


Figure 17: Total Expenses and Program Uptake

[5] Data compiled from the start of the program to the end of Q2 2010. Solar Hot Water and Solar Electric system data is up to September 23, 2010.

Figure 18 shows the energy efficiency programs by cost and number of customers per quarter. All of the programs have gained momentum with greater numbers of participants in each quarter. The program participation increased considerably in the first quarter of 2010. The Federal ecoENERGY program had a March 2010 deadline for several products, which could have contributed to the significant increase in the HAT Smart rebates.

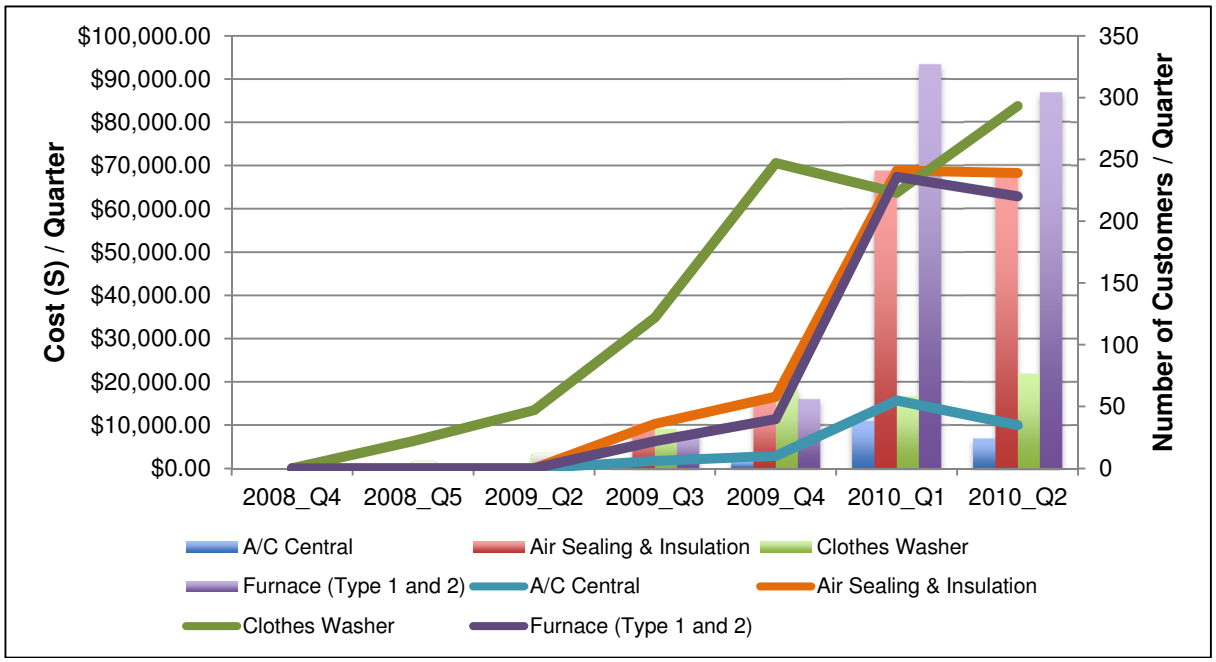


Figure 18: Conservation programs by Quarterly Cost and Customers

3.2.2.1 Energy and GHG Savings

For energy savings, there are two types of direct savings at the home: natural gas and electricity. However, since the electricity used in Medicine Hat is generated by burning natural gas at the city's power plant, as shown in Figure 19 electricity savings also equals natural gas savings. It takes approximately 8.8 GJ of natural gas for every 1000 kWh of electricity generated.

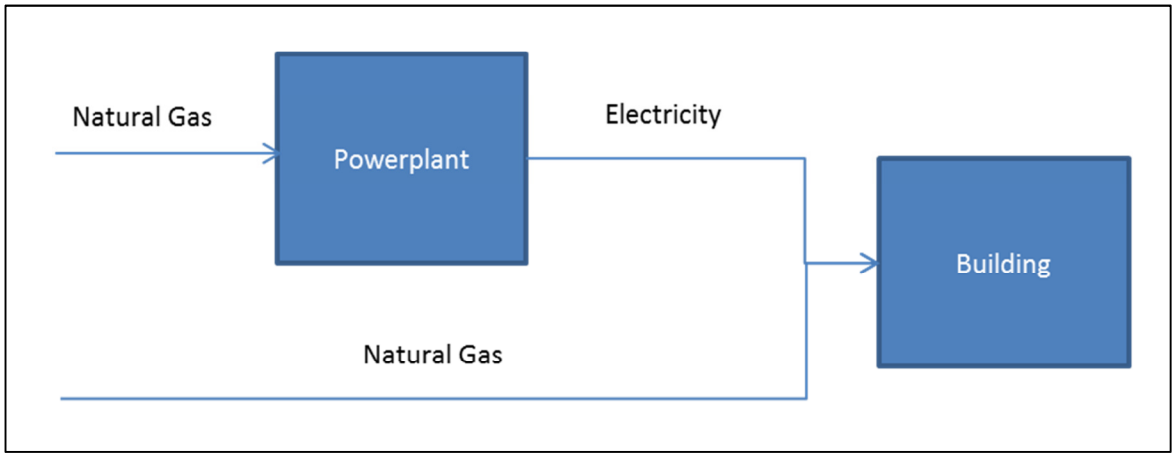


Figure 19: How Electricity Savings Result in Natural Gas Savings

In order to compare the different types of incentives offered by HAT Smart, the electricity savings have been presented in both kWh of electricity savings at the home, as well as GJ of natural gas savings at the power plant.
As shown in Table 2, furnace, insulation and air sealing rebates provide the greatest reduction in natural gas use per $100 of incentives provided (annual reduction above 4 GJ / $100 in each case).

Rebates for air conditioners save 83 kWh per year for every $100 of incentives provided, but that translates to saving only 0.7 GJ of natural gas at the power plant for every $100 of rebates. Rebates for washing machines save about the same amount of natural gas, but they also save a significant amount of water. Over 11 million litres of water per year are estimated to have been saved through the program.

Incentives for new home construction are estimated to save up to 0.6 GJ of natural gas each year for every $100 of incentives provided when compared to a house built to the minimum building code (approximately EnerGuide 70). However, some houses in Alberta are already being built to a mid-70s level. If this is considered to be the more likely construction practice in Medicine Hat, the cost effectiveness of the new home incentives is reduced to below 0.15 GJ of natural gas saved per year for every $100 of incentives.[6]

Both the solar electric (PV) and hot water systems are estimated to reduce less than 0.4 GJ of natural gas per year for every $100 of rebates.

[6] Energy saving estimates for new homes provided by: Lio and Associates. 2011. *Developing Energy Efficiency Upgrades for Houses in Medicine Hat, Alberta*.

Table 2: Cost Effectiveness of Residential Sector Incentives

		Natural Gas (NG) Savings at Home		Electricity Savings at Home		Natural Gas Savings at Powerplant (from reduced electricity consumption at home)		Total Savings
Measure	Total Incentives	Total Annual Savings (GJ)	Annual Savings (GJ) / $100 Incentive	Total Annual Savings (kWh)	Annual Savings (kWh) / $100 Incentive	Total Annual Savings (GJ)	Annual Savings (GJ) / $100 Incentive	Annual Savings (GJ) / $100 Incentive
Based on Total Program Performance to Dec. 31, 2009								
Air conditioner	$3,200	-	-	2670	83	23	0.7	0.7
Furnace	$24,400	1023	4.2	-	-	-	-	4.2
Clothes washer*	$32,850	261	0.8	86	0.3	1	0.002	0.8
Insulation and air sealing	$26,125	1537	5.9**	-	-	-	-	5.9**
Based on a Single Home (compared with a home built to EnerGuide 70)								
EnerGuide 78	$1,000	1.4	0.1	524	52	4.6	0.46	0.60
EnerGuide 80	$1,500	1.5	0.1	552	37	4.9	0.32	0.42
EnerGuide 82	$3,000	2.4	0.1	405	13	3.6	0.12	0.20
EnerGuide 86	$10,000	2.3	0.0	2553	26	22.5	0.22	0.25
Based on a Single Home (compared with a home built to EnerGuide 75)								
EnerGuide 78	$1,000	0.1	0.0	153	15	1.3	0.13	0.15
EnerGuide 80	$1,500	0.4	0.0	205	14	1.8	0.12	0.15
EnerGuide 82	$3,000	0.8	0.0	61	2	0.5	0.02	0.04
EnerGuide 86	$10,000	1.4	0.0	167	1.7	1.5	0.01	0.03
Based on a Single Installation								
Solar Electric System (1kW)	$6,000	-	-	1,400	23	12	0.2	0.2
Solar Hot Water System	$3,000	12	0.4	-	-	-	-	0.4

*saves significant amounts of water as well
**does not include savings from air sealing; value likely underestimated

3.2.2.2 Influence of HAT Smart on Participation in other Government Programs

Participation of Medicine Hat residents in Provincial rebate programs (clothes washers and furnace) is higher than in other municipalities and regions of Alberta as shown in Figure 20. Communities identified with an asterix (*) have municipal rebate programs.

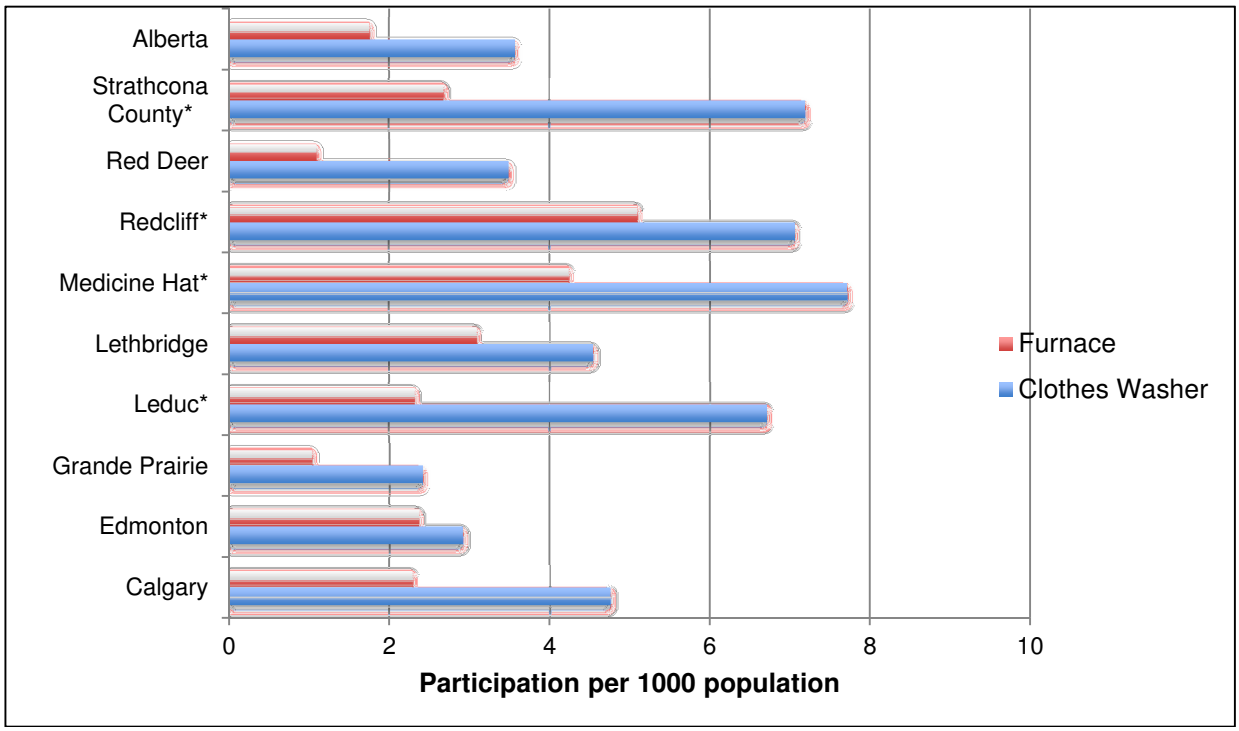


Figure 20: 2009 Participation Rate in Provincial Rebate Program per 1000 residents

Medicine Hat participation in the Federal ecoENERGY rebate program is also higher than in other municipalities and regions of Alberta as shown in Figure 21. The 'D' and 'E' audit evaluations refer to pre and post retrofit home audits, respectively.

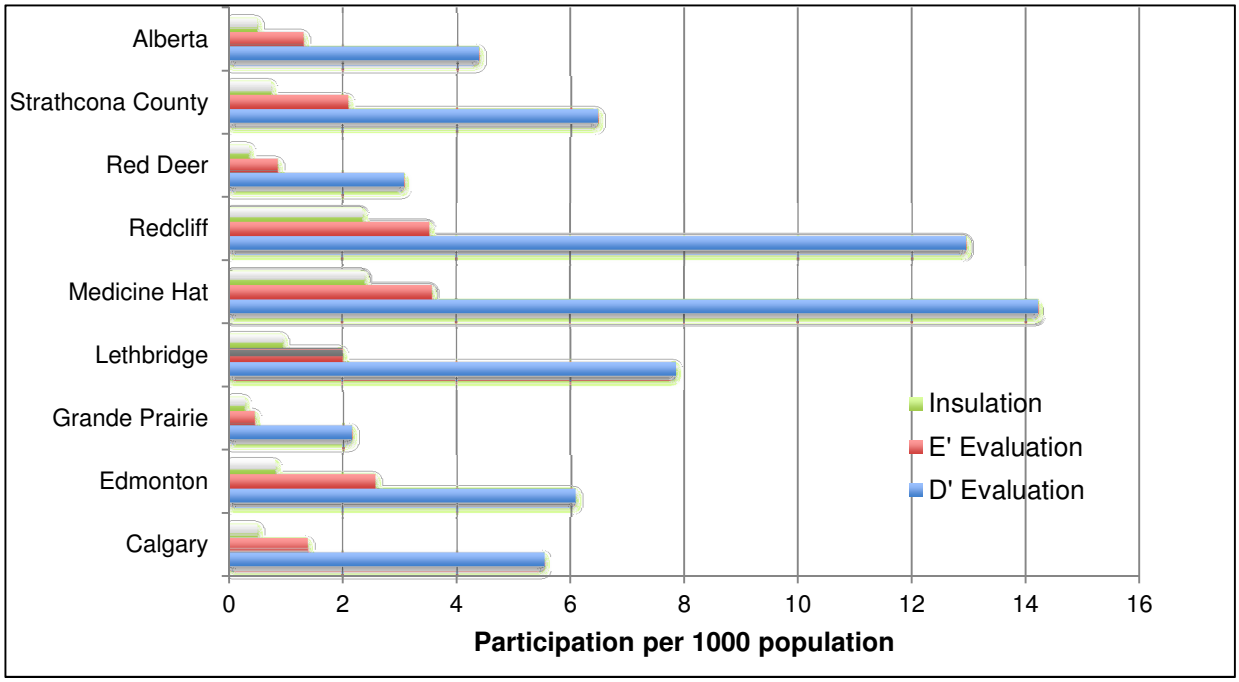


Figure 21: 2009 Participation Rate in each ecoENERGY Retrofit Program per 1000 residents

3.2.2.3 Additional Benefits from the Current HAT Smart Program

In addition to the energy and GHG savings resulting from the HAT Smart program, education and awareness within the City of Medicine Hat has been improved. This has occurred through the HAT Smart website, free energy conservation seminars that are offered online or in-person at the City, and information provided at community events. For example, since launching the HAT Smart website at the end of 2008, the site has had an average of 1250 unique visitors each month. The greatest number of unique visits occurred in March 2010, most likely due to rebate activities and deadlines for the Federal ecoENERGY retrofit program.

These resources have provided essential roles to generate community support and wider program uptake. The website and associated education programs offer a platform from which additional HAT Smart activities can be launched.

3.3 Commercial Programs

The current HAT Smart program for the commercial sector includes incentives for energy audits, conservation and energy efficiency upgrades, and renewable energy. Energy conservation technology was funded at a rate of 10% of the installed cost up to a maximum of $50,000. Renewable energy incentives were offered at a rate of 50% of the installed cost of the technology, up to a maximum of $50,000.

A total of 30 commercial businesses have applied for one of the HAT Smart programs; of those, 12 have applied for a combination of Energy Audits and Conservation activities, while 18 businesses have applied for funding for renewable energy, or a combination of renewable energy and conservation activities.

Out of the 18 commercial businesses that have participated in the renewable energy program, 15 businesses have installed solar electric systems. The majority of these are 10kw systems, though several have a smaller capacity between 2.5 to 5kw.

12 businesses that participated in the program installed a range of different technologies to help conserve energy. Upgrades that have been completed include: insulation; HVAC upgrades; lighting retrofits; furnace replacements; and window upgrades.

3.3.1 Energy and GHG Savings

As shown in Table 3, energy efficiency upgrades in the commercial sector have been more cost effective than those offered in the residential sector. This could be because of the incentive level set for the upgrades, or it could be a result of the types of upgrades available in the respective sectors. It should also be noted that the incentives directed towards heating energy offer a more cost effective opportunity to reduce energy use.

The cost effectiveness of the incentives for commercial PV systems are similar to those for the residential sector although some installations are more cost effective as the installed cost per kW is lower.

Table 3: Cost Effectiveness of Commercial Sector Incentives

		Natural Gas (NG) Savings at Work		Electricity Savings at Work		Natural Gas Savings at Powerplant (from reduced electricity consumption at work)		Total Savings
Company	Total Incentives	Total Annual Savings (GJ)	Annual Savings (GJ) / $100 Incentive	Total Annual Savings (kWh)	Annual Savings (kWh) / $100 Incentive	Total Annual Savings (GJ)	Annual Savings (GJ) / $100 Incentive	Total Annual Savings (kWh)
Energy Efficiency Upgrades								
1	$8,000	610	7.6	24	0.3	0.2	0.0	7.6
2	$8,000		-	10,445	131	92	1.1	1.1
3	$6,000	595	9.9	10,390	173	91	1.5	11.4
PV Installation								
4	$50,000			14,000	28	123	0.2	0.2
5	$35,800			14,000	39	123	0.3	0.3
6	$37,472			14,000	37	123	0.3	0.3
7	$22,724			7,000	31	62	0.3	0.3
8	$12,668			3,500	28	31	0.2	0.2

4. HAT Smart II – Options and Opportunities

4.1 Market Transformation

The ultimate goal of governments looking to reduce energy consumption or increase the use of renewable energy is 'market transformation'.[7, 8]

Market transformation occurs when a market, such as the market for energy using and producing devices, transitions from one set of products, services and behaviours to another, as shown in Figure 22. The appeal of the market transformation concept is that the transition is supported and even driven by market forces so the transformation is sustained even without continuous attention from government. This does not mean, however, that government is not involved in the process as many examples include government involvement along most of the market transformation progression.

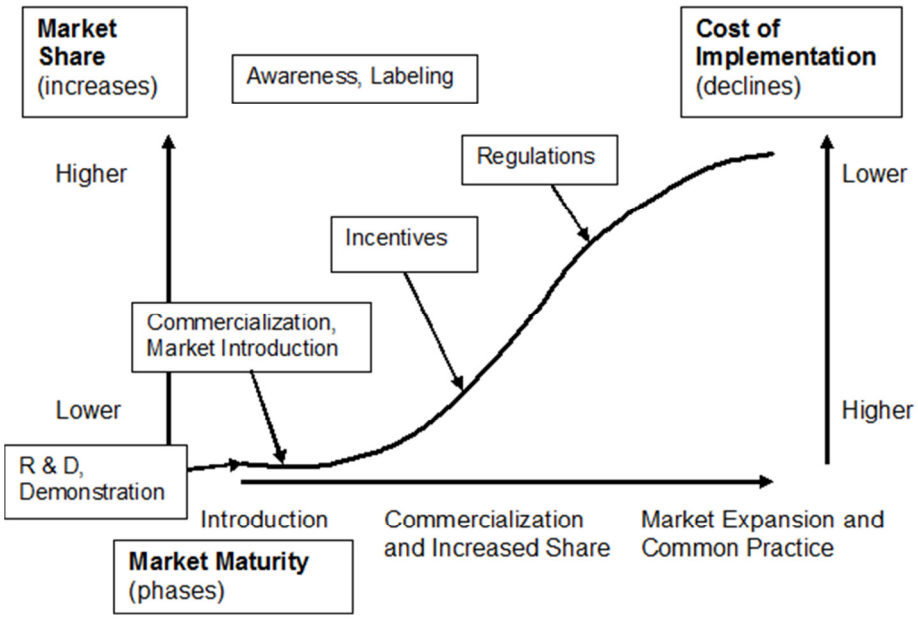


Figure 22: Theoretical Market Transformation Curve

[7] Energy Sector Sustainability Table. 2008. Energy Efficiency in Canada Status and Potential. http://www.tdds.ca/ED717E3F-17AF-48CB-AE8D-7AC3A6FFC178/Foundation_Paper.pdf

[8] North American Energy Working Group. 2002. North American Energy Efficiency Standards and Labeling. http://oee.nrcan.gc.ca/NAenergyefficiency/NAEWG_Standards-Labels.pdf

Market transformation that is government led, such as the desire for reduced energy use and the increased use of renewable energy, typically involves the stages listed in Table 4 for the development, introduction and adoption of new products, services and behaviours. These stages do not always occur sequentially.

Table 4: Stages of Market Transformation

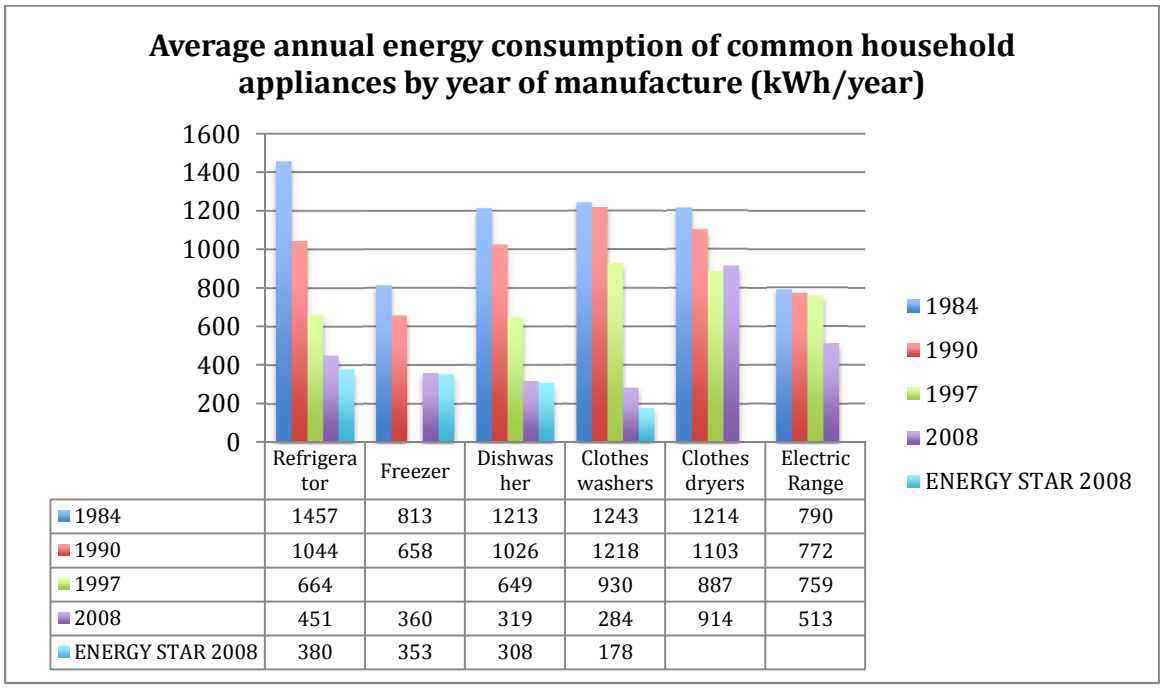
Research and Development	A new product, service or behaviour is developed.
Demonstration	The new product, service or behaviour is demonstrated to be effective in reducing energy use or generating renewable energy. At this stage, the products and services are usually not cost competitive with established products and services.
Commercialization and Market Introduction	A new product, service or behaviour is packaged to be attractive to at least a portion of the marketplace. A small portion of the market known as early adopters are typically the first to adopt the new product, service or behaviour.
Market Penetration	As a product, service or behaviour shows success with early adopters, the level of uptake increases.
Incentives	When market penetration is still relatively small, but the product is well-proven, governments often provide financial and non-financial incentives to adopt the new product, service or behaviour. Disincentives can also be used to discourage old products, services or behaviours.
Regulation	Once a new product, service or behaviour has demonstrated significant value and has a level of market penetration that provides confidence that a significant increase in penetration is possible, regulations are often used to achieve full market penetration
Outreach and Awareness Building	Outreach and awareness building within the market is used throughout the market transformation process to support each of the stages. This can occur through marketing and advertising, studies and research, and voluntary or mandatory energy labels.

For this theoretical example, as well as the examples below, government regulation is the final step in creating the market conditions necessary for sustained and wide-spread energy conservation or the generation of renewable energy.

4.1.1 Examples of Market Transformation

There are several examples of market transformation that have already occurred for some energy-related products, which have resulted in significant energy savings. Figure 23, for

example, shows the significant improvement that has occurred over the past 30 years in the efficiency of household appliances.



	Refrigerator	Freezer	Dishwasher	Clothes washers	Clothes dryers	Electric Range
1984	1457	813	1213	1243	1214	790
1990	1044	658	1026	1218	1103	772
1997	664		649	930	887	759
2008	451	360	319	284	914	513
ENERGY STAR 2008	380	353	308	178		

- data not available for freezers in 1997.
- Clothes dryers and electric ranges are not part of the ENERGY STAR program
- 2008 numbers assumed to include average of all products, including the most efficient, ENERGY STAR products.

Figure 23: Average Annual Energy Consumption of Common Household Appliances by Year of Manufacture (kWh/year)

The improved efficiency of these products has been attributed to energy efficiency regulations, product labeling initiatives such as EnerGuide and ENERGY STAR and consumer choice, which have helped to drive industry innovation and the development of new products.[9] Incentive programs and marketing campaigns have also been noticeable components of government initiatives to improve the efficiency of appliances.

A similar market transformation effort was recently undertaken in B.C. with compact fluorescent lightbulbs (CFLs).[10] In 2002, BC Hydro began a two year CFL giveaway program accompanied by education initiatives. In 2004 and 2005, phase 2 of the program offered rebates for seasonal LED lights, compact fluorescent torchieres and CFLs. For 2006 and 2007, the program offered further rebates and in-store outreach events.

By 2007, it was estimated that 85% of BC households had at least one CFL in their house with the average house having 8 CFLs out of 36 total fixtures. The program itself has been estimated to have directly engaged 50% of BC Hydro customers.

[9] Natural Resources Canada (2009) *EnerGuide Appliance Directory 2009*. Office of Energy Efficiency, Natural Resources Canada.
[10] Energy Efficiency Branch, MEMPR & BC Hydro Power Smart (2008) Regulatory Research Summary for General Service Lighting
http://www.empr.gov.bc.ca/EAED/EnergyEfficiency/Documents/GSL%20Reg%20Summary%20FINAL.pdf

Another result of the significant uptake in CFLs is a significant drop in their prices. CFLs that previously cost $7 to $10, now cost less than $2.

Both the province and the federal government are now moving to regulate the efficiency of lightbulbs as a way to increase the market penetration of energy efficient lighting even further.

4.1.2 Market Transformation in Medicine Hat

The targets stated in the City's Community Environmental Roadmap for energy conservation and renewable energy are:

- 25% of residential energy provided from renewable sources by 2025, and
- 20% reduction in residential natural gas and electricity consumption by 2020.

The concept of market transformation provides a useful framework for achieving these targets as market transformation helps these targets to be maintained over the long term.

When assessing opportunities for the City of Medicine Hat to undertake market transformation activities, it is clear that the City cannot take on all of the steps necessary to create market transformation from start to finish for all of the potential products, services and behaviours that could impact energy use. No single entity can.

The assessment, therefore, focuses on the areas on which the City of Medicine Hat can have a significant impact, and considers the initiatives of other entities that may be beneficial to the overall market transformation process.

For example, potential roles for the City will likely not focus on the research, development and commercialization of new technologies, but will consider what technologies are currently emerging that the City could take advantage of. Similarly, there are certain legal and jurisdictional constraints that limit the City's ability to regulate in certain areas, although there may be a role for the City in engaging other orders of government to set regulations.

4.2 Market Transformation Opportunities for Medicine Hat

Energy use in Medicine Hat and with Medicine Hat residential and commercial customers can be divided into three major end-uses:

- Building heating and cooling
- Other building equipment
- Transportation

Each of these end-uses, along with building-scale renewable energy generation, are initially looked at separately as there are relatively unique opportunities associated with them.

4.2.1 Efficient Building Heating and Cooling

In Alberta, building heating and cooling makes up about 64% of energy use in residential buildings and about 69% of energy use in commercial buildings.[11]

Research shows that the energy efficiency of residential buildings can be improved by 25% to 35%,while net zero energy houses are beginning to be demonstrated. For commercial buildings, a similar 25% improvement in energy efficiency is estimated, while a 60% improvement has also been shown. [12, 13, 14, 15]

Table 5 identifies the stages of market transformation that the City of Medicine Hat could become involved in with respect to efficient building heating and cooling.

Table 5: Efficient Building Heating and Cooling – Potential Roles for the City

Stage	General Description	Current Activity*	Potential Role for the City
Demonstration	Emerging construction practices such as net zero energy homes can be constructed to test and demonstrate feasibility. Building-scale cogeneration is another efficiency measure that could benefit from further demonstrations.	EQuilibrium LEED Platinum	Financial or non-financial support for demonstration projects.

[11] Office of Energy Efficiency. 2010. Comprehensive Energy Use Database, 1990 to 2007. Natural Resources Canada. http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/index.cfm?attr=0
[12] Alberta Energy Efficiency Alliance. 2009. Energy Efficiency in the Provincial Building Code. http://www.aeea.ca/pdf/EE%20in%20the%20AB%20Building%20Code%20-%20AEEA%20-%20March%202009.pdf.
[13] National Round Table on the Environment and the Economy (NRTEE). 2006. *Advice on a Long-term Strategy on Energy and Climate Change*. http://www.nrtee-trnee.com/eng/publications/wedge-advisory-note/ecc-wedge-advisory-note.pdf
[14] Canadian Urban Institute. 2008. *Energy Mapping Study.* Prepared for the City of Calgary. http://www.calgary.ca/docgallery/BU/planning/pdf/municipal_development_plan/plan_it/research/energy_mapping_study.pdf
[15] Kennedy, C. 2010. *Getting to Carbon Neutral: A Guide for Canadian Municipalities.* http://trca.on.ca/dotAsset/81361.pdf

Incentives	Financial or non-financial incentives or disincentives can be offered for advanced construction practices currently in the marketplace.	HAT Smart Provincial Government Carbon War Room	1. Rebates, innovative financing, streamlined approvals or density bonuses[16] for: - Residential new construction - Residential retrofits - Commercial new construction - Commercial retrofits 2. Higher fees for standard construction.
Regulation	Regulations can be set for both new construction as well as renovations.	Provincial Building Code National Building Code Hinton East Gwillimbury Berkeley	1. Set minimum standards for efficiency for development plans, development permits and / or zoning. 2. Encourage the provincial government to set new standards for new construction and renovations.
Awareness Building	Marketing, education and labelling are used to increase the awareness of customers.	Built Green CREB Europe	1. Energy seminars and advertising 2. Messaging within development planning and permitting, and building permitting processes. 3. Subsidized energy audits 4. Work with local realtors on a labelling program. 5. Require energy ratings to be provided at transfer of ownership.

*See Appendix A for more information.

[16] A density bonus is provided by a local government and allows a developer to build a greater number of units (higher density) than what is allowed by the local government's zoning regulations. The developer receives this 'density bonus' at no charge in exchange for supplying a desired community amenity, such as reduced energy use. The revenue generated for the developer by the extra units is intended to cover the cost of providing the community amenity.

Discussion

A Focus on Emerging Regulations

Market transformation within new building construction is currently anticipated through the addition of new energy efficiency requirements within the National Building Code. That being said, these new standards are not expected to impact construction in Medicine Hat until about 2013.

With this in mind, the City of Medicine Hat may be most effective in preparing the local construction industry for the introduction of the new building code standards through an interim mandatory standard that increases efficiency requirements part way towards the expected national standards. This interim standard could be established either at the provincial level, or possibly through mechanisms available to the City such as development planning and permitting, and / or zoning.

Working with the province to develop a renovation standard is another way to have a significant impact on the existing building market.

Innovative Financing

Regulations are the only way to guarantee an impact on all new buildings in Medicine Hat, but since energy efficiency upgrades save people money in the long run, there may be an opportunity to capture a large portion of the marketplace by offering loans for energy efficiency upgrades and having the loans repaid through energy savings. Loans are used in this approach as it may not be feasible to provide incentives for all of the upgrades that are possible in Medicine Hat due to budget availability.

The City could work to establish a program to finance energy efficiency upgrades in both new and existing buildings, and have the loans repaid through utility bills or another mechanism.

Mandatory Labelling

Another approach that has been shown to have market-wide impacts is the introduction of mandatory labelling for houses. This helps to inform consumers about the ongoing costs of properties they are looking to buy, it provides an incentive for owners to upgrade their houses, and it provides a mechanism for owners to recover the cost of energy upgrades.

The City could work to encourage the provincial government to establish mandatory energy labelling, or it could explore opportunities to require the disclosure of energy ratings, such as at the time of registering the transfer of ownership with the City. This second approach would enable prospective buyers to request this information from sellers. The City could also continue to subsidize energy assessments, making it easy for sellers to provide this information to buyers. In order to offer some flexibility, the City could also provide an opt-out mechanism for buyers and sellers if the energy rating is not desired by either party.

Voluntary Labelling

As a means of getting to mandatory labelling and / or increasing awareness in the marketplace, the City could work with local realtors to establish a voluntary energy labelling program.

Incentives

The City could continue to offer rebates for energy upgrades and energy efficient new homes. The upgrade program has already demonstrated success as uptake of the provincial program is much higher in Medicine Hat than in other municipalities.

The City could also look at offering non-financial incentives, such as streamlined permitting or density bonuses, if these are considered valuable and feasible within the local context.

Increasing development or building permit fees for buildings using standard construction practices is another way to incent efficient building practices. In fact, this incentive could reach the entire market if implemented.

Awareness Raising

The City could continue to offer energy seminars and advertise the HAT Smart program. This has likely contributed to achieving the participation levels already seen.

The City could also supplement these awareness raising activities by building communications into other city processes such as development planning and permitting, and building code permitting. It would be beneficial and relatively low cost to add steps where developers, builders, contractors or owners are asked about energy considerations and provided with information about the benefits of energy efficient construction.

Demonstration Projects

The City could support the development of demonstration projects such as a net zero energy house, a LEED Platinum commercial building, or building-scale cogeneration either financially or in other ways.

Summary

Table 6 summarizes the opportunities available to the City to improve the efficiency of building heating and cooling.

Table 6: Efficient Building Heating and Cooling – Summary of City Opportunities

	Little Work to Implement	Medium Work to Implement	Significant Work to Implement
Higher Impact			Set Local Requirements for Minimum Efficiency Standards
Medium Impact			Innovative Financing Mandatory Labelling
Lower Impact	Rebates Energy Seminars Advertising Encourage the provincial government to set standards for new construction and renovations.	Fees for Standard Practices Communication in City Approval Processes Voluntary Labelling Non-Financial Incentives Demonstration Projects	

The existing initiatives (ie. rebates, energy seminars, advertising) are listed as relatively little work to implement as they are already in place.

Regulations are identified to have the highest impact of any of the opportunities with innovative financing and mandatory labelling at a medium level of impact as they can affect the entire marketplace. Most of these opportunities have the highest amount of work and are likely the most challenging to implement given their level of impact.

Market-wide fees for standard construction practices and adding communication within city approval processes also have market-wide impact, but the level of impact depends on the level of fees set and the effectiveness of the communications, so they are listed among the items with lower impact than the top two categories.

The rest of the opportunities are also listed as lower relative impact and a medium amount of work to implement as they are not market-wide and they have not been previously implemented.

4.2.2 Other Building Equipment

In Alberta, building equipment in the form of appliances and lighting uses electricity and makes up 10% and 3% respectively of total residential energy consumption. In the commercial sector auxiliary equipment[17] and lighting is about 13% and 10% respectively of total commercial energy consumption.[18]

4.2.2.1 Residential Sector

The ENERGY STAR label has emerged as the North American standard for energy efficiency, and products must be 10% to 50% more efficient than the minimum Energy Efficiency Standards in Canada, depending on the product and model. Research suggests that by replacing standard appliances and lighting, a combined energy savings of between 10% and 50% is achievable. [19, 20]

Feedback system technology and processes offer opportunities to teach residential consumers about energy consumption and end use patterns. For example, direct feedback displays have shown energy reductions of between 5% and 18% per unit, and typically provide information to customers from a meter, display monitor or computer program. The simple units typically show electricity consumption in real time along with a cost per hour at a pre-programmed rate. [21, 22, 23, 24]

Indirect feedback in the form of enhanced billing information has also achieved some energy saving successes in pilot programs. Savings from indirect feedback have ranged from 0% to 10% and vary according to the context and quality of information given. [25] For example, informative billing that includes energy consumption comparisons to other households in the same neighbourhood have been shown to save between 1.5% - 3.5% of total household energy. This range of energy savings was calculated from 15 different pilot programs in different utilities across the United States, and over all fuel types.[26]

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[17] National Resources Canada defines auxiliary equipment as: "stand-alone equipment powered directly from an electrical outlet such as computers, photocopiers, refrigerators and desktop lamps. It also includes equipment that can be powered by natural gas, propane or other fuels, such as clothes dryers and cooking appliances."

[18] Office of Energy Efficiency. 2010. Comprehensive Energy Use Database, 1990 to 2007. Natural Resources Canada. http://oee.nrcan.gc.ca/corporate/statistics/neud/dpa/comprehensive_tables/index.cfm?attr=0

[19] Kennedy, C. (2010). Getting to Carbon Neutral: A Guide for Canadian Municipalities. Produced for: Toronto and Region Conservation. Sustainable Infrastructure Group, University of Toronto.

[20] Natural Resources Canada (2009) "EnerGuide Appliance Directory 2009." Office of Energy Efficiency, Natural Resources Canada.

[21] Darby, S. (2006). The Effectiveness of Feedback on Energy Consumption: A Review for DEFRA of the Literature on Metering, Billing and Direct Displays. Environmental Change Institute. University of Oxford.

[22] Parker, et. al. (2006). How Much Energy Are We Using? Potential of Residential Energy Demand Feedback. Florida Devices. Florida Solar Energy Centre.

[23] McKenzie-Mohr, Doug. 2000. Fostering sustainable behavior through community-based social marketing. http://www.cbsm.com/public/images/FosteringSustainableBehavior.pdf

[24] Electric Power Research Institute. (2009) Residential Electricity Use Feedback: A Research Synthesis and Economic Framework. http://mydocs.epri.com/docs/public/000000000001016844.pdf

[25] A review of over 10 sources shows reductions of between 0-10 percent as a result of indirect feedback. For more information see: Darby, S. (2006). The Effectiveness of Feedback on Energy Consumption: A Review for DEFRA of the Literature on Metering, Billing and Direct Displays. Environmental Change Institute. University of Oxford.

[26] Personal Communication with Russ Smith, City of Medicine Hat: OPOWER Presentation: Super-Charging Hat Smart's Energy Conservation Program. August 17, 2010.

4.2.2.2 Commercial Sector

Office equipment like computers, printers, photocopiers and fax machines, along with refrigerators and freezers make up the greatest proportion of auxiliary equipment used in the commercial sector in Canada.[27] Research suggests that ENERGY STAR labeled equipment can generate an electricity savings of 75% for computer and monitor equipment (24W per unit) and 40% for photocopier systems (61 W per unit). Refrigeration units that are upgraded to high efficiency multiplexed compressors have the potential to generate energy savings of 25%. Doors and covers for refrigerated display cases can provide refrigeration electricity savings of 20% to 30% over open display cases.[28]

Lighting retrofits in commercial buildings can generate between 26% to 39% savings from lighting energy by replacing T12 technology with standard or next generation T8 bulbs, and between 56% to 67% energy savings from space redesign to reduce the number of lighting fixtures. Other technology used in commercial buildings typically for secondary lighting in common areas can reduce energy used by up to 75%, for example when replacing an incandescent lamp with a CFL or LED array. During new construction, the choice of lighting technology coupled with fewer fixtures and improved control systems (e.g. daylighting or occupancy sensors) offers the opportunity to achieve a 17% to 40% reduction in energy consumed by lighting.[29]

Table 7 illustrates results from modeling work completed at the federal and provincial levels and by industry groups, and shows the energy saving potential of some of the different components of market transformation.

Table 7: Energy Saving Potential of Market Transformation Components[30]

Reduction actions	Potential Savings – Residential Sector	Potential Savings – Commercial Sector
Economic Potential (assumes all opportunities are captured)	26% over 20 years of electricity consumption from appliances	20% over 20 years of electricity consumption from lighting, cooking and plug loads
Regulation and Price Signals	19%	18%
Incentives and Education	3%	4%

[27] Natural Resources Canada. 2007. Commercial and Institutional Consumption of Energy Survey for the year 2005. Ottawa. http://oee.rncan.gc.ca/publications/statistics/cices06/pdf/cices06.pdf

[28] Marbek Resource Consultants. 2007. BC Hydro 2007 CONSERVATION POTENTIAL REVIEW The Potential for Electricity Savings through Technology Adoption, 2006 – 2026 Commercial Sector in British Columbia. Prepared By: Marbek Resource Consultants Ltd. and Applied Energy Group Inc.

[29] Marbek Resource Consultants Ltd. & Applied Energy Group Inc. (2007) "BC Hydro 2007 Conservation Potential Review. The Potential For Electricity Savings through Technology Adoption, 2006-2026."

[30] Marbek Resource Consultants, MK Jaccard and Associates. *Demand Side Management Potential in Canada: Energy Efficiency Study. Appendix C: Achievable Scenarios.* http://www.electricity.ca/media/pdfs/policy_statements/EE-DSM_Appendix%20c%20achievable%20potential%20scenarios.pdf

Table 8 identifies the stages of market transformation that the City of Medicine Hat could become involved in.

Table 8: Other Building Equipment – Potential Roles for the City

Stage	General Description	Current Activity*	Potential Role for the City
Demonstration	Emerging technologies such as LED lighting, light pipes, fibre optics and solar canopy lighting or direct/indirect feedback systems can be implemented to test and demonstrate effectiveness and feasibility.	Hydro One Real Time Monitoring Pilot Sacramento Municipal Utility District – detailed billing pilot	Financial or non-financial support for demonstration projects.
Incentives	Financial or non-financial incentives or disincentives can be offered for energy efficient building equipment currently in the marketplace.	HAT Smart Provincial Government (Light It Right) Fortis BC – Lighting Product rebates BC and Manitoba Hydro - PowerSmart	1. Rebates or innovative financing for: - Appliances and other equipment - Lighting - Computers and office equipment - Feedback systems 2. Higher fees for less using energy efficient technology in construction or renovation, or energy use over a certain threshold.
Regulation	Regulations can be set for the energy efficiency of equipment, appliances and lighting technologies. Regulations could also be implemented to	Canadian Energy Efficiency Regulations BC Energy Efficiency Act US Federal appliance standards	1. Set standards for the provision of feedback systems or energy efficient technology in all new construction through utility or development permits/ or zoning. 2. Encourage the provincial and federal government to set new standards for technology such as building equipment, appliances and

	require the use of end-use feedback monitoring systems.		lighting
Awareness Building	Marketing, education and labelling are used to increase the awareness of customers.	Australian Appliance Labeling Program Energuide (CAN) EnergyGuide (US) mandatory labeling	1. Energy seminars and advertising 2. Raise awareness about energy use and neighbourhood wide and/or customer-to-customer comparisons on utility bills 3. Subsidized energy audits that include lighting and equipment 4. Work with local retailers on an awareness program that includes advertising and education. 5. Encourage federal and provincial governments to increase labelling of products.

*See Appendix B for more information.

Discussion

Regulations

New regulations regarding the efficiency of building equipment currently occurs primarily at the federal level, but could occur at the provincial level as well. The City could work to encourage the provincial and federal governments to develop new standards for emerging and existing products and technologies.

Similar to building heating and cooling, the City may be able to also affect the efficiency of products installed in new buildings through development planning and permitting, and / or zoning.

The City of Medicine Hat may also influence electricity saving behaviour changes in residential consumption by requiring utility customers to install a direct feedback system. This type of program could be required for all new utility customers in Medicine Hat (i.e. new residential homes), and rolled out over a number of years to existing households. These types of systems have primarily been piloted to date, and could benefit from further testing to determine their effectiveness before broad roll out.

Innovative Financing

Regulations are the only way to guarantee an impact across an entire sector, but since energy efficiency technology, such as appliances and lighting upgrades, save people money in the long run, there may be an opportunity to capture a large portion of the marketplace by offering loans or turnkey programs for products and having the loans repaid through energy savings.

The City could work to establish a program to finance appliance, lighting and equipment upgrades, and have the loans repaid through utility bills or another mechanism.

Labelling

Many appliance, equipment and lighting products are already covered by mandatory federal EnerGuide labelling requirements. However, there are products that only have a voluntary labelling requirement, including central air conditioning, furnaces, heat pumps and oil furnaces. Labelling is most often regulated at the provincial or federal level, though Medicine Hat has a role in encouraging those jurisdictions to update the labelling regulation to cover a wider range of products. For example, commercial freezers and fridges are regulated by minimum efficiency standards, but manufacturers are not required to affix an Energuide label.

Incentives

The City could continue to offer rebates for appliances and other building equipment and products. The incentive program has already demonstrated success as uptake of the provincial program is much higher in Medicine Hat than in other municipalities. However, the success of the HAT Smart incentives may be attributed in part to complementary programs offered by the federal ecoENERGY and provincial energy incentive programs. Since the federal ecoENERGY program has been canceled for the time being, the ability of Medicine Hat to impact the existing appliance and equipment market may be lessened.

There are products and equipment that have not been addressed by HAT Smart to date that could result in energy savings from Medicine Hat residents and businesses. For example, commercial lighting upgrades offer relatively high returns for the dollars invested, and still remain an opportunity that has not been fully realized in Alberta. The Provincial Government has begun to address this gap in the commercial lighting sector through their 'Light It Right' program, which has been quickly fully subscribed. There remains opportunity for Medicine Hat to support a second iteration of the program with its own incentives.

Similarly, the City could offer residential customers incentives that cover all or part of the cost of direct feedback systems. This could provide a starting point to pilot the new technology prior to designing a full program for the delivery of feedback systems.

Awareness Raising

The City could continue to offer energy seminars and advertise the HAT Smart program. This has likely contributed to achieving the participation levels already seen.

The City could also supplement these awareness raising activities by building communications into other city processes such as the utility billing cycle. Information such as energy savings tips, details about individual energy use and comparisons to energy used by neighbours can encourage energy saving behaviour change. As these systems have been primarily piloted to date, a local trial may be warranted before a very large investment of resources is made.

As well, the City could work with local retailers to promote energy efficient appliances, products and equipment at local stores.

Demonstration Projects

The City could support the development of demonstration technologies such as new lighting technology in a commercial building or through the demonstration of feedback systems in a pilot project either financially or in other ways.

Summary

Table 9 summarizes the opportunities available to the City to improve energy conservation and efficiency of building equipment.

Table 9: Other Building Equipment – Summary of City Opportunities

	Little Work to Implement	Medium Work to Implement	Significant Work to Implement
Higher Impact			Require Efficient Equipment in New Construction
Medium Impact		Direct feedback systems Indirect Feedback systems Fees for Standard Practices in Construction or Renovation	Innovative Financing
Lower Impact	Rebates Energy Seminars Advertising Additional Charges for High Energy Use Encourage Federal and Provincial Governments to Increase Regulations and Labelling	Work With Local Stores to Increase Awareness Demonstration Projects	

The existing initiatives (ie. rebates, energy seminars, advertising, additional charges for high energy use) are listed as relatively little work to implement as they are already in place.

Increasing the level of activity in these areas will likely increase their impact, but they will also require additional effort.

Initiatives that are relatively straightforward, but are new; such as demonstration projects, promotion of energy efficient products at local stores, or encouraging the federal or provincial governments to increase regulations and labelling; are listed as little to medium work to implement with limited overall impact compared to the opportunities in the medium impact category.

Feedback systems for consumers have the potential for noticeable system-wide impacts for consumers, but have only been demonstrated at a pilot level to date. These are therefore listed as having the potential for medium level impact, but also a medium level of work to implement.

Innovative financing mechanisms are similarly untested for equipment level purchases, but could result in system-wide impacts if successful.

One of the more challenging options, but potentially a big impact is to require or incent high efficiency equipment through City development processes or approvals, and / or zoning. This approach would be similar to the building heating and cooling requirements where the City could add the performance of the equipment inside the building to the any standards for building heating and cooling performance. This would be easier to accomplish for items that are hard-wired into the buildings such as commercial lighting.

4.2.3 Building-Scale Renewable Energy

Renewable energy sources that individual buildings can tap into are solar energy, wind energy, and heat or cooling from the ground or air.

Solar energy can be captured to heat water, air or buildings, or converted to electricity using photovoltaic (PV) panels. Solar hot water heating and PV are typically installed on roofs with southern exposure (including flat roofs) and limited shading. Solar air heating is typically used for large commercial buildings with high volumes of air intake and a large south facing wall that can be covered by black sheet metal. The sheet metal contains holes that air is drawn through and heated by the sun before being drawn into the building. Direct heating of buildings using the sun is called passive solar heating. Passive heat gain from the sun can be increased through building design (ie. placement of windows and heat storing materials), orientation (ie. south-facing) and appropriate shading from trees or other buildings. By having windows that face south, heating demand can be reduced by 5% to 25%. A more aggressive design that uses materials to move and store heat can reduce heating demand by 40% to 75%.[31]

Building-scale wind energy is often called micro-wind. Micro-wind turbines are small-scale wind turbines that convert wind energy into electricity. "Unobstructed areas in a rural setting with high average wind speeds tend to be good micro-wind sites. "[32] At approximately 5 m/s average wind speed around Medicine Hat at the height of micro-turbines (approximately 10m), a 2.4 kW turbine is estimated to be able to generate approximately 300 kWh per month.

Ground source heat pumps (GSHP), or geoexchange technology, uses the relatively constant temperature beneath the surface of the earth to heat and cool buildings. GSHPs are able to produce three to four units of free thermal energy from the ground for each unit of electricity input.[33] This thermal energy is typically used for space heating and cooling, but thermal energy can be harnessed for water heating and industrial processes as well. Air source heat pumps are also available, but are not as common in Canada given cooler air temperatures during winter months.

Since heat pumps use natural gas-generated electricity to displace natural gas furnaces, the natural trade-off needs to be considered. For a GSHP that generates three units of heat for every unit of electricity, the total natural gas use is reduced by approximately 12% whereas a more efficient system is estimated to reduce natural gas use by one third.

Table 10 identifies the stages of market transformation that the City of Medicine Hat could become involved in with respect to building-scale renewable energy.

[31] Henderson, S. D. Roscow & J. Ward. (2009) Canadian Solar Home Design Manual. Solar Nova Scotia.
[32] ENMAX. 2010. *Micro-Wind Turbine.*
http://www.enmax.com/Energy/Res/Greenmax/Technology/MicroWindTurbine.htm
[33] The Pembina Institute, "Geoexchange: Energy under foot. Fact Sheet," www.pembina.org/pub/2049.

Table 10: Building-Scale Renewable Energy – Potential Roles for the City

Stage	General Description	Current Activity*	Potential Role for the City
Demonstration	Emerging renewable energy technologies, such as a passive solar house, GSHPs and micro-wind, can be constructed to test and demonstrate feasibility.	Passivhaus Vermont	Financial or non-financial support for demonstration projects.
Incentives	Financial or non-financial incentives or disincentives can be offered for renewable energy technologies currently in the marketplace.	HAT Smart ENMAX Ontario	1. Rebates, innovative financing, streamlined approvals or density bonuses for renewable energy installations. 2. Higher fees for buildings with no renewable energy.
Regulation	Regulations can be set for both new construction as well as renovations.	Merton Rule Toronto Spain	1. Set minimum standards for renewable energy, lot orientation and window placement for development plans, development permits and / or zoning. 2. Remove any zoning or bylaw restrictions. 3. Encourage the provincial government to set standards for new construction and renovations.
Awareness Building	Marketing, education and labelling are used to increase the awareness of customers.	HAT Smart	1. Energy seminars and advertising 2. Messaging within development planning and permitting, and building permitting processes. 3. Subsidized feasibility studies

*See Appendix C for more information.

Discussion

Feed-In Tariffs

Many jurisdictions are providing financial incentives for building-scale renewable energy generation through feed-in tariffs. The tariffs provide a payment for electricity generation that is comparable to the cost of generating the power. These systems require a funding mechanism to cover the cost of the tariff.

Installation Incentives

While feed-in tariffs provide an ongoing incentive for power generation and have a larger market influence, many jurisdictions began with and continue to provide incentives for the purchase and installation of solar heating or electricity, ground source heat pumps and micro-wind systems.

Innovative Financing

Another way to make it financially easier for people to install renewable energy systems, is to partner the incentive programs with financing programs that help to spread the remaining cost of the systems over many years.

Removing Barriers

A relatively basic step to enable market introduction of new technologies is to identify and remove regulatory barriers to their installation. At the municipal level, this may require changes to zoning or bylaw regulations regarding micro-wind or geoexchange systems. The City could also set a policy to allow the use of public laneways for geoexchange as was done in Toronto.

For solar energy, the existing orientation and shading of buildings can be either a benefit or a barrier to solar energy applications. The City could either promote or require south facing lots and consider shading within development plans to increase the access of buildings to solar energy.

Building Design

Building design at the development planning, permitting or zoning stages, or within the building code, could also be considered to facilitate the use of renewable energy. The placement of windows can have a dramatic effect on passive solar heating.

For roof mounted renewable energy, installing a utility conduit from the mechanical and electrical rooms to the roof at the time of construction is much cheaper than a later retrofit.

Awareness Raising

The City could continue to offer energy seminars and advertise the HAT Smart program. This has been essential to achieving the participation levels already seen.

The City could also supplement these awareness raising activities by building communications into other city processes such as development planning and permitting, and building code permitting. It would be beneficial and relatively low cost to add steps where developers, builders, contractors or owners are asked about energy considerations and provided with information about the benefits of energy efficient construction.

Demonstration Projects

The City could support the development of demonstration projects such as a passive solar energy buildings, ground source heat pumps or micro-wind installations either financially or in other ways.

Summary

summarizes the opportunities available to the City to increase the amount of building-scale renewable energy.

Table 11: Building-Scale Renewable Energy – Summary of City Opportunities

	Little Work to Implement	Medium Work to Implement	Significant Work to Implement
Higher Impact		Lot Orientation and Shading	Set Local Renewable Energy Requirement for New Buildings Passive Solar Design
Medium Impact		Remove Zoning or Bylaw Restrictions	Solar Ready Requirement
Lower Impact	Rebates Energy Seminars Advertising Innovative Financing Encourage the provincial government to set standards for new construction and renovations.	Fees for Standard Practices Communication in City Approval Processes Non-Financial Incentives Feasibility Studies Demonstration Projects	

The existing initiatives (ie. rebates, energy seminars, advertising) are listed as relatively little work to implement as they are already in place. Innovative financing has been added to this category as ENMAX is planning to roll out a program that will be available to residents throughout the province. This program is listed as lower impact because the number of systems to be installed is lower than if a regulation were put in place for example.

Regulations are identified to have the highest impact of any of the opportunities, but also the highest amount of work and likely the most challenging to implement given their level of impact.

The ability of the City to impact lot orientation and shading within development plans of new areas is considered to have market-wide impacts, but less challenging to implement given the City's current authority within the design of new communities.

Identifying and removing barriers at the zoning or bylaw level, if they exist, is identified as medium impact because it impacts all buildings, and a medium level of work as it is not currently in place, but is within the City's power to affect for buildings within Medicine Hat.

A solar ready requirement would also have an impact on all buildings, but is not necessarily within the power of the City, so is listed as significant work to implement. This measure, however, would make future installation of solar energy on these buildings much easier.

Market-wide fees for standard construction practices and adding communication within city approval processes also have market-wide impact, but the level of impact depends on the level of fees set and the effectiveness of the communications, so they are listed among the items with lower impact than the top two categories.

The rest of the opportunities are also listed as lower relative impact and a medium amount of work to implement as they are not market-wide and they have not been previously implemented.

4.2.4 Transportation

Gasoline and diesel used for transportation in Medicine Hat consists of approximately 7% of total energy consumed in the city. Residents and businesses spent over $13 million each year on gasoline, and over $1 million on diesel. To date, programs for energy conservation have not addressed transportation.

This section highlights opportunities for the City of Medicine Hat to work with residents to improve the efficiency of personal mobility, as well as to reduce the amount of vehicle travel with other transportation options like walking and cycling.

4.2.4.1 Technology for Efficient Personal Mobility

As shown in Figure 24, the fuel economy in new passenger vehicles in Canada has improved between 2002 and 2008, and it is expected to continue to improve over the next 6 years. Figure 24 also shows that average fuel economy is higher in some other countries, and implies that fuel economy levels in Canada could be improved even further than projected. This can be accomplished through more efficient engines and drivetrains, lighter vehicles, and new vehicle technologies such as hybrid electric vehicles, electric vehicles and natural gas vehicles.

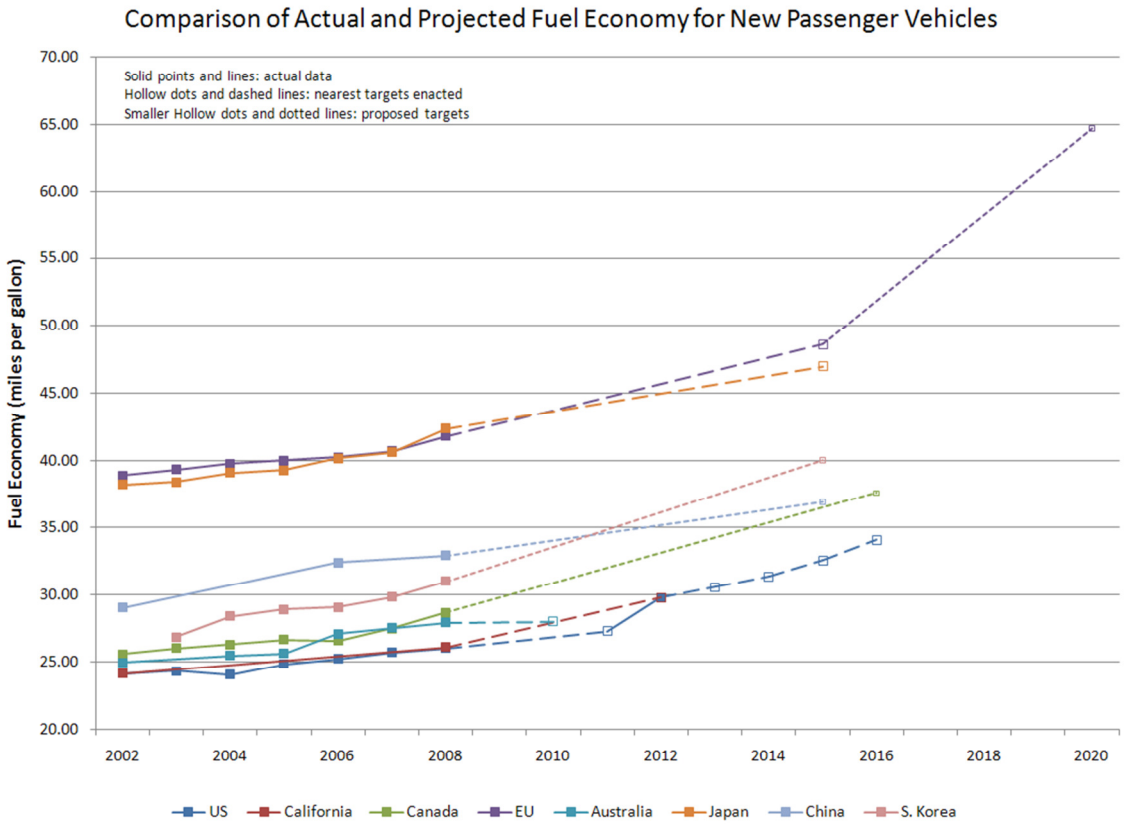

Figure 24: Comparison of prospective National Fuel Economy and GHG emission standards

Hybrid electric cars are 34% to 60% more efficient at converting energy than conventional vehicles.[34] Fully electric cars are 90% more energy efficient than conventional cars from a vehicle perspective, but overall energy efficiency depends on where the electricity comes from. [35] In Medicine Hat, where the majority of electricity comes from burning natural gas, electric vehicles are estimated to create about half of the GHG emissions as gasoline vehicles[36]. If wind power was used to charge the vehicles, 40 – 90 % less emissions than conventional cars is expected, depending on the vehicle used.[37] Tailpipe emissions for electric vehicles are zero.

Compressed natural gas in light-duty vehicles reduces GHG emissions by around 25% relative to gasoline.[38]

4.2.4.2 Personal Mobility Choices

Drivers can also reduce their fuel use by up to 33% by using fuel efficient driving techniques and keeping their car well-maintained.[39] Large scale demonstration of efficient driving techniques has been realized in commercial fleets, where driver engagement programs have shown 10% to 20% reduction in fuel use.[40] On the other hand, programs aimed at the general public are estimated to achieve 1% to 2% in GHG reductions.[41]

There are also many opportunities for the City of Medicine Hat to reduce the amount of vehicle travel in the city by encouraging residents to use less fuel intensive means of transportation like walking, bicycling, riding a bus, carpooling or telecommuting. Transportation mode choices are impacted by a number of factors including speed, convenience, cost, access, the location of the destination, and the purpose of the trip. A lot of these factors are themselves impacted by the design of the city and the type of transportation infrastructure that is developed (eg. roads, transit, pathways and sidewalks).

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[34] U.S. Environmental Protection Agency. 2008. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006. Washington, DC. http://www.epa.gov/climatechange/emissions/downloads/08_CR.pdf.

[35] Kockelman, Kara, Matthew Bomberg, Melissa Thompson, and Charlotte Whitehead. 2009. GHG Emissions Control Options: Opportunities for Conservation, for the Committee on the Relationships Among Development Patterns, Vehicle Miles Traveled, and Energy Consumption; for Special Report 298, Driving And The Built Environment: The Effects Of Com. *Transportation Research*. Washington, DC. p. 8, 15

[36] Pembina Institute. 2002. *Life-Cycle Value Assessment of Fuel Supply Options for Fuel Cell Vehicles in Canada.* http://pubs.pembina.org/reports/report020610.pdf

[37] University of Calgary. *News and Events: Plug-in cars could cut vehicles emissions up to 90 per cent in Alberta.* http://www.ucalgary.ca/news/july2009/hybrid Accessed 13 August 2010. See also: Hajian, Mahdi, Hamidreza Zareipour, and W. D. Rosehart. 2009. Environmental benefits of plug-in hybrid electric vehicles: The case of Alberta. *2009 IEEE Power & Energy Society General Meeting*: 1-6. https://www.ucalgary.ca/news/files/news/PHEV_study.pdf

[38] MIT Energy Initiative. 2010. The Future of Natural Gas: an interdisciplinary MIT study. http://web.mit.edu/mitei/research/studies/report-natural-gas.pdf Accessed 9 Aug 2010. p. 50

[39] Environment Canada. 2010. A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act. *Change*. Ottawa, ON. p20.

[40] City of Edmonton, *Fuel Sense Project* (2002), http://www.edmonton.ca/environmental/documents/CityGov/FuelSenseProject.pdf Accessed 6 July 2010

[41] Greene, David, and Andreas Schafer. 2003. Reducing Greenhouse Gas Emissions from US Transportation. Washington, DC. http://www.pewclimate.org/docUploads/ustransp.pdf. Accessed 6 July 2010. P54

Site and regional land use planning and design - Neighbourhood development that is situated adjacent to a major transit system, is designed to support pedestrian and bike uses, and includes a mix of land uses have reduced vehicle kilometers traveled by 10% to 30%, per site. Reductions in VKTs of up to 50% have been shown when these neighbourhood design features are combined with infill and redevelopment of existing land, though the results depend on the density and location relative to key destinations and transit features.[42]

A regional or city-wide approach to land and transportation planning that locates new development around multiple transit corridors coupled with other improvements to transit frequency and options has the potential to reduce total, regional VKT by 2% to 5%, [43] [44] while the addition of comprehensive smart growth planning has been shown reduce total VKT by up to 20%. [45]

Transit: It is estimated that with each 1% growth in service levels (increased transit vehicle coverage, and expanded operating hours), average ridership increases by 0.5%, while the implementation of one bus rapid transit corridor route can reduce the VKT in the area by 1% – 2%.[46]

Bicycle programs: Research suggests that each 1.6 km of bikeway installed per 100,000 residents increases bicycle commuting by .075%.[47]

Pedestrian environments: A key outcome of pedestrian oriented design is the replacement of automobile trips with walking, particularly for short trips. Research suggests that pedestrian design can reduce local, area-specific VKT by 1% to 10%. [48]

Telecommuting: Research conducted in 2005 estimated a national level energy savings of 0.01% to 0.4% in the United States and 0.03% to 0.36% in Japan is attributed to telecommuting practices. In a future scenario where 50% of information workers telecommute 4 days per week, the US and Japan national energy savings are estimated be 1% in both cases. [49]

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[42] Dierkers et al. (2005). CCAP Transportation Emissions Guidebook. Part one: Land Use, Transit and Travel Demand Management. *Center for Clean Air Policy*. Washington, DC. http://www.ccap.org/guidebook

[43] Puget Sound Clean Air Agency. 2004. Roadmap for Climate Protection : Reducing Greenhouse Gas Emissions in Puget Sound The Puget Sound Clean Air Agency. *Clean Air*. http://www.pscleanair.org/news/library/reports/rptfin.pdf

[44] Dierkers et al. (2005). CCAP Transportation Emissions Guidebook. Part one: Land Use, Transit and Travel Demand Management. *Center for Clean Air Policy*. Washington, DC. http://www.ccap.org/guidebook

[45] Dierkers et al. (2005). CCAP Transportation Emissions Guidebook. Part one: Land Use, Transit and Travel Demand Management. *Center for Clean Air Policy*. Washington, DC. http://www.ccap.org/guidebook

[46] Dierkers et al. (2005). CCAP Transportation Emissions Guidebook. Part one: Land Use, Transit and Travel Demand Management. *Center for Clean Air Policy*. Washington, DC. http://www.ccap.org/guidebook

[47] Victoria Transport Policy Institute (2010) Nonmotorized Transportation Planning. Identifying ways to improve pedestrian and bicycle transport. TDM Encyclopedia. Accessed Sept 27, 2010. http://www.vtpi.org/tdm/tdm25.htm

[48] Dierkers et al. (2005). CCAP Transportation Emissions Guidebook. Part one: Land Use, Transit and Travel Demand Management. *Center for Clean Air Policy*. Washington, DC. http://www.ccap.org/guidebook

[49] Matthews, H. Scott, and Eric Williams. 2005. Telework Adoption and Energy Use in Building and Transport Sectors in the United States and Japan. *Journal of Infrastructure Systems* 11, no. 1: 21. doi:10.1061/(ASCE)1076-0342(2005)11:1(21). http://link.aip.org/link/JITSE4/v11/i1/p21/s1&Agg=doi.

Parking Programs – Increasing the rates to park downtown has been shown to decrease the numbers of drivers into a city's core area from between 15% and 30% per site. [50] Other studies indicate the potential for a 2.2% reduction in VKT from work commuting trips over 10 years[51], and that a 1% increase in parking price corresponds to a .07% decrease in drivers.[52] Research suggests that financial incentives given to employees for not driving to work can decrease parking demands by an average of 24%. The average cost per employee was $47 per month. [53]

Table 12 identifies the stages of market transformation for personal mobility and transportation that the City of Medicine Hat could become involved in.

[50] Dierkers et al. (2005). CCAP Transportation Emissions Guidebook. Part one: Land Use, Transit and Travel Demand Management. *Center for Clean Air Policy*. Washington, DC. http://www.ccap.org/guidebook

[51] Rodier, Caroline. 2009. Review of International Modeling Literature. *Transportation Research Record: Journal of the Transportation Research Board* 2132, no. 1: 1-12. doi:10.3141/2132-01. http://trb.metapress.com/openurl.asp?genre=article&id=doi:10.3141/2132-01.

[52] Kennedy, Christopher. (2010) Getting to Carbon Neutral: A Guide for Canadian Municipalities.

[53] Victoria Transportation Insitute. Online TDM Encyclopedia. http://www.vtpi.org/tdm/index.php.

Table 12: Personal Mobility and Transportation – Potential Roles for the City

Stage	General Description	Current Activity*	Potential Role for the City
Demonstration	Emerging technologies such as electric and hybrid vehicles, or programs such as anti-idling can be implemented to test and demonstrate effectiveness and feasibility.	Ottawa – Hybrid Buses Williams Lake and Ontario – Idling Reduction Programs	1. Financial or non-financial support for demonstration projects. 2. Lead by example by implementing technology and/or practices in municipal operations
Incentives	Financial or non-financial incentives can be offered for efficient vehicles; to encourage walking, cycling or transit or to fund a driver education course. Disincentives can also be implemented to discourage vehicle use, such as parking fees. Incentives and disincentives can be used to impact land use (re)development	Government of Ontario – Hybrid Vehicle Rebates ecoAUTO Rebate Program (Federal) Vancity – Clean Air Loans City of Kelowna – tiered DCC depending on density and location City of Montreal – Vehicle tax	1. Rebates for: - Hybrid, Electric or Natural Gas Vehicles - Transit passes - Cycling - Driver education courses 2. Disincentives for vehicle use - Higher parking fees in town core - Toll roads 3. Financial support for: - transit, pedestrian facilities and streetscapes, cycling infrastructure 4. Incentives and/or disincentives for development industry – for example DCCs and density bonuses
Regulation	Regulations can be set for the type and location of new development, as well as for certain amenities (transit, electric vehicle	Plan It Calgary – Municipal Development and Transportation Plans City of Toronto – Anti Idling Bylaw	1. Set standards for the type and location of development that over time will provide conditions that enable transit, cycling and pedestrian streetscapes. 2. Require features as part of development approvals – such as cycling and pedestrian

	plug-ins, cycling or multi use paths) required as a condition of development. An anti idling bylaws could also be implemented to reduce air emissions and fuel usage.	Renewable Fuel Standards Low Carbon Fuel Standards	infrastructure, electric vehicle infrastructure etc. 3. Encourage the provincial and federal government to set new standards for vehicle and fuel standards and technology 4. Implement an anti-idling bylaw
Awareness Building	Marketing, education (driver training programs) and labelling are used to increase the awareness of citizens.	Transport Canada – ecoTECHNOLOGY for Vehicles Auto$mart Fuel Efficient Driver Curriculum City of Whitehorse – Wheel 2 Work campaign City of Calgary - Telecommunting Edmonton – Driver training	1. Include transportation, vehicle technology, driver training and alternative options for personal mobility in the HAT Smart program and add education components to the travelling 'road show' and home energy seminars. 2. Launch an information and awareness campaign for alternate transportion opportunities, such as cycling to work or walking to the grocery store. 3. Work with local realtors to include transportation connectivity to other amenities in the city as a characteristic communicated to prospective home buyers.

*See Appendix D for more information.

Discussion

Regulations

Land use and transportation planning can be used to establish the type of development that occurs within the city, and the type of transportation infrastructure that is developed. The City of Medicine Hat has primary control and responsibility for land use and transportation planning, having the authority to set the design and determine land use characteristics within the City. In order to continue to create a busy streetscape that supports pedestrian and cycling uses, the City can prioritize infill development and redevelopment of underutilized land.

The City's transportation plan and capital works budget can prioritize the development of bicycle lanes during the development and upgrading or repaving of road networks. The development of bicycle lanes is least expensive when implemented in conjunction with other road maintenance activities.

As a requirement for site plan approvals, zoning amendment or development permit approval, the City could require alternative transportation amenities such as the development of cycling or pedestrian paths, bike parking facilities, or electric vehicle infrastructure.

In order to reduce fuel emissions and to improve air quality, the City could implement and enforce a community-wide anti-idling bylaw.

As a leader in energy efficiency, the City could work with the provincial and federal governments to encourage these jurisdictions to upgrade and set new standards for vehicle technology and fuel content.

Incentives

The City could start to offer a rebates for hybrid, electric or highly fuel efficient vehicles. However, other rebate programs that have been implemented to date in Canada (such as, for example, the ecoAUTO Rebate Program) had a very high cost per tonne of GHG emissions reduced.

Awareness Raising

The City could start to include transportation, vehicle technology and alternative options for personal mobility in its HAT Smart program. The travelling 'road show' could start to highlight opportunities for efficient driving behaviour and vehicle maintenance tips that can save fuel. The HAT Smart program is a key platform that could also be used to raise awareness of lower carbon vehicles and fuels. This can be achieved through the website, other community based publications, and technology demonstrations.

Education and raising awareness among personal vehicle drivers, professional drivers and fleet managers can help increase the uptake of other approaches. Research suggests that information and awareness campaigns are important drivers to support citizen and commuter choices to use alternative transportation. The City of Medicine Hat could implement a rideshare or alternative transportation awareness and social media campaign. In other jurisdictions, such campaigns have been estimated to decrease GHG emissions from transportation fuel by 2% in 2015 from year 2000 levels.[54] Driver training is another education program that has the potential to reduce fuel emissions. The City of Medicine Hat could offer driver training seminars in the same way it runs energy assessments: in order to be eligible for any other transportation incentive program, a resident must complete a driver training course.

The City could start to supplement the awareness about transportation opportunities in the community by adding educational components to information disseminated from other departments, such as planning and transportation.

As well, the City could work with local realtors to ensure that prospective buyers are aware of transportation amenities, such as bike paths and the pedestrian networks, and access to local amenities prior to purchasing homes.

[54] Greene, David, and Andreas Schafer. 2003. Reducing Greenhouse Gas Emissions from US Transportation. Washington, DC. http://www.pewclimate.org/docUploads/ustransp.pdf.

Demonstration Projects

The City could support the development of demonstration technologies for personal vehicles, such as new types of renewable fuel or electric vehicles. There are several programs that are still in pilot phases and not widely implemented that could be tested in a demonstration project such as community wide anti-idling programs or driver training. The City could support such technology and/or programs financially or in other ways, like a demonstration in its municipal operations. This would display leadership and allow the programs to be tested before possibly rolling them out to the wider community.

Summary

Table 13 summarizes the opportunities available to the City to improve the awareness and uptake of opportunities to reduce vehicle kilometers traveled, and to operate and maintain vehicles for greater fuel efficiency.

Table 13: Personal Mobility and Transportation – Summary of City Opportunities

	Little Work to Implement	Medium Work to Implement	Significant Work to Implement
Higher Impact		Community wide anti-idling bylaw	Prioritize infill and redevelopment Require alternative transportation amenities as condition of development approvals
Medium Impact		Prioritize creation of bicycle lanes during road construction/repaving	
Lower Impact	Add Transportation Information to Energy Seminars Advertising Encourage Federal and Provincial Governments to Increase Regulations and Incentives for Vehicles	Rebates for Purchasing Efficient Vehicles Start a driver training program Work With Local Stores to Increase Awareness Demonstration Projects	

Land use and transportation planning have the potential for a high impact on energy use, connectivity and mobility in Medicine Hat, but often require significant work to implement, including community and industry consultation, and staff time for revisions to bylaws and other planning documents. A community wide anti idling bylaw may be slightly easier to implement, though still has the potential for a city-wide impact on fuel use.

The creation of bicycle lanes during road construction or repaving has medium impact and is relatively simple to implement if completed in conjunction with other capital works projects.

Activities that have a relatively low impact but require little work are providing transportation information at energy seminars, advertising, and lobbying the federal and provincial government about transportation standards. Many of these activities are ongoing but focus on topics other than transportation.

Activities that have a relatively low impact but are a bit more work to implement include demonstration projects, work with local retailers, and a driver training program. Rebates for energy efficient vehicles are also listed in this category due to the administrative time and cost associated with rebate programs.

5. Summary

Based on the analysis completed, there are several different options that the City of Medicine Hat could consider for HAT Smart II. The City may also wish to consider various combinations of the options presented.

It should be noted that advertising, promotion and possibly further energy seminars can be used in combination with any of these options to support their successful implementation.

Rebates for Energy Efficiency

Rebates for energy efficient products (particularly those that are heating related) have provided the highest reduction in energy use for each incentive dollar issued to date. The City could continue to provide these rebates, and possibly increase the number of products eligible, to achieve a similar level of energy savings.

Continued rebates for energy efficient products could be worthwhile for the City if short-term energy savings are a priority (although regulations provide even greater savings).

Rebates for Renewable Energy

Rebates for renewable energy installations have produced much lower energy savings per incentive dollar issued than rebates for energy efficient products. The projects are, however, relatively high profile and they potentially make it easier for future installations of building-scale renewable energy.

Continued rebates for renewable energy projects could be worthwhile for the City if it is a priority to:

1. continue to benefit from the profile of renewable energy projects, (although demonstration projects may provide even greater profile)
2. maintain momentum for future solar energy projects (although the importance of momentum for future solar energy projects has not been evaluated), or
3. support the development of the solar energy industry.

Rebates for Hybrid Electric and Electric Vehicles

Rebates could also be expanded to emerging transportation technologies as a way to reduce energy use.

Local Government Policies

There are a number of opportunities identified where the City could have an impact on energy use through changes to its policies and procedures. These include:

- Efficiency or renewable energy requirements as part of development planning or approvals, or as a part of zoning
- Require increased orientation to the sun and appropriate shading in new developments
- Local government requires disclosure of building energy performance at the time of transfer of property ownership
- Additional fees for standard construction practices
- Raising awareness of energy considerations throughout development and buildings approvals processes
- Offering non-financial incentives such as density bonuses
- Removing barriers to energy efficiency and renewable energy technologies
- Prioritization of infill and redevelopment, as well as bicycle lanes during road construction
- Requirements for alternative transportation amenities in new developments
- Idling bylaw

One or more of these options may be of interest to the City if it is a priority to create city-wide changes that could significantly impact energy use.

Engaging Other Governments

The direct impact of encouraging other governments to increase standards or incentives for energy efficiency and renewable energy is unknown, but may also require a limited amount of resources.

This option may be of interest to the City if it is a priority to create very broad policy changes that significantly impact energy use (although there may be a higher chance of success through pursuing local policies).

Demonstrations

The City could also help to promote new technologies that may not be ready for city-wide incentives. These include:

- Net zero energy homes
- LEED Platinum buildings
- Building-scale cogeneration
- LED lighting, light pipes, fibre optics and solar canopy lighting
- Direct or indirect consumer feedback systems
- Passive solar energy houses

- Ground source heat pumps
- Micro-wind installations
- Electric vehicles
- Anti-idling programs

Funding or support for demonstration projects could be worthwhile for the City if it is a priority to:

1. create significant profile for the city, or
2. support the development of new technologies.

Other Initiatives

The City could also support or undertake a variety of other initiatives that do not involve incentives or policy changes. These include:

- an innovative financing program,
- a voluntary building labelling program,
- implementing a feedback system for consumers,
- partnering with local stores to promote energy efficiency or renewable energy products, and
- funding renewable energy feasibility studies (although the need for these may be limited).

Each of these options have their own set of benefits and challenges, but are they all share the characteristics that they do not involve incentives or regulation. In most cases, they require partnering with other organizations, or the establishment of a formal program to deliver the service. There are also a range of potential impacts associated with them as highlighted throughout the previous section.

Evaluation of Options

Figure 25 attempts to rank the various options by their estimated level of impact and their likelihood of implementation.

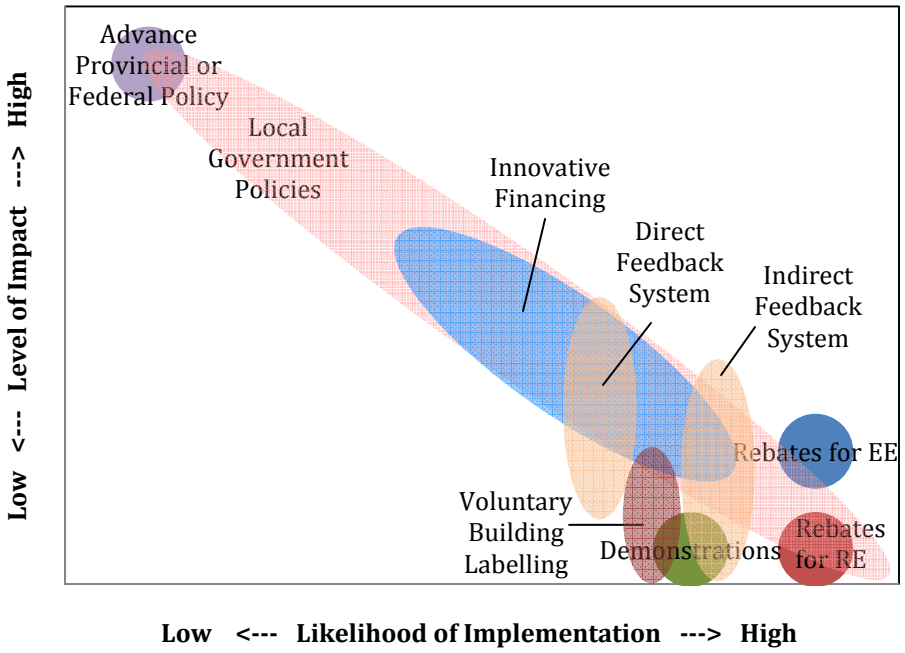

Figure 25: Estimated Level of Impact for HAT Smart II Options

Local, provincial or federal policies are likely to have the greatest level of impact on energy use, but also have a high degree of uncertainty regarding whether they can be implemented. Some local policies, however, may be easier to implement than others, although in some cases, such as providing energy-related information throughout the development approval process, the level of impact is less.

Innovative financing programs and feedback systems have the next highest ranked level of impact as they have the potential to reach city-wide. Again, a highly impactful financing program may be challenging to implement, but a less impactful one is likely easier to establish. This is the reason why it has a wide range across the chart.

Pilot and demonstration projects for residential utility feedback systems have produced a wide range of results. The direct feedback systems, such as dedicated digital displays inside homes, showed higher levels of impact, but are more expensive than indirect feedback systems such as providing information on bills. Therefore, the direct feedback systems are indicated to be more challenging to implement, but a higher level of impact than indirect systems. The ranges shown in Figure 25 assume city-wide implementation as opposed to a pilot project.

Rebates for renewable energy projects are listed as the lowest level of impact, but easy to implement because they impact only a limited number of buildings, but they are relatively easy for the City to continue.

Rebates for energy efficient products are similarly easy for the City to continue, but have a higher level of impact on energy use per rebate dollar.

Voluntary building labelling likely requires the City to engage with realtors or directly with consumers to encourage them to undertake the labelling. It is therefore listed as more difficult to

implement than the current rebate programs. The level of impact is shown to vary is it depends on the level of participation.

Building-level demonstration projects typically have a limited level of impact on city-wide energy use, and also depends on other parties for implementation.

6. Options for Moving Forward

With all of the information provided in this report, it may be difficult to determine the most appropriate path forward. The following section suggests several different approaches that could be used.

Market Transformation Approach

One strategy to determining an appropriate short-term focus for the City is to use the market transformation approach. In this approach, regulations are often used to have market-wide impacts, and are the ultimate end-goal for a particular market transformation, particularly in energy markets.

The City of Medicine Hat, therefore, may wish to review the policies that could be implemented at the municipal level that can have a significant impact on city-wide energy use to determine which could potentially be implemented in the short- or medium-term.

For those policies that may be possible within the short-term, beginning the work to develop them may be the best next step.

For policies that may be possible in the medium-term, it would be valuable to identify the steps that could be taken now to support the implementation of these policies at a later time.

For example, if the City wished to possibly establish a passive solar heating policy within the next five years, they could begin in the short-term with:

1. research into passive solar design and policy setting,
2. the demonstration of a passive solar house,
3. incentives for appropriate building orientation and design, and
4. providing information to citizens regarding the benefits of passive solar design.

Other Initiatives That Impact All Consumers

Another area that the City could also look at is the implementation of programs that could have a city-wide impact on their own. Those identified in this report include innovative financing programs, consumer feedback systems and voluntary building labelling.

A Focus on Incentives

A third option for the City is to maintain a similar level of impact that is currently achieved through a continued rebate program; however, the impact per rebate dollar could be increased

through a focus on energy efficiency instead of renewable energy. Incentives could also be broadened to include emerging transportation technologies.

Supplementary Activities

Further education and demonstration programs can be used to enhance the implementation of any of the options listed.

Next Steps

The City may wish to select one or more than one of these approaches to pursue. Once a set of focus areas have been selected, work can be undertaken to define a development and implementation plan for HAT Smart II.

Appendix A

Efficient Building Heating and Cooling – Examples of Current Activities

Demonstration

EQuilibrium Sustainable Housing Demonstration Initiative

An initiative of the CMHC, EQuilibirum helps to fund demonstration homes that are designed to be healthy, energy-efficient, environmentally-friendly, resource-efficient and produce as much energy as they consume on an annual basis.[55].A national design competition was held to select 15 demonstration homes. In Alberta, Edmonton's Riverdale NetZero Project,[56] and Red Deer's Laebon CHESS Project were selected as Equilibrium demonstration homes.

Leadership in Energy and Environmental Design (LEED) Platinum

LEED is a green building rating system that promotes sustainability in site development, water efficiency, energy efficiency, materials selection and indoor environmental quality.[57] Through a suite of tools and performance criteria, green buildings can be rated according to their sustainability; LEED Platinum is the highest achievable rating. An increasing number of municipal governments in Canada are adopting a minimum LEED standard for new municipal and institutional buildings or certain private buildings. As of March 2010, there were three LEED Platinum buildings in Calgary and none in Edmonton.[58] By pursuing LEED Platinum certification, demonstration projects can provide much needed case studies and assist in market penetration.

Incentives

HAT Smart

In February 2010, the City of Medicine Hat began to offer incentives for new home construction that meet a minimum Energuide rating. The City offers a rebate of $1,500 for homes meeting Energuide 80 standards, $3,000 for homes achieving Energuide 82 standards, and $10,000 for homes that comply with the Energuide 86 standard.

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[55] Canadian Housing and Mortgage Corporation, 2010, *The Equilibrium Sustainable Housing Demonstration Initiative,* http://www.cmhc-schl.gc.ca/en/co/maho/yohoyohe/heho/eqho/eqho_002.cfm

[56] Canadian Housing and Mortgage Corporation, 2010, *Riverdale NetZero Project, http://www.cmhc-schl.gc.ca/en/inpr/su/eqho/rinezepr/index.cfm*

[57] Canada Green Building Council, 2010, *What is LEED?,* http://www.cagbc.org/leed/what/index.php

[58] Stephanie Sparks, "*LEED buildings in Alberta: how Edmonton and Calgary stack up"*, Aug 1, 2010, Alberta Venture, http://albertaventure.com/2010/08/leed-buildings-in-alberta/

Government of Alberta

The Government of Alberta offers complementary incentives for new home construction at the same funding level for each Energuide rating standard as those offered in Medicine Hat.

Green Mortgages

A number of financial institutions in Canada offer green mortgages to incent homebuyers to choose energy efficient homes. For example, CMHC offers an energy efficient mortgage where qualified participants receive a 10% premium refund on mortgage insurance and can qualify for amortization periods of up to 35 years. TD Canada Trust offers a green mortgage or home equity line of credit discounts and rebates.[59] The RBC Home Energy Saver Mortgage provides customers with a $300 rebate on a home energy audit and its Energy Saver Loan provides customers with a 1% discount off the posted rate on a fixed rate installment loan over $5,000 with a qualifying purchase.[60]

Carbon War Room

The Carbon War Room works with cities around the world to accelerate the market for energy efficient buildings by partnering with institutions to develop innovative financing programs.

City of Burnaby, B.C. – Density Bonus

Density bonus is a voluntary program in which developers may opt into building to a higher density in return for providing amenities such as efficient buildings or environmental protection. In this planning agreement, the developer receives an increase in density over what is allowed in the base zoning and the community receives a desired amenity. For example, the City of Burnaby introduced a density bonus in a range of zones, where developers could opt into building above the base units allowed up to a predetermined maximum in exchange for providing a community benefit. The amenities provided by developers have been 19 rental units and $8 million to an amenity fund. In Burnaby the key community priority is affordable housing, though municipalities can choose various different amenities based on the needs of the community.[61]

Regulation

Provincial Building Code

The province has a building code that sets minimum insulation requirements for house construction. The current minimum insulation levels are estimated to result in a house that is rated at approximately EnerGuide 70.

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[59] CMHC (2010) Canuhome Launches at Green Living Show. http://www.newswire.ca/en/releases/archive/April2008/25/c9474.html

[60] Royal Bank of Canada (2010) http://www.rbcroyalbank.com/renovating/eco-renovation.html?ProspectID=8B25D577D02A493181B9007AA10032E2

[61] Curran, D. & Wake, T. (2008) Creating Market and Non-Market Affordable Housing. A Smart Growth Toolkit for BC Municipalities. Smart Growth B.C.

National Building Code

For the first time in 2012, the National Building Code is expected to have minimum energy efficiency requirements for both small and large buildings. The National Building Code is typically adopted by provinces a year or two following its release.

The National Building Code is currently expected to be set at a level of EnerGuide 80 for small buildings and 25% better than the 1997 Model National Energy Code for Buildings.

Hinton

The Town of Hinton has established an eco-industrial park where developments are required to be energy efficient (25% better than the Model National Energy Code for Buildings) and they must orient and mass buildings to maximize opportunities for passive solar heating and cooling, natural lighting and ventilation.[62]

East Gwillimbury

At the local level, the town of East Gwillimbury, Ontario requires all new residential developments requiring either Site Plan or Subdivision approval to construct to Energy Star standards. Energy Star qualified homes are approximately 30 to 40% more energy efficient than those built to minimum Ontario Building Code standards.[63]

Berkeley

Berkeley, California requires any building sold, exchanged or substantially renovated to meet minimum energy and water efficiency standards. The extent of upgrades required is limited to a defined Maximum Expenditure amount.[64]

Awareness Building

Built Green

Built Green Canada is an industry driven voluntary program that promotes 'green' building practices. Built Green requires builders to be trained and provides a system for new homes (single family, row houses, and multi-story & residential towers) to be rated. In Alberta, Built Green certified homes have made up between 5% and 10% of the market over the past few years, with a significant majority of the homes built to a Built Green Gold or Silver level. These include EnerGuide levels of 77 and 75 respectively. Built Green Canada has also recently released a renovation guide and checklist. [65]

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[62] Town of Hinton. 2005. Hinton Eco-Industrial Park Eco-Industrial District Zone & EIP Development Guidelines. http://www.eip.hinton.ca/images/stories/pdf/zoning&developmentguidelines.pdf

[63] Town of East Gwillimbury. 2010. "Energy Star." http://www.eastgwillimbury.ca/Environment/Thinking_Green_Initiatives/Energy_Star_.htm

[64] City of Berkeley. 2009. *Title 19, Buildings and Construction*. http://www.codepublishing.com/CA/Berkeley/html/pdfs/Berkeley19.pdf

[65] Built Green Canada Website: www.builtgreencanada.ca

Calgary Real Estate Board

The Calgary Real Estate Board has launched a 12-month pilot program to introduce new energy rating and rating date fields to the Multiple Listing Service (MLS) System that identify a home's energy efficiency based on the EnerGuide rating system. It is the goal of the program to have at least 2,500 homes rated using the EnerGuide rating system within 12 months.[66]

Mandatory Labeling – European Union & Austin, Texas

In 2002, the European Union issued a directive on Energy Efficiency of Buildings that requires all member states introduce energy certification requirements for new and existing buildings at the point of sale or rent. The compliance period for member states to implement the appropriate policy was January 2009, though the degree of compliance with the directive is unclear.

In 2009, the Austin City owned electricity utility, Austin Energy, implemented the Energy Conservation Audit and Disclosure Ordinance. It applies to residential buildings and requires audits to be carried out a the point of sale of existing buildings that are older than 10 years. As well, a copy of the audit report is provided to the potential home buyer. [67]

HAT Smart

Education and awareness about energy conservation and renewable energy is encouraged through the use of the HAT Smart website which generates an average of 1250 unique visitors each month since its launch at the end of the 2008. The City also runs free energy conservation seminars that are offered online or in person at the City, and information is provided at community events. These resources have provided essential roles to generate community support and wider HAT Smart program uptake.

[66] Calgary Real Estate Board. 2010. *What is the CREB Go Green Challenge?* http://www.crebgogreen.com/partners/

[67] Zirnhelt, H. (2010) Energy Labeling and Efficiency Requirements for Existing Buildings. Green Building Leaders Discussion Paper. The Pembina Institute.

Appendix B

Other Building Equipment – Examples of Current Activities

Demonstration

Hydro One's Real Time Monitoring Pilot – Ontario, Canada

Ontario's Hydro One utility company tested the influence of a real time feedback device on energy consumption in a pilot program that tracked consumer energy use over 2.5 years in over 400 residential households. The aggregate reduction in electricity consumption (kWh) across the study sample was 6.5%. A greater range of energy reduction was reported depending on the source of residential heating. For example, houses with non-electric space heating achieved an aggregate reduction of 8.2%, compared to a 1.2% aggregate reduction for households using electric space heating. Follow up reporting indicated that 65.1% of users reported they planned to continue using the monitor.[68]

Florida

A small scale pilot of 17 residential homes in Florida that used a low cost direct feedback system (retail price approximately $140 US) showed an average 7% reduction in the 2nd year of monitoring after controlling for weather related influences. However, results varied widely from home to home ranging from an energy increase of 9.5% to an energy decrease of 27.9%. Eleven homes showed savings and six homes showed energy use increases. [69]

Sacramento Municipal Utility District – Detailed Billing Pilot

The Sacramento Municipal Utility District started a pilot program in 2008 to determine the effect of providing a more detailed electricity consumption report during its billing cycles. An independent measurement and verification firm has confirmed a continued improvement and persistence in energy savings across 35,000 homes. For example, the first year of the program saw a 2.2% average energy demand reduction, while the program impact increased to 2.8% in the second year. In 2009, an energy demand reduction of 3.5% was achieved during the summer months.[70]

Innovations in Lighting Technology

Though LED lighting is penetrating the market for niche applications like flash lights, traffic signals, street lighting and emergency signs, they have yet to achieve much uptake for main

[68] Mountain, D. (2006) The Impact of Real-Time Feedback on Residential Electricity Consumption: The Hydro One Pilot. Mountain Economic Consulting and Associates Inc. Ontario.

[69] Parker, et al. (2008). Pilot Evaluation of Energy Savings from Residential Energy Demand Feedback Devices. http://www.fsec.ucf.edu/en/publications/pdf/FSEC-CR-1742-08.pdf

[70] Summit Blue Consulting LLC (2009). Impact Evaluation of OPOWER SMUD Pilot.

commercial lighting. Such uses remain opportunities for demonstration of LED lighting. Other emerging technologies include light pipes, which transport natural light to the interior of buildings. Solar Canopy lighting is being developed at UBC and is designed to capture outside light and distributes it within a building using an aluminum frame solar collector.

Incentives

HAT Smart

The HAT Smart programs offers incentives for a range of appliances and building equipment, including: clothes washers, air conditioners, air sealing and insulation, and furnaces. In order to be eligible for one of the rebates, residential customers must complete a home energy assessment. Energy efficiency incentives were offered in the commercial sector, for 10% of the installed cost for a total amount up to $50,000.

Provincial Government (Light it Right)

The Government of Alberta 'Light It Right' program was launched in August 2010 and offered rebates to commercial businesses for lighting retrofits. In order to be eligible, businesses needed to complete a lighting assessment and inventory. The program was very quickly fully subscribed.

Fortis BC – Commercial Sector Lighting Product Rebates

Fortis BC offered its commercial customers lighting product rebates of $5 or 50% of the cost of compact fluorescent lights (CFL), or a grant of 5 cents/kWh saved with a 2 year minimum payback period. The program generated an annual savings of 3.3 GWh in 2005. The electricity savings from the program were approximately $234,000 based on an approximate rate of 7.1c/kWh. Program costs were approximately $282,000, while customer costs were approximately $170,000. [71]

BC Hydro and Manitoba Hydro – Power Smart Programs

BC Hydro and Manitoba Hydro both operate Demand Side Management Programs in their respective jurisdictions to help to reduce energy use for residential, commercial and industrial consumers.

For example, BC Hydro offers a Refrigerator Buy Back Program for its residential customers and provides a $30 rebate and a free pick up of a second operating fridge. During the fiscal year of 2005-2006, the annual reported electricity savings attributed to the program was 27 GWh. A product incentive program implemented by BC Hydro that applied to commercial lighting, rooftop HVAC, controls, pumps and motors is reported to have generated an annual savings of 15 GWh in the fiscal year 2005-2006. [72] The program savings amount to approximately 0.05% and 0.03%, respectively, of BC Hydro's total electricity demand in 2006.[73]

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[71] Horne, M., and A. Bailie. (2007). Evaluation of Energy Efficiency Initiatives in BC. The Pembina Institute.

[72] Horne, M., and A. Bailie. (2007). Evaluation of Energy Efficiency Initiatives in BC. The Pembina Institute.

[73] Total electricity demand: Marbek Resource Consultants Ltd. (2007) Conservation Potential Review: Potential for Electricity Savings, 2006-2026. Residential, Commercial and Industrial Sector in British Columbia (Summary Report). http://www.llbc.leg.bc.ca/public/pubdocs/bcdocs/431498/info54519.pdf

In 2008-2009, Manitoba Hydro offered over 40 incentive and customer service programs with target technologies ranging from energy efficient lighting, to commercial equipment such as clothes washers and kitchen appliances. Since 1989, the combined effect of incentive based programs, customer service initiatives and codes and standards saved 1,510 GWh of electricity. The cumulative customer savings to date total more than $399 million. [74]

Seattle City Light Utility

The Seattle City Light Utility began a program in 1998 that offered free Facility Assessments to commercial and industrial customers, coupled with financial incentives for upgrades to lighting, HVAC systems and auxiliary motor equipment. During the first two years of the program, an assessment of 96 projects found that the facility assessments identified 23 million kWh of potential electric savings, of which 9 million kWh of savings were realized through the implementation of recommended measures. Lighting, HVAC and controls were the measures most commonly recommended in the assessments. [75]

Xcel Energy Utility

In 2003, Xcel Energy Utility offered low cost energy assessments, low cost financing and both prescriptive and custom rebates for lighting equipment and installations in both existing commercial buildings and new construction. Close to 900 lighting projects were completed that to achieved a net energy savings of over 61 million kWh.[76]

ENERGY STAR

An assessment of the effectiveness of rebates offered by utility companies for ENERGY STAR labeled appliances in the United States from 2001 to 2006 revealed that the programs increased the market share of ENERGY STAR qualified clothes washers by 4.5 percent. Utility supplied rebates had no significant impact on the sales of dishwashers and refrigerators. For the rebate programs to save one megawatt hour (MWH), the cost to the utility is approximately $US35. The cost estimate is significantly lower than the cost for a utility to purchase on peak power at an average price of $60/MWh).[77]

Regulation

Canadian Energy Efficiency Regulations

The cumulative impact of the residential appliance standards implemented by the Canadian Energy Efficiency Regulations is estimated to generate an aggregate annual energy savings of

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[74] Manitoba Hydro. 2010. Sustainable Development Report 08/09. Winnipeg, Manitoba. http://www.hydro.mb.ca/environment/publications/sdr_08_09.pdf

[75] Amann, Jennifer Thorne, and Eric Mendelsohn. 2005. Comprehensive Commercial Retrofit Programs: A Review of Activity and Opportunities. Washington, D.C. http://www.aceee.org

[76] Quantum Consulting Inc. 2004. National Energy Efficiency Best Practices Study. Volume NR1 - Non-Residential Lighting Best Practices Report. San Francisco, CA. http://www.eebestpractices.com/pdf/BP_NR1.PDF.

[77] Datta, S. & S. Gulati. (2009). Utility Rebates for Energy Star Appliances: Are They Effective? http://grad.econ.ubc.ca/souvik/datta_energystar.pdf

117.20 PJ in 2010 and 133.84 PJ in 2020. The cumulative impact of standards for residential and commercial lighting and auxiliary motors is estimated to generate an aggregate annual savings of 31.96 PJ in 2010 and 39.54 PJ in 2020. [78]

BC Energy Efficiency Act

The Government of BC's Energy Efficiency Act sets energy performance standards for devices that use, control or affect the use of energy such as household appliances, heating and cooling systems, lighting and some industrial equipment. Currently, the province is undergoing public consultation for proposed new efficiency standards for televisions.

US Federal appliance standards

US Federal appliance standards are applied to major residential appliances, commercial building equipment and lighting technology. The collective impact of all appliance and equipment performance standards implemented by 2005 is estimated to generate an electricity savings of 268 TWh/year in 2010 and 394 TWh/year in 2020. The reduction in electricity is 6.9% of the estimated US electricity demand in 2010, and 9.1% of the estimated US demand in 2020.

Cost benefit analysis of the standards indicates a cumulative consumer savings of $234 billion through to 2030, with a benefit-cost ratio of approximately 3 to 1. As well, consumer savings outweigh government expenditures about the program by more than 2000 times. [79]

Awareness Building

Australian Appliance Labeling Program

An evaluation of the Australian labeling program estimated that due to the label, from 1986 to 1992 the sales-weighted energy consumption of products sold was reduced by 12% for refrigerators and freezers, 16% for dishwashers, 1%for clothes dryers and 6% for air conditioners.[80]

Energuide (CAN) EnergyGuide (US) mandatory labeling

Both mandatory and voluntary product labeling programs are used around the world as an educational tool to depict the energy use of home appliances as a part of national demand side management and market transformation programs aimed at reducing overall energy consumption. In Canada and the United States, respectively, the Energuide and EnergyGuide labels are mandatory on all major appliances and electrical equipment, while the ENERGY STAR label is voluntary and initiated by product manufacturers.

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[78] Natural Resources Canada. (2009). Improving Energy Performance in Canada. Report to Parliament Under the Energy Efficiency Act For the Fiscal Year 2007-2008. Ottawa. http://oee.nrcan.gc.ca/publications/statistics/parliament07-08/pdf/parliament07-08.pdf

[79] Waide, Paul, et al. (2007). Energy Efficiency in the North American Existing Building Stock. *International Energy Agency*. http://www.iea.org/Papers/2007/NAM_Building_Stock.pdf.

[80] Thorne, J., and C. Egan. (2002). An Evaluation of the Federal Trade Commission's EnergyGuide Appliance Label: Final Report and Recommendations. *American Council for an Energy-Efficiency Economy* http://aceee.org/pubs/a021full.pdf?CFID=4907152&CFTOKEN=72223637

HAT Smart

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Appendix C

Building Scale Renewable Energy – Examples of Current Activities

Demonstration

Passivhaus

Passivhaus is a building code standard that promotes all-season energy efficient design in buildings.[81] PassivHaus buildings on average are 90% more energy efficient when compared to existing buildings. Over 17,000 buildings worldwide have been constructed according to the PassivHaus Principles, but there are no known demonstrations in Alberta.

Micro Wind Turbines

Small-scale wind turbines (blade diameter less than 12 feet) are increasingly being seen as a cost-effective way to produce on-site renewable energy. The Skystream 3.7 micro wind turbine is a fully integrated, grid-tied wind energy system for residential homes.[82] It costs $5400 US, requires 12.8 km/hr wind to produce power and can generate 550 kWh per month (at 5 m/s winds).

Vermont Small-Scale Wind Energy Demonstration Program

This program has installed 20 micro wind turbines at schools, municipal and state facilities, and farms in Vermont.[83] These turbines are not only used to generate 200 kW of renewable energy, they also reduce electricity bills and are seen as an educational tool to promote adoption of renewable energy in the state.

Incentives

HAT Smart

The HAT Smart program offers residential customers a rebate on the installation of a Solar Hot Water system ($3000) and a Solar Electric system ($6000). Commercial customers were offered 50% of the installed cost of renewable energy systems, up to a maximum of $50,000. Most commercial businesses have installed 10kW solar electric systems.

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[81] PassivHaus, 2010, http://www.passivhaus.org.uk/

[82] CleanTechnica, 2008, *The Top Five Micro Wind Turbines*, http://cleantechnica.com/2008/03/21/the-five-best-micro-wind-turbines/

[83] The Vermont Small-Scale Wind Energy Demonstration Program, 2010, *About the Program,* http://www.vtwindprogram.org/about/

ENMAX – Distributed Solar and Wind Energy Program

ENMAX, the Climate Change Emissions Management Corporation and Climate Change Central have launched a five year initiative to install up to 9,000 distributed solar or wind energy installations.[84]

Feed-in-Tariff, Ontario

In Ontario, the MicroFIT (feed-in-tariff) program provides residents and businesses with a fixed-price contract for 20 years for the sale of power to the grid. The separate treatment of small-scale systems (appropriate for residential and businesses) encourages the participation of homeowners and commercial building operators within city limits by streamlining the application process and providing a higher rate for electricity sold, ensuring investors can have a reasonable rate of return on their investment.

Regulation

Merton Rule

General renewable energy requirements were first implemented in Merton Borough, London, U.K. in 2003.[85] Croydon implemented its renewable requirement in 2003 and Greater London followed in 2004. Similar policies have since been implemented by approximately 325 of 390 England councils as well as councils in Scotland and Wales.[86] All Local Planning Authorities in the U.K. are required to have a similar policy by 2010.[87] Similar policies have also been implemented in Ireland, Spain, Germany and France.[88]

Green Roof Regulation, Toronto

The City of Toronto has adopted a by-law that will require all new developments above 2,000 m^2 of gross floor area to have between 20 to 60 per cent of their roofs constructed as green roofs[89] (i.e., a vegetated area on the roof of a building).

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[84] O'Meara, D. 2010. *Enmax launches solar, wind power generation project aimed at 9,000 Alberta homes*. Calgary Herald. http://www.calgaryherald.com/technology/Enmax+launches+solar+wind+power+generation+project+aimed+Alberta+homes/3161837/story.html#ixzz12M8ov0L5

[85] Adrian Hewitt, former Environmental Officer, London Borough of Merton, e-mail communication, June 3, 2009.

[86] London Borough of Merton, *Merton Rule Conference – Building a zero carbon future* (2008), http://www.merton.gov.uk/living/planning/planningpolicy/mertonrule/building_a_zero_carbon_future.htm (accessed June 2009).

[87] Hewitt, e-mail communication.

[88] For more detail see the section on solar thermal obligations and the subsection entitled "Additional Examples" at the end of this section.

[89] City of Toronto. 2009. *Green Roofs*. http://www.toronto.ca/greenroofs/index.htm. Accessed October 15, 2009.

Spain

In Spain, the building code requires that 30-70% of water heating demand be met with renewable energy for new buildings and major renovations; in Barcelona the requirement is 60% for residential water use, 100% for uncovered swimming pools, and 20% for industrial hot water.

Planet Traveller Hotel

The use of public laneways to bury closed vertical loops facilitated the use of geoexchange for the refurbishment of the Planet Traveller hotel in Toronto, Ontario.

Awareness Building

HAT Smart

Education and awareness about energy conservation and renewable energy is encouraged through the use of the HAT Smart website which generates an average of 1250 unique visitors each month since its launch at the end of the 2008. The City also runs free energy conservation seminars that are offered online or in person at the City, and information is provided at community events. These resources have provided essential roles to generate community support and wider HAT Smart program uptake.

Appendix D

Personal Transportation – Examples of Current Activities

Demonstration

City of Ottawa – Hybrid Buses

The City of Ottawa over the course of two years bought 175 hybrid electric buses. The city expects to reduce carbon emissions by 30% and pay off the cost of the buses within 6 years, due to anticipated fuel savings.[90]

Williams Lake – Idling Reduction

The City of Williams Lake, British Columbia decided to help reduce their municipal fleet emissions through an idle reduction policy. Meetings were held with public works staff to discuss the idle free policy and strategies. Feedback was invited from all staff on ways to reduce idle times with very positive responses. Idle Free signs were installed throughout municipal buildings. Within one year, fuel and maintenance costs and GHG emissions were reduced by 20%.[91]

Ontario – Anti-Idling program

An anti-idling pilot project in Ontario resulted in motorists reducing their idling by 32% and their idling duration by 73%. This was done using both signs and personal commitments to reduce idling. [92]

Incentives

Government of Ontario – Rebates for Hybrid Vehicles

The Government of Ontario has the goal of having one in twenty vehicles be electrically powered by 2020. To do this, they are providing rebates of $5,000 to $8,500 for individuals, business and organizations that purchase or lease a new plug-in hybrid electric or battery electric vehicle.[93]

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[90] ICLEI. 2009. Demonstrating Results: Municipal Initiatives for Reducing GHGs National Measures Report 2009. Toronto, ON. http://gmf.fcm.ca/files/Capacity_Building_-_PCP/Demonstrating-result-reducing-GHGs_EN.pdf.

[91] Green Fleets British Columbia. City of Williams Lake. City shows that idling reduction can achieve results, even in a cold climate. http://greenfleetsbc.com/content/view/62/79/ Accessed 22 July 2010.

[92] http://oee.nrcan.gc.ca/transportation/idling/material/reports-research/turn-off-exec-summary.cfm?attr=28

[93] Government of Ontario. 2010. McGuinty Government Supporting Clean Transportation, http://news.ontario.ca/mto/en/2010/06/ontario-paves-the-way-for-electric-vehicles.html Accessed 18 June 2010.

ecoAUTO Rebate Program

The ecoAUTO Rebate Program provided a cash incentive of $1,000 to $2,000 towards the purchase or lease of a fuel efficient vehicle (less than 8.1 litres / 100km). The program lasted from 2007 to 2008 and issued 169,800 rebates totaling $191.2 million and creating an estimated 0.01-0.03 Mt annual reduction in GHG emissions.[94]

Vancity – Clean Air Loans

Vancity offers a Clean Air Auto Loan that incents customers to buy fuel-efficient cars by giving preferential loan rates. The bank offers loans for Prime +1% for vehicles that emit at least 50% less CO_2 than average and prime +2% for vehicles that emit at least 33% less CO_2 than average. Choosing a fuel efficient vehicle can eliminate 18 tons of CO_2 emissions and cut gasoline costs by $1,500 over five years.[95]

Kelowna – Neighbourhood Design and Compact Development

The City of Kelowna, BC is promoting smart growth and compact development through the use of varied development cost charges (DCC) that are levied against new developments and paid by the developer. Two factors determine the charge: density and geographic location. In general, higher density development that is close to the downtown core is charged a lower DCC compared to single-family development located at the periphery of the city. The program is allowing the City to optimize its infrastructure investments. [96]

City of Montreal – Vehicle Tax

The City of Montreal has recently announced a new tax that will be applied to all vehicles registered in the city. Though the exact amount of the tax will be revealed in December, the funds will go to financing public transit infrastructure.[97]

Regulation

Plan It Calgary – Municipal Development and Transportation Plans

In 2009, The City of Calgary adopted new Municipal Development and Transportation Plans. These plans outlined future development for the city. The new plans included a greater emphasis on compact, mixed use and walkable developments as well as a primary transit network with high levels of service.

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[94] Environment Canada. 2010. A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act. *Change*. Ottawa, ON. p20.

[95] Vancity, Clean Air Auto Loan, https://www.vancity.com/Loans/CleanAirAutoLoan/ Accessed 22 July 2010.

[96] Tomalty, R. (2007) Innovative Infrastructure Financing Mechanisms for Smart Growth. Smart Growth B.C.

[97] CBC (2010) Montreal rolls out new car tax. November 5, 2010. http://www.cbc.ca/canada/montreal/story/2010/11/05/montreal-tax-car.html

Anti-Idling Bylaws

Dozens of municipalities in Canada have adopted anti-idling bylaws in an attempt to improve local air quality, save on fuel costs and reduce GHG emissions. For example, Toronto limits idling to no more than three minutes in a sixty-minute period.

Renewable Fuel Standards

In Canada, federal regulations require 5% renewable content in the gasoline pool. A 2% requirement for renewable content in diesel has also been announced for 2012. Similar timelines and targets are expected from the provincial government. The United States has had a federal renewable fuel standard since 2005 that requires 8.25% renewable content for both gasoline and diesel by 2010.[98]

Low Carbon Fuel Standard

The low carbon fuel standard (LCFS) regulates transportation fuel producers and on the life cycle emission of their fuel. California has had a LCFS since 2009 that aims to reduce GHG emissions by 10% by 2020.[99] Ontario and British Columbia are both considering modified versions of California's policy.[100]

Awareness Building

Transport Canada

Transport Canada's ecoTECHNOLOGY for Vehicles (eTV) program works to increase Canadians' awareness of these vehicle efficiency technologies through outreach events, technology articles, newsletters, interactive websites, a technical glossary, educational curricula and other demonstration and development activities.[101] eTV also connects industry and government, working to identify and address potential market barriers to the introduction of promising new passenger vehicle technologies in Canada. eTV is a four year $15 million initiative that is expected to reduce annual GHG emissions by 0.09 to 0.56 Mt in 2012.[102]

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[98] United States Environmental Protection Agency. *EPA finalizes regulations for the National Renewable Fuels Standard Program for 2010 and beyond,* http://www.epa.gov/otaq/renewablefuels/420f10007.pdf. Accessed 13 August 2010.

[99] California Air Resources Board. California's Low Carbon Fuel Standard (An Update on the California Air Resources Board's Low Carbon Fuel Standard Program). 2009:35. Available at: http://www.arb.ca.gov/fuels/lcfs/100609lcfs_updated_es.pdf

[100] Moorhouse, Jeremy, and Nathan Lemphers. 2009. Low-Carbon Transportation Policies: a comparison of California's low carbon fuel standard and other transportation policies. *Pembina Institute,* Calgary, AB.

[101] Environment Canada. 2010. A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act. *Change*. Ottawa, ON. P23

[102] Environment Canada. 2010. A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act. *Change*. Ottawa, ON. P23

Auto$mart Fuel Efficient Driving Curriculum

The Government of Canada's Auto$smart fuel efficient driving curriculum reached 350,000 novice drivers in 2009/10 and was projected to reduce national GHG emissions by 90,000 tonnes.[103]

City of Whitehorse – Wheel 2 Work

In 2006, the City of Whitehorse implemented a 'Wheel 2 Work' campaign that uses social marketing to promote active transportation in the summer months. The program is designed to complement bicycle network and facility investments so that citizens use the new infrastructure to its full potential. During the program's first summer there were 210 registered participants that logged over 40,000km of bike travel. In total, the program is estimated to have offset approximately 4.5 tonnes of C02e.[104]

City of Calgary - Telecommuting

Calgary Economic Development is promoting the 'WORKshift' initiative and piloted a program with municipal staff at the City in 2007. Within four months of 100 employees engaged in part time teleworking, 656 fewer commute trips were taken which saved approximately 80,000 kilometers of driving. [105]

City of Edmonton - Driver Training

The City of Edmonton has been able to reduce fuel consumption in their municipal fleet through a driver training program for city employees. In just one year, the city trained 700 employees and saw a fuel efficiency gain of 1.8 L / 100km. As a result they saved $175,000 worth of fuel and were able to reduce 5.5% (310t) of GHG emissions from city fleet vehicles as a result of this program.[106]

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[103] Environment Canada. 2010. A Climate Change Plan for the Purposes of the Kyoto Protocol Implementation Act. *Change*. Ottawa, ON. p20.

[104] http://www.tc.gc.ca/eng/programs/environment-utsp-wheel2work-268.htm

[105] Calgary Economic Development, WORKshift. http://www.workshiftcalgary.com/workshift-planet/casestudies

[106] City of Edmonton, *Fuel Sense Project* (2002), http://www.edmonton.ca/environmental/documents/CityGov/FuelSenseProject.pdf Accessed 6 July 2010