REPORT

"Switch Green": Analysis of Feebate for Major Household Appliances in Canada

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Executive Summary

Canada's government is under significant pressure to enact policies to reduce greenhouse gas emissions. Greenhouse gas emissions in Canada were 27% above 1990 levels in 2004 and are projected to continue to grow in the absence of aggressive policies.

The objective of this study is to describe and evaluate a new economic instrument aimed at reducing the GHG emissions and energy consumption from household appliances, furnaces and boilers in Canada. In 2004, the average Canadian household consumed 31.9 MWh of energy per year, and was responsible for 6.2 tonnes of carbon dioxide equivalent (CO_2e). In total, Canadian households produced 77 Mt CO_2e in 2004, or 10% of Canada's aggregate emissions. Additionally, GHG emissions from the residential sector have grown by 10% between 1990 and 2004, and are likely to continue growing in the absence of a policy aimed at reducing emissions. This sector is therefore a significant contributor to Canada's overall GHG emissions, and an important source for potential reductions.

The policy described in this document is targeted at major household appliances, air conditioners, furnace, and boilers, to which we refer in aggregate as "appliances". The policy would be implemented at a federal level, and consist of a rebate for high efficiency appliances, coupled with a fee on low efficiency appliances. Appliances are classified as high or low efficiency based on their "Energy Star" qualifications, which are determined by Natural Resources Canada.

This report analyzes the environmental effects of alternative combinations of rebates and fees. The base policy analyzed here combines a 6% rebate on Energy Star qualified appliances and a 6% fee on appliances not qualified as Energy Star. We also analyze several other combinations of rebates and fees, as illustrated in Table 1.

Table 1: Policy scenarios analyzed in this report

Scenario	Rebate for Energy Star	Fee for non Energy Star
Base	6%	6%
P1	10%	10%
P2	5%	5%
P3	9%	9%

To conduct the analysis, we developed an appliance choice and stock accounting model, based on the CIMS energy-economy model. The model simulates how households purchase new appliances to replace retired stocks and to meet the growing demand for appliances, and it simulates household choice between high and low efficiency appliances based on empirical observations of behaviour in Canada. The model forecasts the effects of the policy on energy consumption, greenhouse gas emissions, criteria air contaminant emissions, appliance stocks, government revenue, and employment in the Canadian retailing, wholesaling and appliance manufacturing sectors.

Results of the modelling associated with each of the policy scenarios described in Table 1 are shown in Table 2. For the Base policy scenario, annual energy consumption is reduced by 1,440 Giga Watt-hours (GWh) at the end of our simulation period (2020). This reduction in energy consumption is equivalent to the annual energy consumption of 45,000 Canadian households or almost 80,000 passenger vehicles.

The model predicts GHG reductions of 72 kt CO_2e annually by 2010 and reductions of 275 kt CO_2e annually by 2020. Reductions in GHG emissions result mostly from the reduction in household fossil fuel use in furnaces, boilers and for water heating. Together, these appliances account for 58% of the reduction in GHGs. The policy also reduces electricity consumption, which accounts for the remaining 42% of the reduction in GHG emissions. In addition, the model predicts reductions in emissions of all criteria air contaminants (CAC) – emissions of particulate matter, sulphur oxides, nitrogen oxides, volatile organic compounds and carbon monoxide.

Our results under the Base case scenario forecast an increase in federal government revenue, because government charges a fee on appliances that capture the majority of market share. By 2020, federal revenues increase by $67M (2003 dollars). Other policy scenarios are substantially closer to revenue neutrality. Under the Base case scenario, employment in the Canadian retailing, wholesaling and appliance manufacturing sectors is forecasted to increase by 743 jobs compared to business as usual.

Table 2: Results for all policy scenarios

Scenario	Annual GHG Reduction 2010 (kt)	Annual GHG Reduction 2020 (kt)	Annual Energy Consumption Reduction 2020 (GWh)	Annual CAC reduction 2020 (t)	Annual Reduction/(Increase) in Gov't Revenue 2020 ($2003M)	Direct Job Increases 2020
Base	72	275	1,444	1,101	(67)	743
P1	114	461	2,422	1,805	25	1,393
P2	60	227	1,194	914	(72)	595
P3	104	416	2,185	1,638	(8)	1,226

In order to address uncertainty in the model parameters, an effort was made to determine the robustness of the results to changes in parameter values using a sensitivity analysis. Empirical data exists to allow informed choice of these parameters, but some uncertainty about their true values remains. The analysis showed that the results are sensitive to assumptions about the discount rate and elasticity values. If the discount rate or elasticity values are significantly lower than simulated, emissions reductions could be as much as 40% lower.

Evaluation using the criteria in *The Budget Plan 2005* showed that by targeting energy consumption, the policy reduces electricity consumption across the board, including in provinces where generation has low emissions intensity. Therefore, the policy is less effective at reducing greenhouse gas emissions than a policy that targets emissions directly. The fiscal impact of the policy is dependent upon policy design, and the policy could be designed to ensure that it is revenue neutral. Fiscal impacts should not be used on its own to evaluate a policy, since it does not account for social or environmental costs and benefits. Implementation of the policy could improve economic efficiency since it acts to correct prices for negative environmental externalities by providing improved price signals. Overall, there are minimal impacts on fairness, as the impacts are similarly distributed among the provinces. Finally, the policy is considered relatively simple, since it is based on the Energy Star label, which is already fairly well understood by Canadians.

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1 Introduction

1.1 Objective and structure of this report

This report presents the results of a quantitative analysis to determine the effect of changing taxation of residential appliances to reflect energy consumption and greenhouse gas emissions. A qualitative evaluation of the policy is also conducted, using the criteria established in *The Budget Plan 2005: Framework for Evaluating Environmental Tax Proposals*.[1]

Section 1 of this report briefly outlines the context for the tax proposal evaluated here, beginning with a summary of trends in Canada's greenhouse gas emissions and energy consumption. A discussion of important trends in residential energy consumption is then presented, followed by a discussion of policies already in place to address energy consumption from household appliances. Section 2 describes the policy being evaluated in more detail, including administrative issues with policy implementation. Section 3 outlines the method by which the policy is evaluated, and section 4 presents the quantitative results of the modelling exercise used to determine policy effectiveness. Section 5 is an evaluation of the policy using the criteria suggested by the federal government in *The Budget Plan 2005*.

1.2 Background

Canada's greenhouse gas (GHG) emissions have grown from 599 mega tonnes (Mt) of carbon dioxide equivalent (CO_2e) in 1990 to 758 Mt CO_2e in 2004, a 27% increase in 15 years.[2] Canada's overall GHG emissions represent 2% of the global total, making Canada the seventh largest emitter in the world. On a per capita basis, Canada's 23.5 t CO_2e per capita is higher than virtually every other industrialized country, and likewise the rate of growth of GHG emissions in Canada exceeds that of almost every other developed country.[3] As a result, Canada's federal government faces increasing pressure from the international community and Canadians to develop new policies to reduce greenhouse gas emissions.

Canada also faces pressure to reduce greenhouse gas emissions due to commitments made under the Kyoto Protocol to the United Nations Framework Convention on Climate Change, which it signed in 1997 and ratified in 2002. The Kyoto Protocol obliges Canada to reduce emissions to an average of 6% below 1990 levels during the period 2008-2012. According to a recent forecast by Natural Resources Canada, emissions are

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[1] Department of Finance, 2005, "The Budget Plan 2005", Government of Canada, Ottawa, 313-327.

[2] Environment Canada, 2006, "National Inventory Report 1990-2004, Advance Copy", Government of Canada, Ottawa. These values exclude GHG emissions associated with land use, land use change, and forestry.

[3] United Nations Framework Convention on Climate Change, 2005, "Key GHG Data", Bonn, Germany.

projected to reach 828 Mt by 2010, 38% over 1990 level and 47% higher than the level required under the Kyoto Protocol.[4] Failure to adhere to emissions reductions stipulated by a country's Kyoto Protocol commitment requires the country to reduce emissions even further in subsequent international climate change agreements.[5] Therefore, the compliance mechanism provides a strong incentive to reduce emissions significantly.

In *The Budget Plan 2005*, the Government of Canada outlines the importance of economic instruments, such as grants, subsidies, and tax measures, in meeting economic and environmental goals simultaneously. In particular, the government discusses the potential for using the tax system to pursue broader government objectives (additional to the tax system's basic role of generating revenue). One such objective is the correction of "negative environmental externalities", which occur when an individual or company does not pay the full cost of polluting (e.g., costs of adapting to climate change or impacts on human health from higher temperatures or CAC emissions). In this situation, market prices understate actual costs to society, and the individual or company produces more pollution than is socially optimal. Because the outcome in this situation deviates from the socially optimal outcome, economists call this a "market failure". Under certain conditions, government may be able to correct for such market failures by using economic instruments to establish improved price signals. This type of market-based approach can be more economically efficient than using a more traditional regulatory approach to achieve the same goal.[6]

Greenhouse gas emissions are a negative externality associated with many activities; there is typically no monetary cost for emitting GHGs, and GHG emissions are responsible for human-induced climate change. By using economic instruments to incorporate the social cost of GHG emissions into the market prices for activities that produce emissions, it may be possible to reduce GHG emissions in an economically efficient manner.

The Government of Canada is already using economic instruments to reduce GHG emissions. For example, in 2001 it announced the Wind Power Production Incentive, which is designed to stimulate investment in wind power using subsidies. In 2005, it announced changes in the tax treatment of renewable energy and cogeneration technologies, which should stimulate investment in such technologies. To date, however, most economic instruments in Canada designed to address greenhouse gas emissions have been fiscal incentive mechanisms, with no existing examples of fiscal disincentive

[4] Natural Resources Canada, 2006, "Canada's Energy Outlook: The Reference Case 2006", Analysis and Modelling Division, Natural Resources Canada, Government of Canada, Ottawa.

[5] Countries that fail to reduce emissions to the level committed to in the Kyoto Protocol are required to make up those reductions in the subsequent period with an additional 30% penalty. United Nations Framework Convention on Climate Change, 2006, "An Introduction to the Kyoto Protocol Compliance Mechanism", Bonn: http://unfccc.int/kyoto_protocol/compliance/introduction/items/3024.php.

[6] Stavins, R., 2001, "Experience with market-based environmental policies", in eds. Maler, K.-G. and Vincent, J., The Handbook for Environmental Economics, North-Holland/Elsevier Science.

mechanisms, which most analysts suggest are more effective.[7]

Many other governments have experience with using economic instruments, and fiscal disincentives in particular, to reduce GHG emissions. For example, the European Union has implemented an emission trading system that requires operators of large industrial facilities to hold permits to cover all GHG emitted by the facility. Several countries, among them the UK, Norway, and Denmark, have implemented greenhouse gas taxes that embed the environmental cost of GHG emissions into some activities that emit GHG emissions. In addition to these broad economic instruments, governments around the world have also implemented more targeted taxes and subsidies aimed at reducing GHG emissions from particular technologies or processes, and have made changes to tax systems with the same goal. For example, many European countries have implemented vehicle surcharges to reflect environmental performance, and the United Kingdom has recently changed the tax treatment of company cars to reflect GHG emissions.

This paper reports on the potential for a new policy to address energy consumption and greenhouse gas emissions in major household appliances. The policy is called a feebate, because it combines fees on low efficiency technologies with rebates on more efficient technologies. In other words, it combines a fiscal incentive with a disincentive.

1.3 Trends in household energy consumption and emissions in Canada

In 2004, the average Canadian household consumed 31.9 MWh of energy per year, with the bulk of energy coming from natural gas or electricity. Average energy consumption per household decreased by about 12% between 1990 and 2004 as a result of improvements in the efficiency of all end-uses. However, improvements in efficiency were offset by growth in the number of households, so that overall household energy consumption increased by over 10% in the same period.[8]

Figure 1 shows that space heating and water heating account for approximately 80% of total household energy consumption. Appliances are responsible for the bulk of the remaining energy consumption, with small contributions from lighting and from space cooling. Of the appliances, refrigerators consume the most energy, followed by clothes washers, clothes dryers, range/ovens, freezers, dishwashers, and other small appliances.[9]

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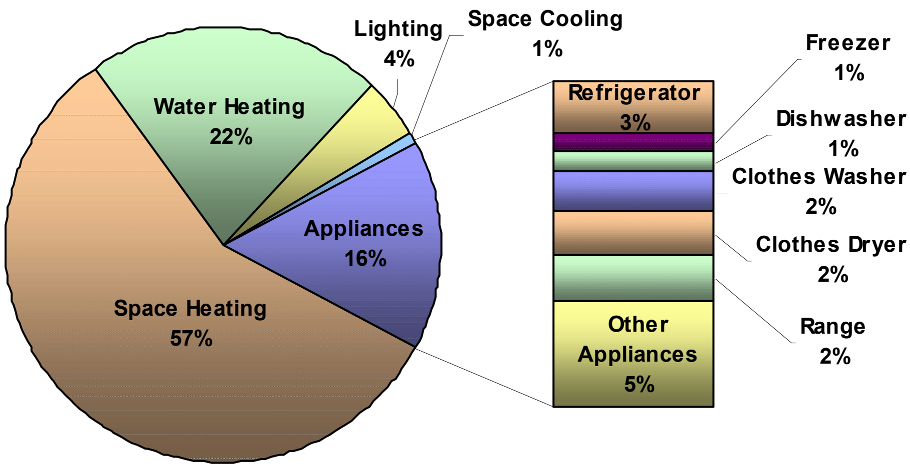
[7] According to Robert Stavins, a well-known and respected economist at the John F Kennedy School of Government at Harvard University, "subsidies, in general, have important and well-known disadvantages relative to taxes". Stavins, R., 2001, "Experience with market based environmental policy instruments", in eds. Maler, K.-G. and Vincent, J., "The Handbook of Environmental Economics", North-Holland/Elsevier Science, Amsterdam.

[8] Natural Resources Canada, 2006, "Energy Use Data Handbook, 1990 and 1998 to 2004", Ottawa.

[9] In Figure 1, the water heating required to run dishwashers and clothes washers has been allocated to the appliances.

Figure 1: Household energy consumption in Canada, 2004



Source: Natural Resources Canada, Comprehensive Energy Use Database. Values may not sum to 100% because of rounding.

The energy efficiency of each major appliance type has improved significantly over the past two decades. Natural Resources Canada estimates that new refrigerators, freezers, dishwashers, and clothes washers are all at least twice as efficient today as fifteen years ago. However, new end-uses for energy are constantly being developed, particularly consumer electronics and computers, and these represent a large and growing demand for electricity that at least partly offsets energy efficiency improvements.

Consumption of energy in households is associated with both direct and indirect (from electricity generation) GHG emissions. Households emitted about 42.9 Mt CO_2e of direct GHG emissions and 33.8 Mt CO_2e of indirect GHG emissions in 2004.[10] On average, this works out to 6.2 tonnes of CO_2e per household.

1.4 Existing policies for reducing energy consumption and emissions in Canadian appliances

Governments and energy utilities have a long history of developing policies and programs to address energy consumption from household appliances. In 1992, the federal government passed the *Energy Efficiency Act*, which allows government to make and enforce regulations governing the minimum energy performance of energy-using products, including household appliances. The first minimum energy performance standards came into effect in 1995, and the list of regulated products has been augmented several times since. In addition, the standards for regulated products have been and will continue to be gradually tightened over time as efficiency improves. In general,

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[10] Indirect GHG emissions refer to the emissions resulting from the generation of electricity for residential use.

minimum energy performance standards in Canada are harmonized with those in the United States, which reflects the integrated appliance market in the two countries.

Minimum energy performance standards are designed to help eliminate the least energy efficient products on the market, but government also has policies to promote more efficient product choices. Under the *Energy Efficiency Act* government requires all major appliances to have labels showing their average annual energy consumption. This labelling initiative is called EnerGuide and is designed to show consumers the energy costs of appliance use to enable them to make more informed purchases.

The federal government also delivers the Energy Star program in Canada, which is designed to complement the EnerGuide labelling program by identifying the most energy efficient appliances. The Energy Star program was originally developed by the US Environmental Protection Agency, and Energy Star qualifying standards for many appliances are harmonized between the two countries. The Energy Star program covers all major household appliances identified in Figure 1 except water heaters, clothes dryers, and ranges.

Most provincial governments also have policies to promote appliance energy efficiency, including minimum energy performance standards that supplement the federal regulations. Some provinces offer tax credits or exemptions for energy efficient products. For example, the Government of Saskatchewan offers a provincial sales tax exemption for Energy Star qualified appliances, furnaces, and boilers, and the Government of British Columbia offers a similar exemption for Energy Star qualified furnaces, boilers, and heat pumps.

Electric and gas utilities have also long played an important role in promoting appliance energy efficiency. For example, Hydro-Québec offers consumers a $50 rebate on the purchase of a new Energy Star refrigerator, Manitoba Hydro offers consumers a $245 rebate on the purchase of a new Energy Star furnace or boiler, and Terasen Gas offers a $1,000 rebate on the purchase of a new Energy Star natural gas fired furnace or boiler.

In the following sections, we describe and analyze a federal appliance feebate policy to reduce the energy consumption and emissions from Canadian household appliances.

2 Description of policy

The policy described in this report would be implemented at the federal level, and would consist of a rebate on the purchase of Energy Star qualified appliances complemented with a fee on the purchase of appliances that do not qualify for the Energy Star standard. This type of design can be more effective than a simple rebate for two reasons. First, the fee component of the policy provides additional incentive for consumers to switch to Energy Star appliances, and should improve the effectiveness of the program. Second, since the policy combines a fee with a rebate, it can be designed to be revenue neutral to the federal government, which can improve economic efficiency and prospects for political acceptability.

The policy would affect the appliances shown in Table 3. Water heaters, ranges, and clothes dryers would not be affected because the Energy Star standard does not apply to these appliances. Other residential energy consuming durables, including minor appliances and electronic equipment, would not be affected because energy consumption is a much smaller part of life cycle costs.

Table 3: Appliances affected by policy[11]

Category	Appliance
Major Appliances	Refrigerators
	Clothes Washers
	Dishwashers
	Freezers
Space Cooling Equipment	Central Air Conditioners
	Room Air Conditioners
Space Heating Equipment	Furnaces
	Boilers

There are many possible configurations for the policy. We outline key variations in possible policy design using three variables:

- ***Tax rate basis*** – the rate basis is the variable upon which changes in tax treatment are based. Tax treatment could be based on (i) the rated energy consumption of the appliance, (ii) the specific rated energy consumption (e.g., energy consumption per unit volume), or (iii) whether or not the appliance is Energy Star qualified. Basing tax treatment on (i) would provide incentive for consumers to use smaller appliances with fewer energy consuming features as well as more efficient appliances. Basing tax treatment on (ii) would not provide incentives for consumers to choose smaller appliances, but would maintain a continuous incentive for improvements in energy efficiency throughout the energy efficiency spectrum. Basing tax treatment on (iii) does not provide incentives for choosing smaller appliances and only differentiates appliances into two tax categories. The

[11] Dehumidifiers and combination washer-dryers could also be covered by the policy, but these appliances were not included in the analysis conducted for this report because of a lack of reliable data.

policy modelled in this report uses (iii) as a rate basis for tax changes. Using the Energy Star standard to differentiate tax rates does offer the advantages of simplicity and transparency.

- ***Tax rate*** – the tax rate is the percentage of appliance price given as a rebate on Energy Star qualified appliances and the fee on non Energy Star appliances. The fee and rebate rates do not have to be equal, but this report only shows results for scenarios where the fee and rebate are equal.
- ***Builder/retail sales*** – depending on the appliance type, a significant number of appliances are sold through homebuilders rather than through retail channels, as shown in Table 4. If the rebate were distributed through retail outlets, appliances installed by builders would not be affected by changing tax rates. If the rebate were implemented at manufacturer level, appliances sold through builders would be affected. The scenarios modelled in this report assume that the rebate and fee are applied at point of sale in retail outlets, so that sales through builders are unaffected.

Table 4: Appliance sales by channel

Appliance	Percent builder sales
Refrigerators	18.3%
Clothes Washers	10.4%
Dishwashers	13.9%
Freezers	0%
Central Air Conditioners	32%
Room Air Conditioners	0%
Furnaces	40%
Boilers	43%

Source: Data for 2005 from Canadian Appliance Manufacturers Association, 2006, "2006 Major Appliance Industry Trends and Forecast", Mississauga, Ontario, Electro-Federation Canada. Central air conditioners, furnaces, and boilers from author calculations.

All scenarios modelled in this report assume that the policy is implemented by January 2008.

3 Methodology

The purpose of this report is to show how changes to the tax treatment of residential appliances could affect energy consumption and greenhouse gas emissions. We developed a model to predict appliance choice and forecast appliance stock evolution in both business as usual (no policy) and policy scenarios. Separate models were developed for each of 8 different types of appliances. In this section, we briefly describe the model and its potential limitations. We also discuss the scenarios that were simulated using the model.

3.1 Model description

The basic modelling framework applied for the analysis described here is shown in Figure 2. The model starts with a forecast of appliance demand for each category of appliance. This baseline forecast is based on a non-linear regression of appliance ownership on household disposable income and household size, and explicitly controls for other factors that affect appliance ownership in each province.[12] Overall appliance stock is then forecast based on exogenous forecasts of disposable income, household size, and population from Natural Resources Canada.[13] In the policy scenarios, the baseline forecast for appliance demand is adjusted using a price elasticity of appliance demand and the predicted change in weighted average appliance price induced by the policy.

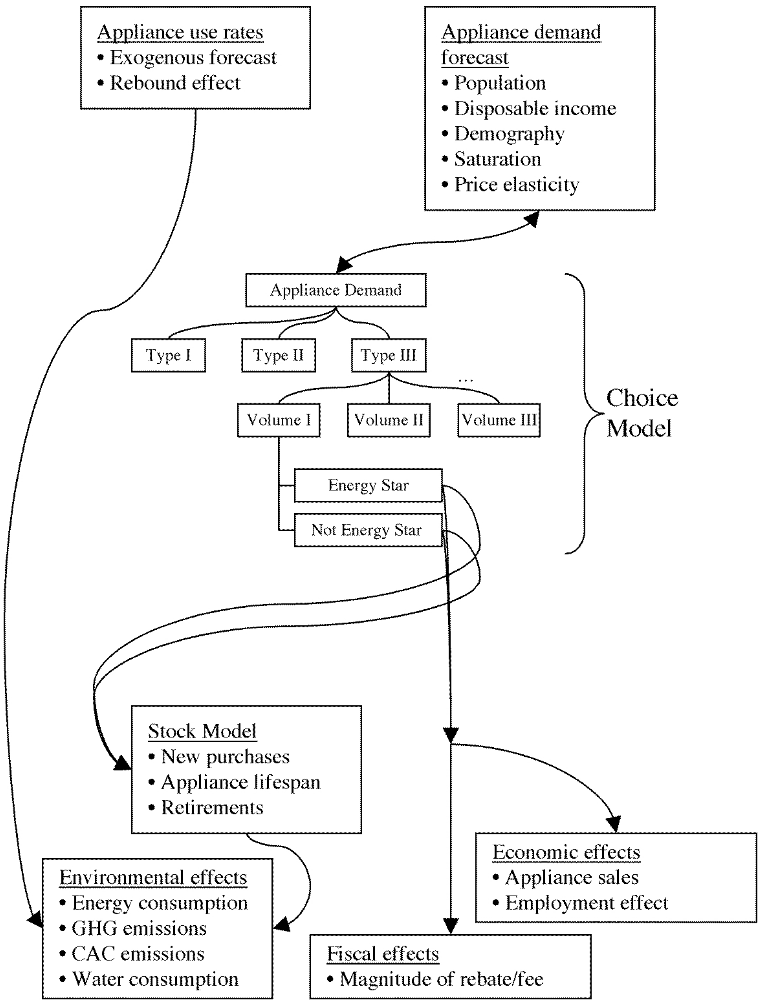
[12] For most appliances, the forecast of appliance ownership per household in year *t* and province *i* is based on:

$$Own_{i,t} = \sum_i \beta_i \cdot d_i + \beta_1 \cdot occ_{i,t} + \beta_2 \cdot \left(\frac{1}{1 + e^{-inc_{i,t} \cdot a + b}} \right)$$

where d_i is a vector of provincial dummy variables, $occ_{i,t}$ is the average household occupancy, and $inc_{i,t}$ is household disposable income. Historic values of appliance ownership in each province are from Statistics Canada, Table 203-0020, and historic demographic (household size, population, disposable income) statistics are from Natural Resources Canada Comprehensive Energy Use Database and Statistics Canada Table 384-0012. Model fit (R^2) was generally excellent, and nearly all parameters were significant (5%) and of expected signs.

[13] Forecasts for population, personal disposable income, and household size for each province are from Natural Resources Canada, *Canada's Energy Outlook: The Reference Case 2006*, Ottawa, Analysis and Modelling Division, Natural Resources Canada.

Figure 2: Modelling framework



Based on the forecast of overall appliance demand and a projection of appliance retirements,[14] the model determines how much new appliance stock must be purchased each year. Where appropriate, the appliance stock is exogenously allocated to certain type and capacity categories of appliance based on historic trends. Within each of these categories, new stock is allocated to Energy Star or non Energy Star categories based on a technology choice algorithm developed for the CIMS energy economy model. Technology choices are based on appliance price, energy efficiency, fuel prices, tax treatment of Energy Star appliances, and parameters that capture purchasing behaviour of

[14] Appliance retirement is based on a logistic retirement function where average appliance lifespan is from Natural Resources Canada (http://oee.nrcan.gc.ca/Publications/infosource/Pub/appliances/consider-price.cfm?attr=4#average), Lawrence Berkeley National Laboratory, and the CIMS model database. The lifetimes of appliances used for this study are: dishwashers – 13 years; refrigerators – 17 years; clothes washers – 14 years; freezers – 21 years; ranges – 18 years; room air conditioners – 10 years; central air conditioners – 13 years; gas furnaces – 18 years; oil furnaces – 17 years; boiler – 20 years.

consumers. Prices for Energy Star qualified appliances are adjusted according to the simulated tax treatment, assuming that consumers value one dollar in rebate equally to one dollar in cash.[15] Key variables that capture consumer behaviour are shown in Table 5, along with assumptions about the values of these parameters.

Table 5: Descriptions of model parameters and base case scenario values

Parameter	Description	Value in Base Scenario
Discount rate[16]	The implicit interest rate applied by consumers in determining the present value of future cash flows (energy costs)	25%
Reduction in discount rate for Energy Star[16]	The reduction in discount rate applied by consumers for appliances bearing the Energy Star symbol, corresponding to improved information about lifecycle appliance costs	5%
Model elasticity[17]	The relative percentage reduction in the market share of an appliance corresponding to a 1% increase in the discounted life cycle cost of the appliance	1.3%[18]
Overall elasticity[17]	The relative percentage reduction in overall new appliance demand corresponding to a 1% increase in the weighted average capital cost of new appliances	0.25%
Rebound effect[19]	The percentage increase in appliance use (where applicable) corresponding to a 1% decrease in the annual energy cost of the appliance	0.2%

Not all appliances are assumed to be affected by the rebound effect or by the overall elasticity. For example, refrigerator usage is not likely to change as a result of changes in

[15] This is consistent with research conducted by US utilities on appliance rebate programs. Train, K. and Atherton, T., 1995, "Rebates, loans and customers' choice of appliance efficiency level", *The Energy Journal*, 16(1), 55-69.

[16] Many empirical studies seek to determine the implicit discount rate applied by consumers during purchases of appliances. Most studies find fairly high discount rates (compared to bank interest rates), with substantial variation between studies depending on methods and data. This study assumes that discount rate for Energy Star appliances are reduced somewhat because of improved information about tradeoffs between up-front and annual costs. Train, K., 1985, "Discount rates in consumers' energy-related decisions: A review of the literature", *Energy*, 10(12), 1243-1253.

[17] The elasticity values in the model are from research conducted during the development of the CIMS model, and have uncertainty associated with them. Nyboer, J., 1997, "Simulating the evolution of technology: An aid to policy analysis", PhD Dissertation, Simon Fraser University. The modelling actually uses a parameter similar to the elasticity, called a "market heterogeneity parameter".

[18] The model elasticity varies with the difference between the discounted life cycle costs of the Energy Star and non Energy Star appliances. If the difference is already large (e.g., 50%), further increases in the difference yield less of a change in market share. The Base value reported here represents the model elasticity for an average difference in life cycle costs (around 15%).

[19] Estimates of the rebound effect for residential energy consumption generally range from about 0.1 – 0.3, although the exact size is very uncertain. A rebound effect is only applied in the model for appliances where the user controls the intensity (e.g., air conditioners but not refrigerators). Greening, L., Greene, D., and Difiglio, C., 2000, "Energy efficiency and consumption – the rebound effect – a survey", *Energy Policy*, 28, 389-401.

energy costs induced by efficiency improvements, and consumers are not likely to demand fewer furnaces in response to increased furnace prices. Table 3 shows which appliances are subject to the rebound effect and the price elasticity effect.

Table 6: Rebound effect and price elasticity effect by appliance

Appliance	Rebound Effect	Price Elasticity Effect
Refrigerators	X	√
Clothes Washers	√	√
Dishwashers	√	√
Freezers	X	√
Central Air Conditioners	√	√
Room Air Conditioners	√	√
Furnaces	√	X
Boilers	√	X

The energy efficiency of appliances is assumed to improve continuously throughout the analysis period, with the rate of efficiency improvement modelled as an exogenous extrapolation from the historic energy efficiency for each appliance. The model also assumes that the Energy Star standard is periodically revised such that Energy Star appliances capture on average 25% of appliance sales in the business as usual scenario.[20]

With sales of Energy Star and non Energy Star appliances simulated through to 2020, a standard stock vintage model is applied to model the total energy consumption and direct and indirect greenhouse gas emissions resulting from appliance use. Indirect greenhouse gas emissions (from electricity generation and hot water consumption) are calculated based on marginal emissions intensity in each province, as shown in Table 7.[21] Energy costs in the business as usual and policy scenarios are calculated based on forecasts of electricity and natural gas price.[22]

[20] This is consistent with the objective of the Energy Star program, which aims to isolate the most efficient appliances in each category. For appliances where the federal government has announced revisions to the Energy Star requirements (these have been announced through 2009), we model changes to the Energy Star standards in this year, with periodic changes thereafter so that Energy Star models capture on average 25% of the total sales. For other appliances, we assume the Energy Star standard will be revised when the market share of Energy Star appliances reaches 70% of the market.

[21] Criteria air contaminant emissions intensity for electricity generation is determined at a provincial level based on a forecast of criteria air contaminant emissions from Environment Canada's 2006 CAC Emissions Summary and Forecast. Energy and emissions intensity for domestic hot water generation is calculated for each province using Natural Resources Canada's 2006 Comprehensive Energy Use Database. CAC emissions for hot water generation are from Environment Canada's 2006 National Pollutant Release Inventory.

[22] Electricity and natural gas price forecasts are from Natural Resources Canada's 2006 Energy Outlook.

Table 7: Marginal electricity generation source and intensity

Province	Marginal Electricity Source	Marginal Emissions Intensity (t CO_2e/TJ)
Newfoundland and Labrador	Heavy fuel oil	224.2
Prince Edward Island	Orimulsion	244.5
Nova Scotia	Natural gas	99.3
New Brunswick	Orimulsion	244.5
Quebec	Natural gas	99.3
Ontario	Natural gas	99.3
Manitoba	Hydro	0
Saskatchewan	Natural gas	99.3
Alberta	Coal	287.8
British Columbia	Natural gas	99.3

Source: Demand Policy & Analysis Division, Natural Resources Canada.

In addition to environmental effects, the model is also able to predict fiscal and economic effects of the policy. Fiscal effects are simply an estimation of the change in the federal tax induced by the policy, and help to show the revenue effects of the policy. The key economic effect reported by the model is the employment effect. Employment effects are calculated using an input-output model developed using detailed data on flows of inputs and outputs to the economy, as well as employment in each sector of the economy.[23] The employment effects reported here only include the direct employment effects, or the effects of the policy on employment in retailing, wholesaling and appliance manufacturing. Effects on the employment in other sectors of the economy, such as the food services sector are excluded from the report. Including the indirect effects of the policy on other sectors would tend to balance the direct effects that are reported here.

The modelling is conducted separately for each province in Canada and for each appliance, although we present most results as a sum across regions and appliances.

3.2 Modelling scenarios

The primary purpose of the analysis described here is to show how changes to the tax treatment of Energy Star appliances affect the energy consumption and greenhouse gas emissions from appliances, and to provide some understanding of the cost of this type of policy from consumer and government perspectives. Although this report only examines one type of policy, we model several variations of the policy in order to provide a sense of how changes to policy design can affect key model results.

[23] Data to develop the input-output model is from Statistics Canada Tables 381-0009, 381-0010, and 383-0009, and is based on the year 2002, the most recent year for which data is available.

Table 8 shows the policy scenarios that were chosen for modelling. All policies modelled start in 2008 and are held constant throughout the analysis period until 2020.

Table 8: Policy scenarios modelled in this report

Scenario	Rebate for Energy Star	Fee for non Energy Star
Base	6%	6%
P1	10%	10%
P2	5%	5%
P3	9%	9%

In addition to modelling the effect of alternative policy designs, we also provide sensitivity analysis to show the effect of changing key model parameters and assumptions on the results. This analysis conveys the robustness of the model results to assumptions about uncertain parameters. Table 9 shows the sensitivity scenarios included in this report. While these scenarios do not exhaustively describe the uncertainty present in the model, they do convey a sense of the effect of each of the key assumptions on the final results.

Table 9: Sensitivity analysis scenarios on key uncertain parameters

Scenario	Description
S1	Discount rate = 10%
S2	Energy star discount rate reduction = 0%
S3	Model elasticity = half of base value
S4	Model elasticity = 1.5 times base value
S5	Overall elasticity = 0.5
S6	Rebound effect = 0.1
S7	Residential energy prices = 25% above NRCan forecast
S8	Residential energy prices = 25% below NRCan forecast

3.3 Model limitations and uncertainties

Like any model, this one is a partial representation of the real world, and as such contains uncertainties. The main uncertainties in this model are as follows:

- ***Discount rate*** - the discount rate is a concept frequently applied in modeling trade-offs between present costs or benefits and a stream of future costs or benefits. However, there is significant controversy in the energy economics community about the appropriate discount rate to apply in order to accurately forecast decisions made by consumers. Most empirical studies find that consumers implicitly apply relatively high discount rates (20-50%) in making decisions relating to energy consuming goods. Some analysts suggest that the high discount rates found in empirical studies are inconsistent with proper market function (they exceed rates of return on common stocks by a factor of three or more, exceed rates of return to public utilities, and exceed lending rate offered by credit card companies by a factor of two or more), and should therefore be discredited.[24] However, the bulk of the literature on private-sector decision making with regards to energy finds that high discount rates revealed in empirical studies are likely a reflection of the reality of obtaining information in the market,

[24] DeCanio, S. and Laitner, S., 1997, "Modeling technical change in energy demand forecasting: A generalized approach", *Technological Forecasting and Social Change*, 55, 249-263.

the high perceived risk of energy efficiency investments, the skepticism of consumers to *ex ante* claims of high rates of return on energy efficiency investments, the option value of waiting for more information before making a decision, and the limited time available to consumers to evaluate energy saving technologies, among other factors.[25] The value used in the base case in this study is selected as representative from several studies going back over two decades.[26]

- ***Reduction in discount rate from Energy Star label*** – part of the reason for high implicit discount rates applied by consumers in the purchase of energy using goods is a poor understanding or lack of information about the trade off between up front and ongoing appliance costs.[27] The Energy Star label is designed in part to address this issue, and could lower the implicit discount rate applied by consumers. While there is information about the growing awareness of Energy Star in Canada and the US as well as qualitative information about whether consumers use the Energy Star label in making purchases, to our knowledge there is not quantitative study in either country to assess the degree to which the Energy Star label might affect consumer choice. This parameter in the model is therefore an assumption based on judgement rather than empirical evidence. We test this parameter in the sensitivity analysis.
- ***Rebound effect*** – when the cost of running an appliance becomes lower, consumers are likely to run the appliance more intensively. For example, studies show that customers that improve the efficiency of their furnace (and therefore lower the cost of space heating) will set their thermostat relatively higher.[28] There is significant uncertainty associated with this parameter, especially related to the boundary of analysis (i.e., will consumers drive cars more if the cost of home heating falls, or just turn up their thermostats?). The value used in the base case in this study is selected as representative from a survey of over 75 studies of rebound effect.[29]

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[25] Dixit, A. and Pindyck, R., 1994, "Investment under uncertainty", Princeton; Princeton University Press. Hasset, K. and Metcalf, G., 1994, "Energy conservation investments: Do consumers discount the future correctly?" *Energy Policy*, 21(6), 710-716.

[26] Train, K., 1985, "Discount rates in consumers' energy-related decisions: A review of the literature", *Energy*, 10(12), 1243-1253. Jaccard, M. and Dennis, M., 2005, "Estimating home energy decision parameters for a hybrid energy-economy policy model" *Environmental Modeling and Assessment*, 11(2), 91-100.

[27] Jaffe, A. and Stavins, R., 1994, "The energy efficiency gap: What does it mean?" *Energy Policy, 22(10)*, 804-810.

[28] Dubin, J. et al., 1986, "Price effects of energy efficient technologies: A study of residential demand for heating and cooling", *RAND Journal of Economics*, 17(3), 310-325.

[29] Greening, L., Greene, D., and Difiglio, C., 2000, "Energy efficiency and consumption – the rebound effect – a survey", *Energy Policy*, 28, 389-401.

- ***Elasticity*** – the concept of elasticity is used frequently in economics. In this study, the "model elasticity" determines how the market share of Energy Star appliances will change in response to a change in the life cycle costs of Energy Star and non-Energy Star appliances induced by the feebate. The "overall elasticity" is the absolute percent reduction in sales of appliances associated with a one percent increase in the weighted average up-front cost of new appliances. The model elasticity used in the base case is from market research conducted in the development of the CIMS energy-economy model. The overall elasticity is based on studies of durable good demand.[30]
- ***Appliance efficiency*** – the energy efficiency of most appliances modelled in this study has improved significantly over the last two decades, and is likely to continue to improve throughout the period analyzed in this report. The rate of improvement in energy efficiency is based on an extrapolation of improvements made since 1990. However, actual improvements in energy efficiency may diverge from this forecast.

[30] Gowrisankaran, G. and Ryseman, M., 2006, "Dynamics of consumer demand for new durable goods", *National Bureau of Economic Research*, Working paper.

4 Modelling results

This section is divided into three parts. First, detailed results are presented corresponding to the Base policy and Base assumption scenarios. Next, results are summarized for all policy scenarios, with a discussion on the effect of alternative policy designs on results. Finally, results are summarized for all sensitivity scenarios, with a discussion on the effect of assumptions about key uncertain parameters. Detailed results from each scenario and policy are summarized in the Appendix.

4.1 Base Case Results

4.1.1 Impacts of policy on energy consumption and emissions

The forecasted effect of the change in appliance tax treatment on household energy consumption is illustrated in Figure 3. Overall, total energy consumption is forecast to decline by 1,440 GWh in 2020 as a result of policy implementation. Reductions in natural gas and electricity consumption account for the majority of the total reductions (800 and 570 GWh, respectively). The reduction in energy consumption is equivalent to the annual energy consumed by 45,000 Canadian households or almost 80,000 average passenger vehicles. The policy also causes a reduction in total household spending on energy of $80 million (2003 dollars) annually in 2020.

Figure 3: Annual reduction in energy consumption from policy implementation

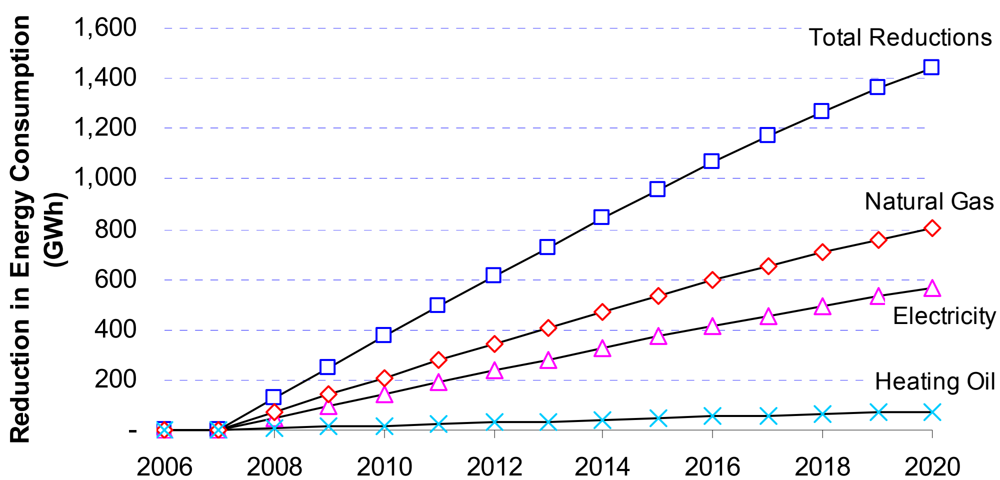
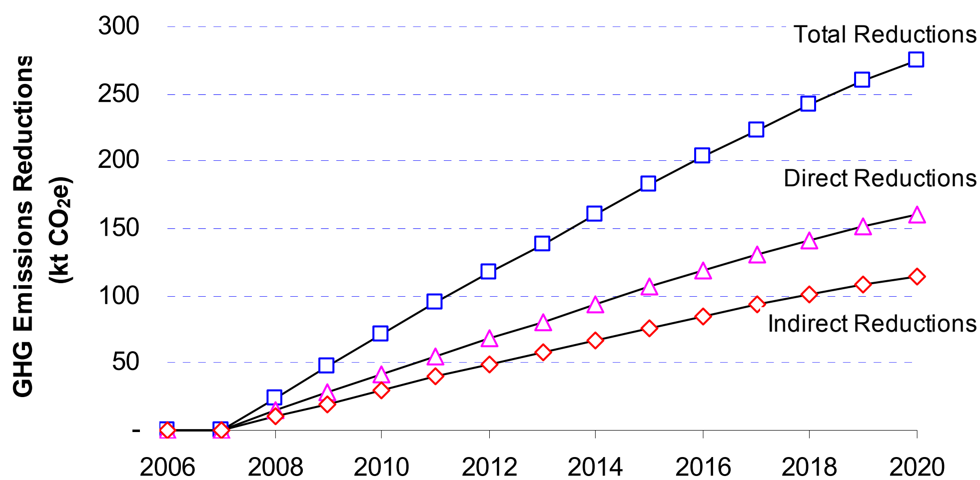


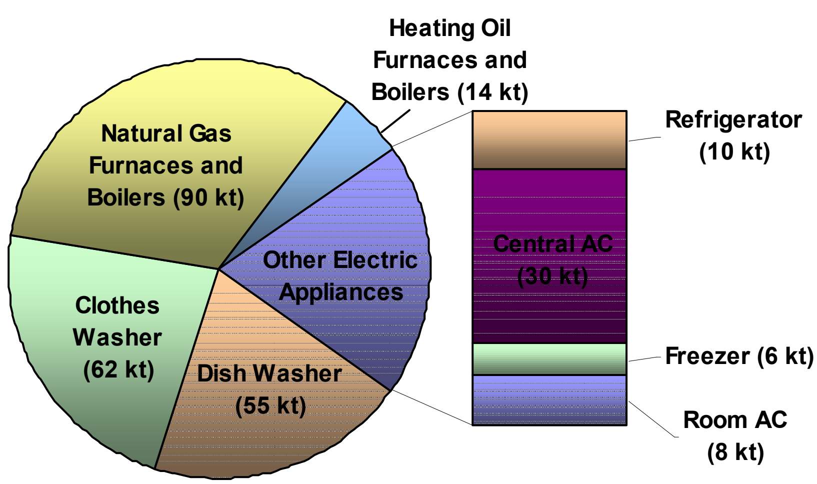
Figure 4 shows the projected reduction in total greenhouse gas emissions from the Base policy. By 2020, the policy is forecasted to cause a reduction in total emissions of 275 kilotonnes (kt) of CO_2e. Emissions reductions can be disaggregated into direct reductions, which occur when households reduce their demand for fossil fuels, and indirect reductions, which occur at the point of electric generation when households reduce their demand for electricity. As illustrated, the majority of emissions reductions are direct (160 kt in 2020), while indirect account for a smaller portion of the reductions (115 kt in 2020).

Figure 4: Annual GHG emissions reductions from policy implementation



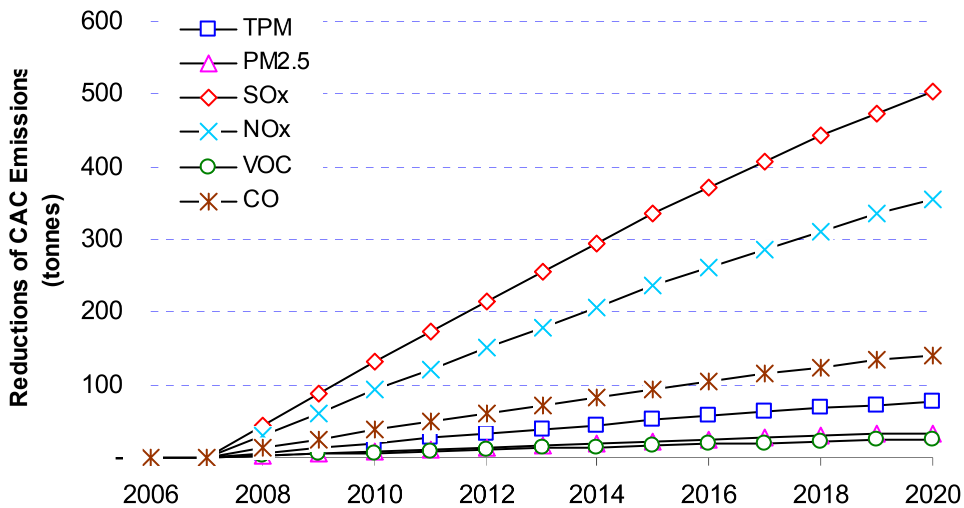
Most GHG emissions reductions result from adoption of more efficient appliances, furnaces, and boilers that consume fossil fuels directly. Accordingly, clothes washers and dishwashers account for 117 kt in 2020, primarily because they demand hot water, which is produced using fossil fuels in many households. Furnaces and boilers also account for 104 kt of the total reductions. The appliances that only consume electricity account for a smaller portion of the emissions reductions (54 kt in 2020).

Figure 5: Forecasted annual GHG emissions reductions by appliance, 2020



In addition to reducing GHG emissions, the policy also causes a reduction in Criteria Air Contaminants (CAC). CACs are associated with air quality pollution, and have negative impacts on human and ecosystem health. Figure 6 shows the projected reduction in CAC emissions that results from the policy's implementation. Similar to GHG emissions, reduction of CAC emissions occurs both within a household and at the point of electricity generation. In the model, most reduction of SO_X emissions is at the point of electricity generation, while for other CACs it is at the household during fuel combustion.

Figure 6: Annual Criteria Air Contaminant (CAC) reductions from policy implementation (including both direct and indirect CAC reductions)



4.1.2 Impacts of policy on government revenue

A change in appliance tax treatment could affect federal government revenue in two main ways. First, the extra fee on low efficiency appliances would tend to increase revenue while the rebate on high efficiency appliances would tend to decrease revenue. The actual change in government revenue depends on the behaviour of households in selecting appliance efficiency. Second, households may choose to reduce their appliance purchases if they find appliances to be too expensive after the policy is implemented, thereby reducing the number of appliances sold and government revenues.

For the Base policy, government revenue increased by $21M in 2010 and $67M in 2020 (2003 dollars). The main driver behind this increase is that low efficiency appliances continue to capture a greater market share than high efficiency appliances, so the number of appliances with the extra fee outweighs those with the rebate.

Our estimates do not include impacts on government revenue from expenditures on other household items or services. If the policy changes expenditure on appliances, it will probably also change expenditure on other goods and services, and therefore government revenue. Our estimates also do not include any government costs associated with administering and monitoring of the policy.

4.1.3 Impacts of policy on employment

A change in appliance tax treatment could also affect employment in several ways. First, the policy generally encourages households to purchase more expensive appliances, so retailing revenues and the number of manufacturing, wholesaling, and retailing jobs are likely to increase. Second, households may reduce their appliance purchases, therefore reducing the associated jobs. Third, if households increase their total spending on appliances (in terms of purchasing and energy costs), they will have less disposable income to purchase other goods and services, and the employment associated with other purchases or services may decline.

Overall, the policy causes an increase in direct employment of 677 jobs in 2010, rising to 743 jobs in 2020. As discussed in Section 3, these estimates exclude the indirect employment effects of the policy, which are likely to at least partially offset the increase in employment.

4.2 Results for alternative policy specifications

The Base case described above is based on a specific schedule of tax changes for appliances with different energy efficiencies. Many alternative designs exist that produce different results. In this section, we present and discuss results for several alternative policy specifications.

Table 10 shows the general results for the alternative policy specifications described in Table 8 (the rebate and fee for each policy are illustrated in the parentheses). More stringent policies (high rebate, high fee) have a greater environmental effect in terms of energy consumption and GHG and CAC emissions. More stringent policies also cause greater reductions in government revenue because more households are encouraged to purchase energy efficient appliances and the rebate for these appliances is greater. The increase in direct employment is also greater for more stringent policies because household spending on appliances increases.

Table 10: Results from alternative policy designs

Scenario	Annual GHG Reduction 2010 (kt)	Annual GHG Reduction 2020 (kt)	Annual Energy Consumption Reduction 2020 (GWh)	Annual CAC Reduction 2020 (t)	Annual Reduction/(Increase) in Gov't Revenue 2020 ($2003M)	Direct Job Increases 2020
Base (6%)	72	275	1,444	1,101	(67)	743
P1 (10%)	114	461	2,422	1,805	25	1,393
P2 (5%)	60	227	1,194	914	(72)	595
P3 (9%)	104	416	2,185	1,638	(8)	1,226

4.3 Results from sensitivity analyses

Any model is a simplification of the real world and to some degree produces uncertain results. Sensitivity analyses can be used to estimate the result's sensitivity to assumptions about the parameters. Table 11 shows the sensitivity of the results to key assumptions in the model as outlined in Section 3. In all cases, the policy simulated is the Base policy, as described in Table 8.

- ***Discount rate*** (S1) – The Base case analysis assumes a discount rate of 25%, consistent with empirical studies. If the discount rate is actually 10%, the environmental effectiveness of the policy is reduced as it produces 28% less GHG reductions and 29% less CAC reductions. A lower discount rate simulates fewer emissions reductions because most households already purchase energy efficient appliances in business as usual, and so the incremental effect of the policy is lower, even though more total households purchase Energy Star appliances.
- ***Reduction in Energy Star appliance discount rate*** (S2) – The Energy Star program may reduce the implicit discount rate for Energy Star appliances by improving consumer information about energy consumption and energy costs. However, if the program does not actually reduce the discount rate for Energy Star appliances, the policy produces 39% less GHG reductions and 36% less CAC reductions.
- ***Model elasticity*** (S3 and S4) – There is considerable uncertainty about the appropriate elasticity to realistically simulate appliance purchases. Few empirical studies have been conducted in Canada to ascertain the value of these elasticities. If the actual elasticity is only half the value used in the Base case, both GHG and CAC reductions are about 44% less. If the elasticity is 1.5 times greater than the value used in the base case, the GHG and CAC reductions increase by 29% and 30% respectively.
- ***Overall elasticity*** (S5) – The Base case analysis uses the assumption that the overall demand elasticity is 0.25. If the appliance sales are more sensitive to changes in appliance price (elasticity = 0.5), the policy yields a greater decline in the number of appliances sold and a slight increase in GHG and CAC emissions reductions. Conversely, if the overall elasticity is lower, the environmental effectiveness of the policy will diminish.
- ***Rebound effect*** (S6) – The Base case uses the assumption that the rebound effect is 0.2. If appliance utilization is less sensitive to changes in energy costs (rebound effect = 0.1), the increase in appliance utilization is lower and the policy yields a slight improvement in environmental effectiveness. If the rebound effect is greater, the emissions reductions will be lower than the Base case.
- ***Energy prices*** (S7 and S8) – The sensitivity analyses illustrate that the results are relatively insensitive to increases or decreases in energy prices. In each case, the change in emissions reductions did not exceed 3%.

Table 11: Sensitivity of results to uncertain assumptions

Scenario	Annual GHG Reduction 2010 (kt)	Annual GHG Reduction 2020 (kt)	Annual Energy Consumption Reduction 2020 (GWh)	Annual CAC Reduction 2020 (t)	Annual Reduction/(Increase) in Gov't Revenue 2020 ($2003M)	Direct Job Increases 2020
Base	72	275	1,444	1,101	(67)	743
S1	42	198	1,044	779	172	753
S2	56	167	863	700	(262)	120
S3	39	153	816	616	(3)	392
S4	96	355	1,848	1,436	(117)	934
S5	81	317	1,643	1,323	(63)	507
S6	79	301	1,574	1,187	(67)	743
S7	67	266	1,402	1,070	(47)	742
S8	76	282	1,477	1,126	(88)	738

4.4 Discussion of results

Several general observations emerge from the modelling scenarios described above:

- ***GHG reductions*** – Policy design has an important effect on GHG emissions reductions. For the policies analyzed here, emissions reductions are relatively linear with respect to policy stringency, indicating that emissions reductions increase by approximately the same increment as the policy becomes more stringent. Uncertainty in the model parameters translates into uncertainty about GHG reductions. GHG reductions are particularly sensitive to the discount rate used to select appliances, and the model elasticity. If the discount rate or model elasticity is lower than the values used in the Base case, the effectiveness of the policy may be reduced.
- ***CAC reductions*** – CAC emissions respond to the change in tax treatment similarly to GHG emissions. All policies and scenarios simulated reduce CAC emissions, however the magnitude of the reductions is dependent on policy design and input assumptions. CAC emissions are also similar to GHG emissions in that some reductions occur at the point of energy consumption while others occur at the point of electricity generation.
- ***Energy consumption*** – Energy consumption generally follows trends in GHG and CAC emissions. In the modelling, reductions in natural gas and electricity consumption account for 56% and 39% of total reductions, respectively.
- ***Fiscal impact*** – The net effect on government revenue is particularly sensitive to policy stringency. As the policy becomes more stringent, the rebate offered to energy efficient appliances increases and a greater number of households obtain the rebate by purchasing an energy efficient appliance. As a result, government revenue declines as the policy becomes more stringent. Furthermore, the fiscal impacts of the policy can change over time as government revises the Energy Star standards. If Energy Star appliances begin to capture a large portion of the

market, government could strengthen the standard so that the market share of Energy Star appliances declines.

- ***Employment impact*** – In all scenarios and policies tested, direct employment increases significantly. Direct employment increases in response to the policy because households are encouraged to purchase more expensive appliances, therefore increasing retailing, wholesaling and manufacturing revenues.

5 Policy analysis

Annex 4 of *The Budget Plan 2005* provides five criteria to judge potential policies that use the tax system to advance environmental goals. This section uses these criteria to evaluate the policy described in this report.

- ***Environmental effectiveness*** – whether or not a tax policy is effective depends on how well it is targeted, and whether supply and demand for the product is sensitive to changes in prices induced by the policy.

  The main objective of the policy described here is to reduce energy consumption and greenhouse gas emissions. Although there is a link between energy consumption and greenhouse gas emissions, the environmental effectiveness of the policy is tempered by the fact that it is aimed only indirectly at GHG emissions. In provinces where displaced electricity is hydroelectric or nuclear, reductions in electricity consumption may have little effect on GHG emissions.[31]

  The policy's effectiveness at reducing energy consumption and emissions is further conditioned by the use of the Energy Star label rather than the energy consumption of appliances. The Energy Star label separates appliances into two bins – one that qualifies and one that does not. As a result, there is no incentive for improvement of energy efficiency within either bin, only incentive for movement from one bin to the other.

  The policy being evaluated in this report is targeted at retail appliance consumers. For most appliances, the bulk of appliance sales are at retail outlets, but as shown in Table 4, homebuilders are responsible for a significant number of installations of certain categories of appliance. Since as conceived, homebuilders would not be affected by the policy, the effectiveness of the policy would be somewhat reduced.

  In terms of consumer price sensitivity, the policy would likely do well. Data on purchases of Energy Star appliances since 2001 show that consumers have quickly adopted many types of Energy Star appliances. Many empirical studies on consumer behaviour also show that consumers are extremely sensitive to up-front appliance costs.[32] In addition, research shows that consumers may respond

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[31] While a reduction in hydroelectric or nuclear generation may have little effect on GHG emissions, it may help mediate other environmental impacts, which have not been included in this analysis. For example, a reduction in electricity consumption may prevent utilities from building new hydroelectric facilities, which impact fish and wildlife habitat.

[32] Train, K., 1985, "Discount rates in consumers' energy-related decisions: A review of the literature", *Energy*, 10(12), 1243-1253.

positively to a government fiscal policy for appliances even beyond what the simple dollar value of the policy to the consumer would suggest.[33]

Taking into account most of these factors, we used a detailed demand model to determine the effect of the policy. We found that the policy would reduce annual energy consumption by 1,440 GWh (the equivalent of 45,000 single-family houses), GHG emissions by about 275 kt, and CAC emissions by about 1,100 tonnes in 2020.

- ***Fiscal impact*** – the proposed tax measure is composed of both a fiscal incentive towards the purchase of Energy Star qualified appliances and a fiscal disincentive to deter purchases of non Energy Star qualified appliances. The fiscal impact of the proposed tax measure on government revenue is dependent on the behaviour of appliance consumers. It is still possible to design a policy that is likely to be close to revenue neutral by adjusting the fiscal incentive and disincentive portions of the policy and using empirical estimates of consumer behaviour in a detailed model, as we have done here.

  The base policy illustrated here is projected to increase government revenue by approximately $67M (2003 dollars) in 2020. An alternative policy specification (9% rebate/9% fee) comes much closer to revenue neutrality.

- ***Economic efficiency*** – greenhouse gas and local air emissions resulting from appliance energy consumption impose social costs that are not reflected in the price of energy or the price of appliances. Examples of these negative externalities include the cost of adaptation to global climate change and health costs associated with urban air pollution. In addition to these externalities, analysts have identified an important market failure in electricity markets in Canada. Most of these use "average pricing" where electric utilities charge a rate for electricity that does not accurately reflect the cost of building new electricity supply, which is often much higher. As a result, consumers pay a lower price for electricity than they would in an efficient market, and so consume more electricity than is economically efficient.

  The tax measure evaluated in this report helps to address these market failures and in so doing should improve the efficiency of the economy. The modelling shows that the proposed tax measure would indeed lower greenhouse gas emissions, local air emissions, and electricity consumption, which suggests that it would help to address the market failures associated with environmental externality and with average pricing of electricity.

  There are likely to be few economic costs to firms associated with this policy, since the majority of appliances sold in Canada are imported from other countries. Overall, direct employment increases by 677 jobs in 2010 as a result of the policy

[33] Train, K. and Atherton, T., 1995, "Rebates, loans and customers' choice of appliance efficiency level", *The Energy Journal*, 16(1), 55-69.

because it increases retailing, wholesaling and appliance manufacturing revenues, while overall employment (direct plus indirect) is likely to remain fairly unchanged.

- ***Fairness*** – there are unlikely to be disproportionate effects of the policy on particular regions of Canada, which should improve the acceptability of the policy. In fact, the policy should increase fairness in Canada, since it is generally considered fair that polluters should pay a tax for pollution, and that consumers willing to adopt an environmentally friendly behaviour or technology should be exempt from the tax.[34]
- ***Simplicity*** – tax measures work best if they are relatively simple and can be easily communicated to and understood by taxpayers. The policy described here is based on the Energy Star label, which is already fairly well understood by Canadians, as a result of significant effort by the federal government in promoting the symbol.[35] As described, the policy is simple, with only two proposed tax levels, which consumers should understand if provided with enough information. The policy should also be fairly simple to administer for retailers, most of whom have experience with handling point-of-sale rebates.

[34] Department of Finance, 2005, “The Budget Plan 2005”, Government of Canada, Ottawa, p. 325.

[35] Aided/unaided awareness of the Energy Star label reached 80%/36% of survey respondents in a May 2005 survey conducted for Natural Resources Canada. Wilkins, A., 2006, “Energy Star in Canada: A Year in Review”, Energy Star Participants’ Meeting, Toronto, May 4-5, 2006.