Economic Instruments for On-site Renewable Energy Applications in the Residential/Farm Sector

Final Report

Prepared for Environment Canada

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Executive Summary

Renewable energy technologies can help meet household energy needs with reduced greenhouse gas emissions and local air emissions. Increasing distributed power sources also boosts the robustness of the country's energy networks, and not only reduces demand for centralized supply, but also reduces losses and costs that are associated with shipping or transmitting energy from its source to its end use. As such, the use of renewable energy in the residential and farm sectors is a potential tool in any comprehensive and sustainable energy, climate, and clear air strategy.

This analysis is focused on the application of solar water heating, ground source heat pumps, solar photovoltaics and small wind turbines in the residential and farm sectors. As summarized in Table E1, the performance, relative costs and potential benefits of these technologies vary significantly from region to region across Canada.[1] Nonetheless, the analysis demonstrates that certain technologies are more appropriate for different regions of the country based on the local renewable energy availability as well as the available mix and cost of conventional energy sources. It is also important to note that these cost estimates are reflective of today's reality, and future changes in the cost of renewable energy technology or conventional energy prices could significantly alter the values presented in Table E1.

It is also important to note that estimated costs for delivered electricity in Table E1 assume a 5% discount rate, a 20 year system life, full equity financing and no return on equity. The actual delivered energy and cost of a specific system will vary considerably and will depend in particular on the renewable resource and the means of financing.

Table E1: Technology cost summary

	Solar Hot Water		Ground Source Heat Pump		Electricity			
Region	**Convent. Energy Cost (¢/kWh)**	**Solar Cost (¢/kWh)**	**Retrofit Payback (years)**	**New Installation Payback (years)**	**Grid (¢/kWh)**	**3 kW Solar PV (¢/kWh)**	**2 kW Wind (¢/kWh)**	**10 kW Wind (¢/kWh)**
British Columbia	8.7	18.7	26	18	6.3	60.1	99	36
Prairies & North	6.9	12.0	230	187	11.0	44.0	28	14
Manitoba	7.1	13.0	22	19	6.0	47.2	36	17
Ontario	10.2	14.5	35	26	11.5	50.8	36	17
Quebec	8.6	15.4	12	9	7.3	55.0	36	17
Maritimes	14.4	15.1	12	9	9.7	55.0	48	20

Table E2 illustrates the potential impacts of the alternative energy systems considered in this report if they are deployed to their full potential in the Canadian residential and farm sectors over the next ten years. The impacts are presented in terms of annual energy savings and annual greenhouse gas emissions reductions. The assumptions made for this analysis are intended to

[1] The five regions in Table E1 were evaluated using data from single cities, which were selected as the most representative of the opportunities in their regions. Because of this simplification, it is important to emphasize that individual projects in any region (particularly those well outside the major cities) could have significantly better (or worse) performances and would require a more refined analysis.

represent the order of magnitude of the potential for these technologies, and they should not be viewed as a comprehensive technical or economic modeling exercise.

Table E2: 10-year alternative technology energy saving and greenhouse gas reduction potential

	Solar Hot Water		Ground Source Heat Pumps		Solar Photovoltaics		Small Wind	
Region	**Energy Savings (GWh/yr)**	**GHG Savings (kt_{CO2e}/yr)**	**Energy Savings (GWh/yr)**	**GHG Savings (kt_{CO2e}/yr)**	**Energy Savings (GWh/yr)**	**GHG Savings (kt_{CO2e}/yr)**	**Energy Savings (GWh/yr)**	**GHG Savings (kt_{CO2e}/yr)**
British Columbia	3,769	680	126	5	2,256	1,220	3	2
Prairies & North	6,148	1,100	-	-	3,339	1,800	29	16
Manitoba	897	480	54	29	775	420	6	3
Ontario	13,267	2,380	465	12	7,303	3,940	23	12
Quebec	5,606	3,030	676	365	4,679	2,530	17	9
Maritimes	2,544	460	163	23	1,350	730	7	4

Despite the potential of the technologies and the apparent interest and support from consumers, experience has shown that a variety of barriers currently limit deployment:

- *Information/awareness barriers* which occur where the public, government or industry misunderstands or is unaware of certain aspects of a given technology that would potentially be in its best interest if the information in question were accurately communicated;
- *Industry capacity/training barriers* which occur where the renewable energy technology industry (i.e., manufacturers, designers, installers, etc.) lacks sufficient skills or labour to deliver a given technology to market in its full potential;
- *Market development/availability barriers* which occur where the limited development of a renewable energy technology's market limits the further development of that technology;
- *Regulatory barriers* which occur where government or utility regulations limit or prevent the deployment of renewable energy technologies;
- *Cost/price barriers* which occur where the mix of capital and operating costs of renewable energy technologies relative to conventional options prevents or discourages consumers from purchasing them; and
- *Technology barriers* which occur where the current development status or inherent characteristic of a technology limits its deployment or benefit. These barriers are more common in emerging technologies, but some are still relevant to the four technologies discussed in this analysis.

Due to these barriers, market intervention, at least in the short term, is required if governments want renewable energy to make a significant contribution to an overall climate change and clean air strategy. Economic instruments are one set of tools available to government. These types of tools have been grouped according to those targeted at manufacturers (e.g., tax incentives and rebates/refunds), those designed to decrease capital costs for consumers (e.g., rebates/refunds, property or income tax credits, sales tax rebates, leasing schemes and low interest loans), and those designed to reward system performance (e.g., feed-in tariffs, tradable renewable energy certificates, emissions offsets and production incentives).

Given the long list of potential economic instruments, comparing and contrasting them would be difficult or impossible without a set of clear criteria. The criteria established and used by this research are described in Table E3.

Table E3: Policy Evaluation Criteria

Criteria	Explanation
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?
	Can the policy be used to remove market limits (e.g., encourage power storage)?
	Can the policy apply to systems that sell into the grid as well as meet host load?
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?
	Is there a one-time cost or on-going costs?
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?
	Are the systems needed to support the policy already in place?
	Would the policy require monitoring and reporting systems that are not currently established?
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?
	Will renewable energy industries support the policy?
Fairness	Is there fairness with respect to level of income and the ability to benefit from the measure?
	How would the policy affect different income classes?
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?
	Are there any existing policies that might conflict with the proposed policy?
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?
	Is the instrument applicable to rental and owner-occupied units alike?
Flexibility to be Performance-based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?
Ability to Address Non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeking out the payback of a technology.
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to

Criteria	Explanation
	vary by region?
	Will the policy be supported by urban and rural stakeholders?
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?
	Are there perverse incentives that come into play?
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal level or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology?
Flexibility to Respond to Unforeseen/Unexpected Results	How readily can the policy be adjusted if its goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?

Using the same three broad groupings of economic instruments introduced above, some of the general conclusions that can be drawn from a populated version of Table E3 are described below:

- *Instruments targeted at manufacturers:* While these instruments can provide focused support to the renewable energy products industry in Canada, their contribution is potentially limited because they are less transparent to the public than other instruments, and they raise concerns about trade rules. They are a useful complement to policies targeted at end users because it is important to increase access and supply of renewable technologies in concert with increasing demand.
- *Instruments designed to decrease capital costs for consumers:* These instruments are relatively simple to administer and have the flexibility to adjust the incentive to provide different levels of support to different market segments or technologies. A concern with these types of instrument is that it is difficult to monitor system performance because incentives are based on system deployment rather than on performance.
- *Instruments designed to reward system performance:* These instruments provide the strongest links to the benefits of renewable energy by focusing on energy and emissions as opposed to the number of systems. They can have high administration costs for small systems, however, so the overall cost-effectiveness is likely to be low for the residential and farm sectors.

Based on a review of policy options against the criteria presented in Table E3, a combination of capital cost reductions and financing are recommended. Together, these types of economic instruments will help reduce the higher cost of renewable energy so that it is closer to conventional energy, while also providing the means for consumers to cover the large capital burden of these systems. At the same time, this mix of instruments can provide a highly visible package to consumers that is administratively simple and cost-effective.

To help advance the process of supporting renewable energy technologies in the residential and farm sectors, three next steps have been identified:

1. *Select a mix of technologies.* At present, the specific technologies that are going to be supported have not been selected. This analysis helps initiate that discussion by providing information about the market potential, economics and environmental benefits of

different technologies across the country. As the first next step, those characteristics need to be weighed against one another to determine what mix of technologies will be supported. That mix needs to reflect the extent to which costs, benefits and potential vary significantly from one region to another.

2. *Prioritize instruments.* Although a mix of capital cost reductions and capital financing has been recommended, that recommendation does not prioritize the specific instruments within those categories (e.g., rebates versus tax credits, or loans versus local improvement charges). Making this selection is an important next step, and the decision will depend on: 1) the size of the incentive available through the instrument versus the size required to spur market change; 2) the segment(s) of market being focused on; 3) the level of government implementing the policy; and 4) the relationships between governments and other partners (e.g., financial institutions, utilities and leasing agents).
3. *Choose the amount of the incentive.* This critical action will ideally be based on the expected lifetime performance benefits (energy produced, emission reductions) of the system so as to be large enough to encourage the desired level of market uptake. This analysis has provided some insight into the economics of these technologies to help make this decision; however, additional challenges that relate to how consumers make investment decisions also need to be accounted for.

In moving forward on these next steps, it is important to remember that the choice of economic instruments is just one piece of the puzzle. Two other key considerations also need to be addressed in any strategy to develop a market for renewable energy technologies in the residential and farm sectors:

- Since the variety of barriers present in the current market extends beyond cost, a mix of policy tools (i.e., not only economic instruments) will be needed to overcome them.
- To succeed, any policy instrument needs to have clear long-term commitments. Incentives can decrease over time, but the timing and scale of decreases need to be widely communicated in advance to maintain a strong investment environment.

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Final Report

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1 Introduction

Renewable energy offers the promise of electricity and heat with significantly reduced environmental impacts compared to conventional energy sources. The federal and provincial governments in Canada are having increasing success with their efforts to help establish a market for large-scale renewable projects, but markets for smaller scale projects have not developed as quickly. Smaller scale systems allow individuals to participate in reducing their own energy costs and emissions, and they help to reduce the demand on energy networks such as electric grids and natural gas pipelines. Throughout the world, there is a growing interest in net zero energy buildings and communities, and in the benefits of power grids based on distributed generation sources. Small-scale renewable energy systems on individual residences or farms address both of these objectives.

This report focuses on those smaller projects, with the particular purpose to:

1. Understand the potential for deployment of low-impact renewable energy technologies in the residential and farm sectors, and the resulting environmental benefits of that deployment.
2. Understand the economic instruments that could be used to accelerate the deployment of renewable energy in the residential and farm sectors.

Renewable energy technologies can help meet household energy needs with reduced greenhouse gas emissions and local air emissions. Increasing distributed power sources also boosts the robustness of the country's energy networks, and not only reduces demand for centralized supply, but also reduces losses and costs that are associated with shipping or transmitting energy from its source to its end use. As such, the use of renewable energy is a potential tool in any comprehensive and sustainable energy, climate and clear air strategy.

In addition, Canadians are also placing environmental concerns (and climate change in particular) on a higher and higher standing. A snapshot of recent polling results shows strong support for renewable energy as part of the solution to environmental concerns, although minimal focus was provided to the smaller scale renewable energy options suitable for the residential or farm sectors. Some polling highlights include:

- More than 85% of Canadians are concerned about climate change, with more than half being extremely or definitely concerned. The federal government comes to mind first for 42% of Canadians when asked who should be leading the response to climate change.[2]
- Focus group sessions in Toronto, Montreal and Calgary revealed a sense of urgency for government action on environmental issues and a sense that consumers are more willing to embrace "green technologies" if they are provided incentives.[3]

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[2] Ekos Research Associates, "Public Perceptions of Climate Change" (report prepared for Natural Resources Canada, 2005).

[3] Ipsos Reid, "Qualitative Research on Broad Approaches to Addressing Climate Change" (report prepared for Environment Canada, 2005).

- More than 85% of Canadians support the use of green power as a source of electricity in Canada, and roughly 50% of Canadians would be willing to pay between $5 and $20 more per month for green power. Almost 90% of Canadians were of the opinion that it is important or very important for federal and provincial governments to work together to develop green power sources in Canada over the next 20 years.[4]
- More than 95% of Canadians support the continued development of wind energy, while 92% support the construction of a project for their community and more than 70% would like to invest in such a project. Very few Canadians are aware that wind energy could be utilized at a residential scale, but most were open to the idea for rural areas. Barriers to local installation included concerns about noise, aesthetics and costs (with estimates ranging from $500 to $20,000).[5]

Despite the potential of the technologies and the apparent interest and support from consumers, experience has shown that a variety of cost and awareness barriers currently limit deployment. If governments want renewable energy to make a significant contribution to an overall climate change and clean air strategy, market intervention is required, at least in the short term.

Since supporting residential scale renewable energy is a broad research topic, the scope of this research has been delineated by 1) the types of buildings under consideration; 2) the technologies under consideration; and 3) the types of policies under consideration.

Building Type Scope
Included in the analysis are any buildings covered by Part 9 of the National Building Code. This includes single-family detached and attached row housing (both new and existing, urban and rural). Farms are also included, but only in cases where the farm is also the primary residence.

Technology Scope
Included in the analysis are solar water heating,[6] ground source heat pumps,[7] solar photovoltaics,[8] and small wind turbines.[9] Solar air heating (Solarwall® in particular), micro-hydro and combustible biomass (e.g., wood stoves) have been excluded from this study since wide-scale application of these technologies in the residential and farm sectors throughout Canada is somewhat limited.

Policy Scope
This analysis is limited to economic instruments, which include sales tax rebates, income tax credits, capital cost buy-downs, production incentives, mixed buy-down production incentives and reduced interest rate loans. Many other types of policy instruments are

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[4] Oracclepoll Research, "National Survey Report on Green Power" (report prepared for Pollution Probe, 2004).

[5] Ipsos Reid, "Public Attitudes Towards Wind Power" (presentation prepared for the Canadian Wind Energy Association, 2005).

[6] Solar hot water heating uses the sun's heat to pre-heat water for use in standard household hot-water systems. As a result, less electricity or natural gas is needed to heat the water to standard temperatures.

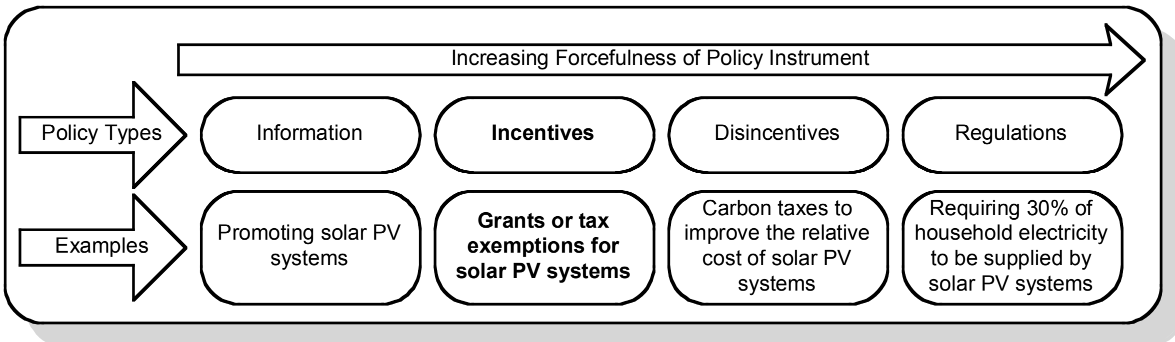
[7] Ground source heat pumps (also known as earth energy systems or geo-exchange systems) use a heating fluid to concentrate heat in the ground for heating and cooling purposes.

[8] Solar photovoltaics convert the sun's energy to electricity.

[9] Small wind turbines convert wind energy to electricity.

available to encourage renewable energy: Figure 1 shows a spectrum of options. Finding the optimal balance between policy types is beyond the scope of this research, but based on the barriers discussed in Section 3, it is clear that economic instruments alone are not sufficient to develop a robust market for renewable energy technologies in the residential and farm sectors.

Figure 1: Spectrum of policy types available to support renewable energy in residential/farm sector



This report is structured as follows:

- Section 2 discusses the costs, the technical potential and the potential uptake of the different technologies in Canada. The technical potential is intended to communicate the potential outcome of a comprehensive market transformation strategy that has overcome most of the barriers currently limiting the deployment of renewable energy in the residential and farm sectors.
- Section 3 summarizes the barriers limiting the adoption of those technologies, which include those that can be overcome by economic instruments and others that necessitate other types of market development strategies.
- Section 4 reviews the existing programs supporting these technologies at the federal and provincial levels in Canada, and then provides an overview of the economic instruments that can be used to encourage deployment in the residential sector. The discussion of economic instruments also examines several specific examples in more detail.
- Section 5 assesses the different economic instruments based on a list of criteria and introduces several additional factors that have important implications for the level of success achieved by a given policy, but are not inherently linked with one type of policy versus another.
- Section 6 closes with some recommended next steps to help federal and provincial governments in Canada advance renewable energy in the residential and farm sectors.

2 Costs and Market Uptake Potential

This section explores the variability of costs and performances of alternative energy technologies in different regions across the country to illustrate their current cost competitiveness and their ability to displace emissions from traditional energy sources. The estimates are based on broad estimates of local renewable resources, installation and energy costs. The estimates could vary significantly for individual cases.

The methods used in this section of the report were employed in order to estimate the market potential based on the current technical feasibility of installing the various renewable energy systems. This approach was taken because implementing incentives or even mandatory policies such as changes to building codes will invariably shift the current market attitudes. The assumptions outlined in this section, therefore, illustrate in most cases the upper end of market penetration that could be achieved with significant enough incentives.

2.1 Approach

Canada is a large country with a diffuse population and varying renewable resources across the landscape. Because the performance of renewable energy systems can vary significantly based on local conditions, and their respective returns on investment and environmental benefits depend on the locally displaced energy, the different technologies evaluated in this report were considered in six different regions of the country using local climate and energy costs to evaluate their performance. Levelized Energy Unit Costs (LEUC) and payback periods were calculated using current installation costs and current energy prices. No attempts were made to forecast rises in energy costs. While energy costs are very likely to fluctuate in the future, the current analysis is intended to provide a snapshot of the status of the various technologies as they stand in 2007. Greenhouse gas and local air pollution reductions were also estimated for each technology based on the fuel that they are likely to be displacing in each region in the case of heating systems, while in the case of electrical systems a Single Cycle Natural Gas (SCNG) was assumed to be displaced in all regions.

2.1.1 Representative Cities

In order to illustrate variations in national energy consumption and price, without modeling each individual case, representative cities were selected to represent various regions in the country. The regions were chosen based on climate and energy sources. Notably, Manitoba is not included with the other Prairie provinces because its electricity is hydro-based as opposed to coal. While significant refinement is clearly possible, and important for any specific case, the following six regions were selected to exemplify national variability: British Columbia, Prairies and the North, Manitoba, Ontario, Quebec and the Maritimes.

Renewable resource data and energy prices were used for one representative city in each region: Vancouver, Calgary, Winnipeg, Toronto, Montreal and St. John. Clearly variations exist within each region, but on balance many differences will cancel each other out. The overall outcome is therefore rough, but does provide an indicative view of the country's opportunities. Specific refinements could be made to improve accuracy in future studies.

The selected cities and the region that they were chosen to represent for this study are listed in Table 1 along with the region's respective populations and housing stocks.[10] Weather data and energy costs were used from each representative city for urban, rural and farm categories. Where appropriate, the outcomes for each technology were multiplied by the number of houses in the region.

Table 1: Canadian population breakdown in 2006

Region	Representative City	Population (1000's)			Houses (1000's)		
		Urban	Rural	Farm	Urban	Rural	Farm
British Columbia	Vancouver	3,665	593	69	1,027	166	16
Prairies & North	Calgary	3,456	718	329	975	202	84
Manitoba	Winnipeg	847	259	72	258	79	17
Ontario	Toronto	10,775	1,742	204	2,824	457	48
Quebec	Montreal	6,166	1,403	100	1,886	429	26
Maritimes	St. John	1,256	1,048	26	374	313	8
Sub-Total		26,165	5,763	800	7,345	1,646	199
Total				**32,728**			**9,190**

Material available online through Statistics Canada was used.[11,12,13,14,15,16,17] This data included 2001 Census information. Where possible, the most recent sources of data were used. Where current (2006) data were not available, the existing data and trends were used to establish relevant figures. Publicly available information from the 2006 Census is currently limited. Appendix A lists overall housing stock.

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[10] Single attached, single detached and mobile houses are included, while apartments are not.

[11] CHASS, "Distribution of Farms, by Farm Type and Net Operation Income Group, Incorporated and Unincorporated Sectors" (Canada and Provinces, CANSIM II Table 20048), dc2.chass.utoronto.ca.ezproxy.lib.ucalgary.ca/cgi-bin/cansim2/getArray.pl?a=20048 (accessed January 20, 2007).

[12] Statistics Canada, "Statistics Canada Online Summary Tables, Censuses of Agriculture and Population" (farm population, by province), www40.statcan.ca/l01/cst01/agrc42g.htm (accessed January 20, 2007).

[13] Statistics Canada, "Statistics Canada Online Summary Tables, Population Urban and Rural" (by province and territory), www40.statcan.ca/l01/cst01/demo62g.htm (accessed January 20, 2007).

[14] Statistics Canada, "Statistics Canada Online Summary Tables, Census of Population, Private Households by Structural Type of Dwelling" (by province and territory), www40.statcan.ca/l01/cst01/famil55a.htm (accessed January 20, 2007).

[15] Statistics Canada, "Statistics Canada Online Summary Tables, Housing starts" (by province, CANSIM table (for fee) 027-0008, Canada Mortgage and Housing Corporation), www40.statcan.ca/l01/cst01/manuf05.htm (accessed January 20, 2007).

[16] Statistics Canada, "Population of Canada," www.statcan.ca/start.html (accessed January 20, 2007).

[17] Canadian Mortgage and Housing Corporation, "Occupied Housing Stock by Structure Type and Tenure, 1991–2001," www.cmhc-schl.gc.ca/en/corp/about/cahoob/data/data_007.cfm (accessed January 20, 2007).

Some of the energy technologies are much better suited to new homes than as retrofits. Ground source heat pumps, for example, require significant disturbance to a home and lot and are thus more easily installed when a house is under construction. Heat pumps as well as solar systems can also operate more efficiently and be installed at reduced costs if a house is designed to accommodate them. Therefore, new home forecasts were also collected for housing in each region. They are listed in Table 2 below. Since the number of farmhouses for much of the country is in decline, the forecast for new farmhouses was left at zero.

Table 2: Annual Housing Starts by Region

Region	New Houses per Year			
	Urban	Rural	Farm	Total
British Columbia	18,355	3,316	0	21,671
Prairies and North	21,961	6,656	0	28,617
Manitoba	2,223	869	0	3,092
Ontario	48,760	8,808	0	57,568
Quebec	29,665	7,232	0	36,897
Maritimes	4,688	4,011	0	8,699
Total	125,653	30,891	0	156,543

2.1.2 Energy Consumption and Costs

The appropriateness and value of any renewable technology depends not only on the local resource, but on the fuel it is displacing. A typical home was modeled for each of the representative cities including space-heating demand, hot water heating demand and electrical appliance demand. These demands were modeled using the HOT2XP software developed by NRCan.

A "typical house" was established based on the current housing stock and new housing construction trends — based on publications from Statistics Canada, Natural Resources Canada (Office of Energy Efficiency) and the Canadian Mortgage and Housing Corporation.[18,19,20] The typical house assumed a 135 square metre floor plan, a fully insulated basement and a 1980 construction, with an occupancy of two adults and two children. This model home was then "moved" to each of the representative cities. The results, listed in Table 3, do not include any furnace and hot water heating efficiencies (i.e., energy demand only). Details of the modeled house can be found in Appendix B. In the current study, apartments were not include,

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[18] Statistics Canada, *Farm Financial Survey* (Whole Farm Data Projects Section, Cat No. 21F0008XIB, ISSN 1481-8213) (Ottawa, Ontario: Statistics Canada, 2006).

[19] Natural Resources Canada, *Energy Use Data Handbook, 1990 and 1998 to 2004* (Energy Publications, Cat. No. M141-11/2004E, ISBN 0-662-43662-8) (Ottawa, Ontario: Office of Energy Efficiency, Natural Resources Canada, August 2006).

[20] Natural Resources Canada, *2003 Survey of Household Energy Use (SHEU) Summary Report* (Energy Publications, Cat. No. M144-120/2003-1, ISBN 0-662-69565-8) (Ottawa, Ontario: Office of Energy Efficiency, Natural Resources Canada, December 2005).

Table 3: Model home assumptions

	Electricity			Hot Water		Space Heating	
	Appliances	Fans for Heating	Space Cooling	Demand	Source	Demand	Source
	(kWh/yr)	(kWh/yr)	(kWh/yr)	(kWh/yr)		(kWh/yr)	
British Columbia	8,500	341	3,300	4,722	Natural Gas	11,260	Natural Gas
Prairies and North	8,500	727	3,090	4,833	Natural Gas	24,070	Natural Gas
Manitoba	8,500	731	4,400	4,722	Electricity	29,550	Electricity
Ontario	8,500	475	4,480	4,250	Natural Gas	17,680	Natural Gas
Quebec	8,500	560	4,665	4,711	Electricity	21,560	Electricity
Maritimes	8,500	550	3,610	4,583	Heating Oil	20,940	Heating Oil

The websites of several utilities from across the country were accessed in order to determine current energy prices (for electricity, home heating oil, natural gas). Table 4 lists the assumed cost for customers in each region. These prices include transmission and delivery fees but do not include demand fees, fee rate steps or fixed costs such as administration or connection fees. For simplicity, farming rates were not treated differently. Sources for the different rates are provided in Appendix C. A cost per energy delivered is calculated for each renewable energy technology based on an annualization of the capital cost over the lifetime of the technology divided by the estimate of energy delivered annually. For the purposes of this report, it was recommended by Environment Canada that a 5% discount rate be assumed for the annualization calculation.

Table 4: Energy costs

	Electricity	Heating	
	Cost (¢/kWh)	Source	Cost (¢/kWh)
British Columbia	6.3	Natural Gas	4.8
Prairies and North	11.0	Natural Gas	3.8
Manitoba	6.0	Electricity	6.0
Ontario	11.5	Natural Gas	5.6
Quebec	7.3	Electricity	7.3
Maritimes	9.7	Heating Oil	7.9

Table 5 lists the assumed displaced emissions for the traditional fuel sources provided by the Office of Energy Efficiency for the purposes of this report.[21] While there are open discussions about the marginal emissions displaced in many parts of the country, Environment Canada requested that single cycle natural gas serve as the displaced marginal electricity generation source in every region. It should be noted that if very significant uptakes of the renewable energy systems discussed in this report are eventually realized, the displaced fuels become "base load" fuels which in Canada are typically coal and nuclear.[22] For each technology, the displaced energy

[21] Office of Energy Efficiency, Energy Technology and Programs Sector, 1 Observatory Crescent, Building 5, Ottawa, ON, K1A 0E4; Phone: 613-944-5138

[22] Hydro is also a common base load in Canada, but because it can be stored easily it is not typically "offset" by other renewables, rather its use is shifted.

calculations are included so that readers have the option to calculate emissions or monetary savings based on different assumptions.

Table 5: Energy emission factors

	Electricity	Residential Natural Gas	Residential Heating Oil
GHG (kg_{CO2eq}/kWh)	0.540	0.179	0.263
NO_x (g/kWh)	0.431	0.143	0.212
SO_2 (g/kWh)	0.003	0.001	0.214
PM_{10} (g/kWh)	0.034	0.011	0.011
$PM_{2.5}$ (g/kWh)	0.034	0.011	0.008
VOC (g/kWh)	0.023	0.008	0.006
CO (g/kWh)	0.200	0.066	0.055

2.2 Solar Water Heating

2.2.1 Technical Assessment

Solar water heating is a mature technology common in many other countries including those where some form of freeze protection is needed. Canada supported a significant solar water heating industry in the 1980s, with collector and system manufacturers producing significant production runs in most regions of the country. This period of development showed that there were no major physical or technical barriers preventing the adoption of solar for water heating in Canada.

Solar hot water heating systems could be added to a majority of homes in Canada. Since houses in valleys and heavily wooded neighborhoods have lower insulation rates, they would be much less likely to use the systems. Houses using solar water heating in most cases mount collectors (and small solar PV for fluid circulation if used) on south-facing roofs and locate the heat exchanger and hot water storage tank where a conventional water heater is typically situated. This may prevent some individual houses from retrofitting solar hot water systems. Otherwise, there are no technical barriers for existing or new homes.

A RETScreen™ analysis for solar water heating was done for each representative city. Solar heating system costs were based on the recent Canadian Solar Industry Association report, *The Price of Solar Water Heating in Canada*.[23] The estimates were based on a survey of 11 solar hot water heating manufacturers in Canada. It found that solar domestic hot water systems had average installation costs of $5,500 for typical 2 x 2.97 square metre installation ($920/m^2 or 1,300$/kW). This cost was used as the reference installed cost for all regions. Table 6 lists the model results from the RETScreen™ analysis. Estimated costs for delivered electricity assume a 5% discount rate, a 20 year system life, full equity financing and no return on equity. The actual delivered energy and cost of a specific system will vary considerably and will depend in particular on location, orientation, and the means of financing.

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[23] Canadian Solar Industry Association, *The Price of Solar Water Heating in Canada* V2.4, May 2006. Available for download at www.cansia.ca/downloads/report2006/C20.pdf (accessed Jan 15, 2007).

As indicated in Table 6, in almost all regions of the country, a solar hot water heating system can meet over 50% of the hot water heating demand. The Prairies represent the most favorable region for solar hot water heating. There, a system can provide approximately 3,600 kWh — or 75% — of the 4,800 kWh annual demand. Even in the regions of the country with the poorest solar resource, namely the west coast of British Columbia, a solar system can provide approximately 2,300 kWh — or 48% — of the annual 4,700 kWh demand.

Table 6: Solar hot water heating system results

	Energy Delivered	Displaced Fuel				Cost of Solar	Annual Savings
	(kWh/yr)	Type	Cost (¢/kWh)	Efficiency	End Use Cost (¢/kWh)	(¢/kWh)	$
British Columbia	2,360	Nat. Gas	4.8	55%	8.7	18.7	172
Prairies & North	3,670	Nat. Gas	3.8	55%	6.9	12.0	180
Manitoba	3,390	Electricity	6.0	85%	7.1	13.0	239
Ontario	3,040	Nat. Gas	5.6	55%	10.2	14.5	232
Quebec	2,860	Electricity	7.3	85%	8.6	15.4	246
Maritimes	2,930	Nat. Gas	8.3	55%	14.4	15.1	347

The cost-effectiveness of solar water heating varies significantly across Canada, depending both on the solar resource and the fuel it is displacing. It should be noted that the energy that a solar water heater displaces is dependent on the fuel and the efficiency of the system that it is preheating. While specific examples were chosen for this study, it is important to remember that a variety of energy sources are used within in each province. For example, in a residence in Ontario with an electric water heater, with an electricity cost of 11.5 cents per kWh and a tank efficiency of 85% (15% of energy is lost due to losses from the tank to the surrounding air), the cost of delivering end-use heated water is 13.5 cents per kWh — almost the same as the cost of solar heating.

Table 7 lists the air emissions including greenhouse gases (GHG), nitrogen oxides (NO_x), sulfur oxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), volatile organic compounds (VOC) and carbon monoxide (CO) that are offset for each year a solar hot water system is in operation in each region. Where the solar hot water systems are displacing fossil fuels, these emissions are reduced locally; in cases where electricity is used, these emissions are reduced at the source of the electricity generation.

Table 7: Air emissions displaced by solar hot water heating systems

	Displaced Energy		Displaced Air Emissions						
	(kWh/yr*)	Type	GHG (t_{CO2e}/yr)	NO_x (g/yr)	SO_2 (g/yr)	PM_{10} (g/yr)	$PM_{2.5}$ (g/yr)	VOC (g/yr)	CO (g/yr)
British Columbia	4,290	Nat. Gas	0.7	614	4	48	48	33	284
Prairies & North	6,670	Nat. Gas	1.1	955	6	74	74	52	442
Manitoba	3,990	Electricity	2.0	1720	11	134	134	93	796
Ontario	5,530	Nat. Gas	0.9	791	5	62	62	43	366
Quebec	3,360	Electricity	1.7	1451	9	113	113	79	672
Maritimes	5,330	Heating Oil	0.9	763	5	59	59	41	353

* Includes efficiency losses of conventional source, i.e., BC = 2,360 kWh ÷ 55 % efficient water heater = 4,290 kWh.

2.2.2 Pricing Variations

Price variations were compared to a recent Canadian Solar Industry Association (CanSIA) pricing report, and by and large the system cost is very close to the reported average of $5,500.[23] Detailed cost breakdowns were provided by two system suppliers in Ontario. These suppliers also identified areas of potential cost savings, and their quotes are included in Appendix D. As noted in the next section, current Canadian costs reflect low production runs by a very small number of manufacturers. Much lower costs would be expected in a developed market similar to those found in jurisdictions such as Austria or Germany.

2.2.3 Potential Market Impacts

The 2004 report, *Smart Generation: Powering Ontario with Renewable Energy* estimated that 63% of homes in Ontario could be fitted with solar hot water (SHW) heating systems.[24] This number was based on housing orientation that could take advantage of southern exposure and seasonal patterns and sufficient roof space (6 m^2). The same report estimated that if new homes are built to consider SHW systems this number could rise to 77% by the year 2025. These estimates are based on a random alignment of houses, and there is no reason not to use them for the rest of the country. They may in fact be conservative estimates: communities including Perth, Ontario and Bathurst, New Brunswick have done estimates in their towns and suggested that over 70% of existing houses could be retrofitted with SHW systems. It can therefore be assumed that close to 60% of the current housing stock could install SHW systems, and close to 75% of new houses could be built to accommodate such systems.

Recognizing that some form of solar rights legislation would be needed in each province for this potential to be realized, Table 8 lists the technically reachable market potential in Canada.

Table 8: 10-year maximum solar hot water heating Canadian market potential

	New Houses (75%)		Existing	Total	Annual Savings		
Region	Per Year	10-year	60% Retrofit		GWh	Fuel	Mt_{CO2e}/yr
British Columbia	16,260	162,600	715,800	878,400	3,769	Nat. Gas	0.68
Prairies and North	21,459	214,590	706,730	921,320	6,148	Nat. Gas	1.10
Manitoba	2,315	23,150	201,800	224,950	897	Electricity	0.48
Ontario	43,180	431,800	1,968,450	2,400,250	13,267	Nat. Gas	2.38
Quebec	27,675	276,750	1,389,355	1,666,105	5,606	Electricity	3.03
Maritimes	6,525	65,250	412,250	477,500	2,544	Heating Oil	0.46
Total	**117,410**	**1,174,100**	**5,394,385**	**6,568,525**	**-**	**-**	**8.12**

2.3 Ground Source Heat Pumps

2.3.1 Technical Assessment

Ground source heat pumps are very mature technologies that can technically be installed in almost any new home in the country. Retrofitting a heat pump can be more challenging especially on small lots where access might be limited.

For this study, it was assumed that any ground source heat pump would be installed to maximize its benefit by also providing hot water heating and space cooling. In each representative city, the

[24] David Suzuki Foundation, *Smart Generation: Power Ontario with Renewable Energy* (Vancouver, British Columbia: David Suzuki Foundation, 2004). Available for download at: www.davidsuzuki.org/_pvw370829/files/Climate/Ontario/Smart_Generation_full_report.pdf

ground source heat pump (GSHP) was assumed to provide 90% of the heating and 100% of the cooling needs of a home as well as an estimated 40% of the annual domestic hot water supply. An operating coefficient of performance of 3.2 was estimated for GSHP heating and of 4.5 for cooling using RETScreen International's medium efficiency assumptions. For each 3.2 net units of heat load supplied, one unit of electricity was required to run the pump.

Table 9 lists the model results for the heating and cooling savings respectively, assuming an 80% efficient furnace for natural gas and heating oil and 100% efficient electric baseboard heaters. Hot water efficiencies were assumed to be 55% for natural gas and heating oil and 85% for electric hot water heaters. Air conditioners were modeled with a 3.0 coefficient of performance.

Table 9: GSHP Heating Savings

	Space and Water Heating				Cooling			
	Displaced Fuel	Net Savings (kWh/yr*)	($)	(t_{GHG})	Displaced Fuel	Net Savings (kWh/yr)	($)	(t_{GHG})
British Columbia	Natural Gas	16,105	$465	0.3	Electricity	367	$18	0.2
Prairies & North	Natural Gas	30,590	$81	0.2	Electricity	343	$13	0.2
Manitoba	Electricity	20,025	$1,024	9.3	Electricity	489	$29	0.3
Ontario	Natural Gas	22,980	$381	0.2	Electricity	509	$29	0.3
Quebec	Electricity	15,110	$1,300	1.6	Electricity	518	$38	0.3
Maritimes	Heating Oil	26,890	$1,290	2.5	Electricity	401	$32	0.2

* Includes efficiency losses of conventional source, i.e., BC = 16,105 kWh = (11,263 kWh heating demand ÷ 80 % efficient furnace * 90 %) + (4,722 kWh water heating demand ÷ 55 % efficient hot water tank * 40 %).

A GSHP displaces space heating, water heating and air conditioning, all of which have various fuels and system efficiencies when supplied by conventional technologies. That variation makes it difficult to compare the cost per energy delivered by a GSHP directly to the traditional fuels that it is displacing without lumping all of the savings together. A simple payback estimate is presented for GSHPs in Table 10.

Installation costs were based on price quotes from various suppliers. It should be noted that costs will vary significantly based on the options that are installed with the system — such as in-floor heating or vertical versus horizontal heat exchanger loops. The costs estimates listed below were developed using installer quotes and varied using RETScreen with the size of system that would be required to meet the local heating demand in each region. In each case, it was assumed that the heat pump would be installed in place of a traditional heating and cooling systems: as a result, a credit of approximately $4,000 could be subtracted from the installation cost of a heat pump, in lieu of the air conditioners and the furnace or baseboard heaters that would not need to be installed.

Table 10: Net GSHP Savings Potential

	Net Annual Savings				Retrofit Install Cost	Simple Payback	New Install Cost	Simple Payback
	Nat. Gas (kWh)	Elec. (kWh)	($)	(t_{GHG})	($)	(years)	($)	(years)
British Columbia	16,105	(4,520)	$ 483	0.5	$ 12,500	26	$ 8,500	18
Prairies & North	30,590	(9,490)	$ 94	0.4	$ 21,500	230	$ 17,500	187
Manitoba	-	20,510	$ 1,054	9.5	$ 23,500	22	$ 19,500	19
Ontario	22,980	(6,795)	$ 475	0.4	$ 16,500	35	$ 12,500	26
Quebec	-	15,630	$ 1,338	9.9	$ 16,500	12	$ 12,500	9
Maritimes	26,890*	(8,200)	$ 1,322	2.7	$ 16,500	12	$ 12,500	9

* Heating oil

While a GSHP saves money in every jurisdiction, it should be noted that savings are highest in areas where electricity is inexpensive and/or the displaced heating fuel is expensive. Savings are most dramatic where houses use electricity for space and water heating, as is the case in many homes in Manitoba and Quebec. The significant energy and cost savings result from the fact that a GSHP is in effect three times more efficient than an electric heating system.

A GSHP has an estimated lifetime of approximately 50 years, although a new pump (at 25% of cost) will need to be replaced once during that period. The systems will pay for themselves during their lifetime in almost every region of the country. When they are installed in new homes, in many cases they will pay for themselves in less than 20 years.

GSHPs require a significant amount of electricity to operate. In cases where they offset electric heating, they are significant energy savers; when they are installed in place of fossil fuel (or wood) heating, they become an additional electric load on the provincial grid. In addition, they can offset significantly different amounts of greenhouse gas emissions depending on the electricity source in each jurisdiction. For the purposes of this study, it was assumed that the natural gas generated was the marginal fuel displaced for electricity. Wide-spread deployment of GSHPs may in fact displace and/or consume base-load electricity source which can in some cases improve and in other cases reduce the greenhouse gas savings potential.

Table 11 lists air emissions including greenhouse gases (GHG), nitrogen oxides (NO_x), sulfur oxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), volatile organic compounds (VOC) and carbon monoxide (CO) that are offset each year for each GSHP that operates in each region of the county. These emissions are reduced locally when a GSHP is installed in place of natural gas or heating oil furnaces. When a GSHP replaces electric space or water heating, these emissions are reduced at the source of the electricity generation.

Table 11: Ground Source Heat Pump Air Emissions Displaced

	Displaced Energy		Displaced Air Emissions						
	Nat. Gas (kWh)	Elec. (kWh)	GHG (t_{CO2e}/yr)	NO_x (g/yr)	SO_2 (g/yr)	PM_{10} (g/yr)	$PM_{2.5}$ (g/yr)	VOC (g/yr)	CO (g/yr)
British Columbia	16,105	(4,880)	0.3	199	1	16	16	11	92
Prairies & North	30,590	(9,840)	0.2	138	1	11	11	7	64
Manitoba	-	20,025	10.8	8,636	55	673	673	468	3,998
Ontario	19,000	(5,940)	0.2	140	1	11	11	8	65
Quebec	-	15,110	8.2	6,517	41	508	508	353	3,017
Maritimes	26,890*	(8,600)	2.4	1,996	5,721	18	(67)	(53)	(243)

* Heating oil

2.3.2 Potential market impacts

The ability to install the ground loops is often the largest technical barrier, because urban neighborhoods make it difficult to access the space necessary to install such equipment. Rural areas, for the most part, have fewer technical constraints, but access to installers and equipment may be more difficult.

New housing developments pose fewer problems not only due to the reduced costs at the time of construction, but also due to the ease of access to the ground, including under driveways and garages, before they are built. Costs can also be reduced by installing several systems in a new subdivision.

Because the size, costs and benefits of installing ground source heat pumps vary greatly by home, it is difficult to assess the overall market potential. At current prices, it seems less likely that GSHPs will have significant uptake in the Prairies, but other regions of the country — notably, the Maritimes, Quebec and Manitoba — have significant savings potential. Table 12 assumes that over the next ten years 10% of new homes in the Maritimes, Quebec and Manitoba are built with GSHPs; 5% of homes in British Columbia and Ontario are built with GSHPs; and no homes are built with GSHPs in the Prairies. Retrofits in all regions are considered insignificant.

Table 12: Example GSHP 10-year Market Impact

	New Houses	Assumed Uptake	Impact after 10-years			
Region	Per Year	Per Year	Units Installed	Elec. Savings (GWh/yr)	N.Gas Savings (GWh/yr)	GHG Savings (t_{CO2e}/yr)
British Columbia	21,670	5%	10,840	(49)	175	4,990
Prairies and North	28,620	0%	0	-	-	-
Manitoba	3,090	10%	3,090	54	-	29,420
Ontario	57,568	5%	28,780	(196)	661	12,390
Quebec	36,897	10%	36,900	676	-	365,365
Maritimes	8,700	10%	8,700	(71)	234*	23,240
Total	156,543		88,310	415	1,070	435,410

* Heating oil

2.3.3 Pricing Variations

System prices vary depending on the system size, installation options, local ground conditions and the use of vertical or horizontal loops. Prices also vary with the size of the house, its insulations levels and the local soil conditions. These variables also affect the system's performance and savings potential. Appendix D includes system quotes obtained for this study from installers which illustrate this pricing variation.

2.4 Solar Photovoltaic

2.4.1 Technical Assessment

Solar photovoltaic (PV) is a mature but still evolving technology. Modules have been in production for many years and tested in harsh environments like space and the arctic. Standard equipment and the balance of system components like inverters are now widely available for installation of a system and its interconnection with the grid. Solar PV is still a rapidly evolving technology, however. Over the next few years, new types of modules, interconnection and metering will make a solar PV system not only less expensive but easier to install and more able to provide power whenever it is needed and not only at peak periods.

Solar PV systems are modular, and since homeowners can feed any amount of power into the grid from a home-based system, there is no one standard system size that can be associated with a residential system. For this study, a 3 kW system has been chosen since it is representative a typical rooftop capacity for a household (20 m^2).

Most jurisdictions in Canada either already allow individuals to sell power back into the grid (e.g., through net metering), or they are investigating opportunities to do so. This is an important aspect of residential-scale renewable electricity sources as it eliminates the need for costly battery systems and in effect enables the grid to be used as a battery by selling power onto the grid when there is excess power generated. The analysis in this section assumes that the PV systems are grid-connected and therefore batteries are not required.

A RETScreen analysis was done for each representative city using a 3 kW system (which can be linearly scaled up to represent smaller or larger systems if desired). The price of solar PV systems was estimated based on conversations with system installers and reported case studies. For this analysis, solar PV costs were estimated at $6,000 per kW and installation / interconnection costs were estimated at $3,500 per kW for a total of $9,500 per kW installed. As with solar water heaters, this price reflects a small market. Table 13 lists the model results for typical 3 kW systems in each region, assuming a 25-year system life. The delivered cost of electricity is estimated assuming a 25-year system life, a 5% discount rate, no financing requirement, and no return on equity.

Table 13: Solar PV System Results

	System Size	Energy Delivered	Electricity Retail Price	Annual Savings or Revenue	PV Cost of Electricity
	(kW)	(kWh/yr)	(¢/kWh)	($)	(¢/kWh)
British Columbia	3.0	3,370	6.3	$212	60.1
Prairies & North	3.0	4,590	11.0	$505	44.0
Manitoba	3.0	4,290	6.0	$257	47.2
Ontario	3.0	3,980	11.5	$458	50.8
Quebec	3.0	3,670	7.3	$268	55.0
Maritimes	3.0	3,670	9.7	$356	55.0

The actual energy delivered and cost per kWh will vary considerably and will depend in particular on location, orientation, the means of financing, and the profit margin needed. For example, with 40% equity and 6.5% return on capital and interest rate the cost in Ontario would be between 77-83 cents/ kWh.[25] While the price of solar PV systems are expected to come down significantly over the next 5–10 years through technological development, mass production and market expansion, in the near term financial incentives such as a feed-in tariffs are needed to spur the Canadian market.

Table 14 lists air emissions including greenhouse gases (GHG), nitrogen oxides (NO_x), sulfur oxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), volatile organic compounds (VOC) and carbon monoxide (CO) that are offset annually for every 3 kW solar PV system that is installed in each region. These air emissions are not displaced at the home, but rather at the central electricity plant where they are created.

Table 14: Air Emissions Displaced per 3 kW Solar PV Installation

	Displaced Energy	Displaced Air Emissions						
	Elec. (kWh/yr)	GHG (t_{CO2e}/yr)	NO_x (g/yr)	SO_2 (g/yr)	PM_{10} (g/yr)	$PM_{2.5}$ (g/yr)	VOC (g/yr)	CO (g/yr)
British Columbia	3,370	1.8	1,452	9	113	113	79	672
Prairies & North	4,590	2.5	1,980	13	154	154	107	917
Manitoba	4,290	2.3	1,848	12	144	144	100	856
Ontario	3,980	2.1	1,716	11	134	134	93	795

[25] Solar Cost Calculator using Chabot-BSI Rate Methods. Ontario Solar Industries Association. http://www.wind-works.org/Solar/SolarCostCalculatorUsingChabot-BSi-RateMethods.html

Quebec	3,670	2.0	1,584	10	123	123	86	733
Maritimes	3,670	2.0	1,584	10	123	123	86	733

2.4.2 Potential Market Impacts

Based on roof sizes, housing orientation and solar exposure, the David Suzuki Foundation's 2004 report, *Smart Generation: Power Ontario with Renewable Energy*, estimates that 47% of the current housing stock in Ontario has roof space suitable for solar.[26] Since there is no reason to assume that the distribution of houses is vastly different in Ontario than in rest of the country, similar rooftop availability was assumed across the country. Efforts could be made to increase the available roof space with proper solar exposure in new houses, but for the purposes of this report, 47% was also assumed for houses built within the next ten years. This number is lower than the solar hot water uptake potential because of the larger roof size required for a 3 kW solar system — approximately 20 square metres compared to 6 square metres for solar hot water.

The results of this analysis can be seen in Table 15, which illustrates that the potential for household solar PV electricity generation is almost 20 GWh per year, roughly the equivalent of 5,500 MW power plants (given the typical size of a coal power plant).[27] This is an aggressive target requiring close to 15,000 MW of installed PV. It is important to keep in mind, however, that the solar PV sales in Germany were 360 MW in 2004[28]: in other words, MW-scale deployment is conceivable.

Table 15: Canadian Residential Solar PV Potential

	Houses		3 kW Systems	Installed Capacity	Electricity Generated	GHG savings
Region	**existing**	**10-year**	**(47%)**	**(MW)**	**(GWh)**	**(Mt_{CO2e}/yr)**
British Columbia	1,209,000	216,710	670,084	2,010	2,256	1.22
Prairies and North	1,261,000	286,170	727,170	2,180	3,339	1.80
Manitoba	354,000	30,920	180,912	540	775	0.42
Ontario	3,329,000	575,680	1,835,200	5,500	7,303	3.94
Quebec	2,341,000	368,970	1,273,686	3,820	4,679	2.53
Maritimes	695,000	86,990	367,535	1,100	1,350	0.73
Total	**9,189,000**	**1,565,440**	**5,054,587**	**15,150**	**19,703**	**10.64**

2.4.3 Pricing Variations

While PV arrays are currently relatively expensive it is important to note that historically their capital costs have been dropping by 5% per year.[29] Nonetheless, significant reductions in the capital costs of the PV units are still required to make them economical.

[26] David Suzuki Foundation, *Smart Generation: Power Ontario with Renewable Energy* (Vancouver, British Columbia: David Suzuki Foundation, 2004). Available for download at www.davidsuzuki.org/_pvw370829/files/Climate/Ontario/Smart_Generation_full_report.pdf

[27] 5 * 500 MW coal power plant operating at 90% capacity = 5 * 500 MW * 8760 hrs/yr * 90% = 19.7 GWh

[28] Rob McMonagle, *The Potential of Solar PV in Ontario*, V2.1 (Ottawa, Ontario: Canadian Solar Industry Association, 2006). Available for download at www.cansia.ca

[29] www.iea-pvps.org/isr/download/2005_table07.xls

2.5 Small Wind

2.5.1 Assumptions and Results

The amount of energy generated by the wind is related to the cube of local wind speed. Therefore, wind energy systems are much more sensitive to their local resource than the other technologies modeled in this work. Wind turbines are also not modular, and different sized systems have significantly different performances. As in the solar PV models, the turbines in this section are modeled assuming that net metering is an option; consequently, battery banks are not required.

Three scenarios were modeled in this section:

1. Micro: 400 W urban wind turbines are small systems that can be rooftop mounted. These systems are currently available through retailers such as Canadian Tire.
2. Mini: 2 kW rural systems are larger free-standing machines that are only appropriate in rural settings.
3. Small: 10 kW farm systems are systems that produce power far in excess of what a typical household can absorb and are considered only in farming applications.

Estimated costs for delivered electricity assume a 5% discount rate, a 20 year system life, full equity financing and no return on equity. The actual delivered energy and cost of a specific system will vary considerably and will depend in particular on location, height, and the means of financing.

Micro Wind Turbines

The power delivered by a wind turbine is proportional to the cube of the wind speed. Therefore, small variations in wind speed will have significant impacts on the power that they can produce. For the micro urban turbines that produce small amounts of power and would operate in turbulent urban areas, the RETScreen wind data was deemed satisfactory for a broad overview of power production capability.[30] While individual turbines could perform significantly better than the estimates in Table 16, it is clear that at a cost of $2,000 installed, such systems are unlikely to pay for themselves in their lifetimes.

Table 16: Urban Micro Wind System Results (0.4 kW)

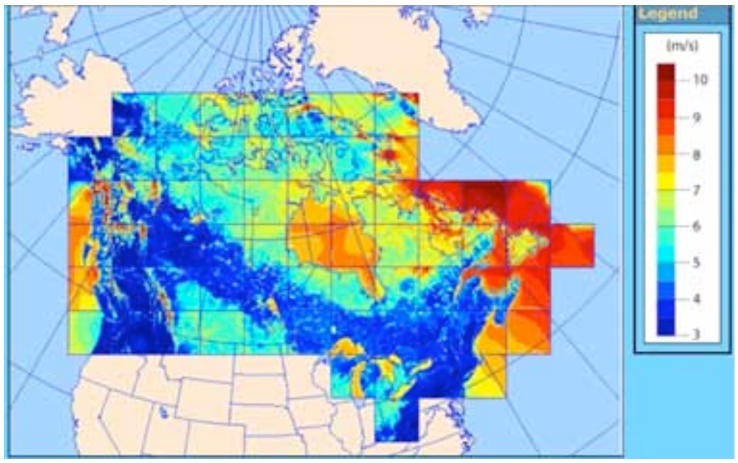
	Wind Speed	Energy Delivered	Displaced Energy		Annual Savings	
	(m/s)	(kWh/yr)	Type	Cost (¢/kWh)	($)	(t_{CO2e})
British Columbia	3.2	80	Electricity	6.3	$5.04	0.04
Prairies & North	4.4	240	Electricity	11.0	$26.40	0.13
Manitoba	4.9	320	Electricity	6.0	$19.20	0.17
Ontario	4.3	210	Electricity	11.5	$24.15	0.11
Quebec	4.0	160	Electricity	7.3	$11.68	0.09
Maritimes	4.9	320	Electricity	9.7	$31.04	0.17

[30] Since Toronto airport data is not available in RETScreen v3.2, London, Ontario data was used in its place.

Mini Wind Turbines

Rural systems were assumed to have higher wind speeds in each region as they are able to avoid obstructions and use taller towers. Typical rural wind speeds for each region were used from the Canadian wind atlas at 30 metre hub heights as shown in Figure 2 below.[31] Estimates were made in regions where the majority of the rural population resides, and are not necessarily representative of the regions as a whole.

Figure 2: Average wind speeds at 30 metres



Source: Canadian Wind Energy Atlas, www.windatlas.ca

Table 17: Rural Mini Wind System Results (2.0 kW)

	Wind Speed	Energy Delivered	Displaced Energy		Annual Savings	Mini-Wind Electricity Cost
	(m/s)	(kWh/yr)	Type	Cost (¢/kWh)	($)	($/kWh)
British Columbia	4.0	810	Electricity	6.3	$ 51.03	$0.99
Prairies & North	6.0	2,830	Electricity	11.0	$311.30	$0.28
Manitoba	5.5	2,240	Electricity	6.0	$134.40	$0.36
Ontario	5.5	2,240	Electricity	11.5	$257.60	$0.36
Quebec	5.5	2,240	Electricity	7.3	$163.52	$0.36
Maritimes	5.0	1,660	Electricity	9.7	$161.02	$0.48

System costs for a 2.0 kW machine are approximately $10,000. Despite being able to collect better winds in rural areas, as a general rule the payback period for such systems is well over 20 years, even in the best-case scenario (the Prairies).

Small Wind Turbines

A 10 kW machine manufactured by Bergey was modeled in this section. Such systems can cost $45,000 to install. While these systems have improved generation costs, in all cases they are significantly above retail prices. However, given a good wind regime and high electricity prices such as in the Prairies, and to a lesser extent Ontario and the Maritimes, these systems can have a payback period approaching 10–15 years, assuming all of the power they generate can be consumed. These systems are fairly large and are, therefore, really only appropriate on farms that have significant annual loads.

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[31] www.windatlas.ca

Table 18: Small Wind System Results (10.0 kW)

	Wind Speed	Energy Delivered	Displaced Energy		Annual Savings	Small-Wind Electricity Cost
	(m/s)	(kWh/yr)	Type	Cost (¢/kWh)	($)	($/kWh)
British Columbia	4.0	10,100	Electricity	6.3	$ 636.30	$0.36
Prairies & North	6.0	25,300	Electricity	11.0	$2,783.00	$0.14
Manitoba	5.5	21,500	Electricity	6.0	$1,290.00	$0.17
Ontario	5.5	21,500	Electricity	11.5	$2,472.50	$0.17
Quebec	5.5	21,500	Electricity	7.3	$1,569.50	$0.17
Maritimes	5.0	17,700	Electricity	9.7	$1,716.90	$0.20

Table 19 lists air emissions including greenhouse gases (GHG), nitrogen oxides (NO_x), sulfur oxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), volatile organic compounds (VOC) and carbon monoxide (CO) that are offset annually for every 10 kW small wind system that is installed in each region. As was the case for solar PV, these air emissions are not displaced at the home, but rather at the central electricity plant where they are created.

Table 19: Air emissions displaced per 10 kW wind energy installation

	Displaced Energy	Displaced Air Emissions						
	Electricity (kWh/yr)	GHG (t_{CO2e})	NO_x (g/yr)	SO_2 (g/yr)	PM_{10} (g/yr)	$PM_{2.5}$ (g/yr)	VOC (g/yr)	CO (g/yr)
British Columbia	10,100	5.5	4,356	28	339	339	236	2,017
Prairies & North	25,300	13.7	10,910	69	850	850	592	5,051
Manitoba	21,500	11.61	9,272	59	722	722	503	4,293
Ontario	21,500	11.61	9,272	59	722	722	503	4,293
Quebec	21,500	11.61	9,272	59	722	722	503	4,293
Maritimes	17,700	9.6	7,633	48	595	595	414	3,534

2.5.2 Potential market impacts

As mentioned earlier, because wind turbines are so dependent on the local wind resource, it is difficult to quantify the potential impacts that such systems may have. Given the high price, small yield, and the municipal by-laws restricting the installation of wind generators in urban areas, the overall impact of the smaller wind systems (400 W machines) in urban areas is almost negligible.

Mini and small and scale systems (2–10 kW) are able to operate more efficiently as they are able to be installed on taller towers in areas with less local turbulence. No overlay of wind speeds and houses has ever been completed to calculate the potential capacity for small wind energy systems. For this study, a sample uptake of 1% of rural homes in the country were modeled installing a 2 kW machine, while 10% of farms were modeled with 10 kW units. Because wind power is so dependent on local wind speeds, and the technology does not scale up linearly, it is difficult to get an accurate estimate of the market size without overlaying a wind map onto detailed population maps. However, the aforementioned estimates are considered to be achievable and conservative in terms of technical capacity.

Table 20: Mini wind system market potential (2.0 kW)

	Machine Annual Output	Rural Home Forecast		Annual Savings	
	(kWh)	10-yr total	1% uptake	(MWh)	(t_{CO2e})
British Columbia	810	199,160	1,992	1,613	871
Prairies & North	2,830	268,560	2,686	7,600	4,104
Manitoba	2,240	87,690	877	1,964	1,061
Ontario	2,240	545,080	5,451	12,210	6,593
Quebec	2,240	501,320	5,013	11,230	6,064
Maritimes	1,660	353,110	3,531	5,862	3,165
Total			**19,549**	**40,479**	**21,858**

Table 21: Small wind system market potential (10.0 kW)

	Machine Annual Output	Farm Home Forecast		Annual Savings	
	(kWh)	Total	10% uptake	(MWh)	(t_{CO2e})
British Columbia	10,100	1,600	160	1,616	873
Prairies & North	25,300	8,400	840	21,252	11,476
Manitoba	21,500	1,700	170	3,655	1,974
Ontario	21,500	4,800	480	10,320	5,573
Quebec	21,500	2,600	260	5,590	3,019
Maritimes	17,700	800	80	1,416	765
Total			**1,990**	**43,849**	**23,678**

2.5.3 Pricing variations

As with PV systems, the capital costs of small wind generators are still very high. The capital costs of mini and micro scale systems need to be reduced by an order of magnitude before such systems have reasonable payback periods (10 years or less). Small systems (10 kW and above) are more efficient because not only can they capture winds at higher speeds, but they also tend to have more efficient designs. Their physical size does limit their deployment, however. Significantly larger machines, those 30–300 kW, are currently commercially available and appropriate for farms with reasonable wind speeds.

2.6 Summary of Results

The performance, relative costs and potential benefits of alternative energy systems vary significantly from region to region across Canada. It is important to remember that this study evaluated entire regions of the country based on single cities. Since this approach was intended to illustrate national variations, individual projects in any region (particularly those well outside the major cities listed in this report) could have significantly better (or worse) performances and would require a more refined analysis. Nonetheless, this analysis reveals that specific technologies are more appropriate for different regions of the country based on not only the local renewable energy availability, but also the mix and cost of conventional energy sources.

The economic analysis of these technologies is summarized by region in Table 22. As noted above, estimated costs for delivered electricity assume a 5% discount rate, a 20 year system life, full equity financing and no return on equity. The actual delivered energy and cost of a specific system will vary considerably and will depend in particular on the renewable resource and the means of financing.

Table 22: Technology cost summary

Region	Solar Hot Water		Ground Source Heat Pump		Electricity			
	Convent. Energy Cost (¢/kWh)	Solar Cost (¢/kWh)	Retrofit Payback (years)	New Installation Payback (years)	Grid (¢/kWh)	3 kW Solar PV (¢/kWh)	2 kW Wind (¢/kWh)	10 kW Wind (¢/kWh)
British Columbia	8.7	18.7	26	18	6.3	60.1	99	36
Prairies & North	6.9	12.0	230	187	11.0	44.0	28	14
Manitoba	7.1	13.0	22	19	6.0	47.2	36	17
Ontario	10.2	14.5	35	26	11.5	50.8	36	17
Quebec	8.6	15.4	12	9	7.3	55.0	36	17
Maritimes	14.4	15.1	12	9	9.7	55.0	48	20

Table 23 and Table 24 illustrate the potential uptake for the alternative energy systems within the Canadian residential sector considered in this report. The assumptions made for this analysis are intended to represent the order of magnitude of the potential for these technologies. Additional opportunities for these technologies exist outside the residential sector in commercial and industrial buildings as well as in other buildings outside the scope of this report such as in off-grid camps, lodges and communities.

Table 23: 10-year thermal alternative technology potential

Region	Solar Hot Water Savings Potential			Ground Source Heat Pump Savings Potential		
	Energy Savings (GWh/yr)	Fuel	GHG Savings (kt_{CO2e}/yr)	Electricity Savings (GWh/yr)	Natural Gas Savings (GWh/yr)	GHG Savings (kt_{CO2e}/yr)
British Columbia	3,769	Nat. Gas	680	(49)	175	5
Prairies & North	6,148	Nat. Gas	1,100	-	-	-
Manitoba	897	Electricity	480	54	-	29
Ontario	13,267	Nat. Gas	2,380	(196)	661	12
Quebec	5,606	Electricity	3,030	676	-	365
Maritimes	2,544	Heating Oil	460	(71)	234*	23

Table 24: 10-year alternative electric generation technology potential

Region	Residential Solar PV Potential			Residential Wind Potential		
	Installed Capacity (MW)	Electricity Generated (GWh)	GHG savings (kt_{CO2e}/yr)	Installed Capacity (MW)	Electricity Generated (GWh)	GHG savings (kt_{CO2e}/yr)
British Columbia	2,010	2,256	1,220	6	3	2
Prairies & North	2,180	3,339	1,800	14	29	16
Manitoba	540	775	420	3	6	3
Ontario	5,500	7,303	3,940	16	23	12
Quebec	3,820	4,679	2,530	13	17	9
Maritimes	1,100	1,350	730	8	7	4

In Table 23 and Table 24 the uptake potential for solar systems was assumed to be every home in the country where they are technically feasible. While this illustrates the very large potential for savings, in practice only a fraction of this market will likely be captured without strict regulations. Ground source heat pumps and residential wind systems were assumed to have a much smaller residential market potential due to the difficulties in installing them as retrofits and the bylaws preventing their use in urban areas respectively. In considering the potential of these systems, it is important to keep in mind that in practice their markets and potential impacts are not restricted to the residential sector analyzed in this report.

Canada is expecting to build an additional 150,000 houses per year. When considered at the time of building, alternative energy technologies can be delivered at reduced cost (such as ground source heat pumps) and at increased efficiency (such as solar hot water and PV systems). Other efforts to increase energy efficiency — such as insulation or reduced electricity consumption — can add to the emissions savings that these technologies deliver.

3 Review of Barriers

The purpose of this section is to summarize the barriers to renewable energy technologies in the residential and farm sectors. Similar barriers limit the deployment and adoption of all of the technologies analyzed in this study — solar water heating, ground source heat pumps, solar photovoltaics and small wind turbines:

- *Information/awareness barriers* occur where the public, government or industry misunderstands or is unaware of certain aspects of a given technology that would potentially be in its best interest if the information in question was accurately communicated. Examples include perceptions that renewable energy technologies are unreliable and will always need conventional back up, that they are too expensive and will always require subsidies, and that they can only make a small contribution to reducing Canada's greenhouse gas emissions.
- *Industry capacity/training barriers* occur where the renewable energy technology industry (i.e., manufacturers, designers, installers, etc.) lacks sufficient skills or labour to deliver a given technology to market in its full potential.
- *Market development/availability barriers* occur where the limited development of a renewable energy technology's market limits the further development of that technology. For example, small market size can limit the industrial capacity to cost-effectively manufacture, distribute, install and operate renewable energy technology.
- *Regulatory barriers* occur where government or utility regulations limit or prevent the deployment of renewable energy technologies. For examples, utilities may not permit net metering or municipal permitting guidelines may prevent the installation of wind turbines of a certain height.
- *Cost/price barriers* occur where the mix of capital and operating costs of renewable energy technologies relative to conventional options prevents or discourages consumers from purchasing them.
- *Technology barriers* occur where the current development status or inherent characteristic of a technology limits its deployment or benefit. These types of barriers are more common in emerging technologies, but some are still relevant to the four technologies discussed in this analysis.

Although there are many commonalities, the type and magnitude of barriers differ by technology. Renewable energy technologies that generate electricity (solar PV systems and small wind power systems) face a unique set of barriers that are not present with renewable heat technologies because of their ability to supply power to the grid. Our current grids are dominated by large central generating plant and transmission systems that distribute power to users in one direction only, and these barriers stem from the idea that the grid is not currently open to distributed generation sources.[32]

[32] Several jurisdictions in the U.S. are preparing their infrastructure and regulator regime for a grid based on distributed power sources controlled by "smart grid" technology.

The following is an overview of the barriers facing each of the four technologies analyzed in this report:

- *Solar water heating*: Solar water heating is unique among the technologies covered by this report in that a) Canada had incentive policies in the early 1980s that supported a significant solar water heating industry;[33] and b) solar water heating systems are a mature technology common in many other countries (including those where some form of freeze protection is needed). As noted by the Western Governors' Association 2005 Solar Taskforce, "No major physical or technical barriers stand in the way of widespread adoption of solar."[34] Instead, the barriers to be addressed with solar water heating are related to lack of local awareness, lack of industry capacity, regulatory impediments (permitting/approvals) and high costs.
- *Ground source heat pumps*: The Canadian market for ground source heat pumps is much more mature than for other technologies discussed in this report. Distributors and installers are found in most communities across Canada. The technology therefore faces fewer market development barriers than the other renewable energy technologies. The main barriers are concerned with size, price, the difficulty in retrofitting and the fact that the systems do not always provide net environmental benefits because of the associated electrical demands.
- *Solar photovoltaics*: Reliable solar PV products that produce grid quality AC power for home/farm use and or feeding into the grid have been available for some time. Few physical or technical barriers stand in the way of widespread adoption of solar PV; the major barriers are in the realm of economic and public policy to reflect the environmental and peak reduction benefits of PV, high costs, grid interconnection and the financing of the high up-front cost.
- *Small wind turbines*: Small wind turbines are now available as "plug and play" products that for the most part produce grid-quality AC power for home or farm use and/or feeding into the grid. While cost reductions are still likely, the technology can be considered mature in that there are few technical reasons to prevent a consumer from purchasing and using a unit. The main barriers are high costs, policies that reflect environmental benefits and financing up-front costs.

Table 25 outlines the specific barriers to renewable energy technologies in the residential and farm sectors. For each barrier, an "X" indicates that the barrier is relevant to a given technology. The list of barriers and their relevance to each technology has been developed from government and industry input and a variety of other sources.[35, 36, 37, 38]

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[33] In the 1980s, a combination of manufacturer production cost reduction/value engineering grants (through NRC), CSA standards, government procurement and user rebates were used to build a relatively strong, country-wide production and distribution network in a relatively short amount of time. This market collapsed because incentives and manufacturer support ended too soon.

[34] Western Governors' Association, *Clean and Diversified Energy Initiative: Solar Taskforce Report* (Western Governors' Association, 2006).

[35] Nitya Harris, "A National Framework for Solar Hot Water Systems" (report prepared for Greenpeace Canada, 2006).

[36] Canadian Solar Industries Association, *Sunny Days Ahead — Ensuring a Solar Future for Canada* (Ottawa, Ontario: Canadian Solar Industries Association, 2004).

The deployment rate of renewable energy in the residential sector cannot be significantly accelerated if many of these barriers persist. Addressing these barriers will require a full suite of support measures including information and labeling, industry development support, regulatory actions, financing mechanisms and financial incentives.

Economic instruments have the potential to directly lower or remove all of the cost barriers. Indirectly, these economic instruments can also help to remove awareness barriers (e.g., as lower costs can spur awareness), industry capacity barriers (e.g., as lower costs lead to higher investment and increasing demand) and market development barriers. Regardless of their scale, however, economic instruments are unlikely to have a significant impact on regulatory or technological barriers.

[37] Center for Applied Economic Research, *Reducing Market and Regulatory Barriers to Small-Scale Distributed Generation in Montana* (Billings, Montana: Montana State University, May 2004).

[38] National Renewable Energy Laboratory, "Overcoming the Technical and Market Barriers for Distributed Wind Applications"(report prepared for the Solar 2006 Conference, Denver, July 7 –13, 2006).

Table 25: Barriers limiting the deployment of renewable energy in the residential and farm sectors

Barrier Description	Solar Hot Water	Ground Source Heat Pumps	Solar PV	Small Wind
Information/awareness barriers				
Lack of public awareness of the technology and its benefits.	X	X	X	X
Lack of public awareness of the technology's reliability, availability, and operation.	X	X	X	X
Lack of awareness of the technology's potential and benefits with architects, engineers, builders, etc.	X	X	X	X
Lack of awareness with some utility and government policymakers that technology can reduce peak demand.			X	X
Lack of awareness with some utility and government policymakers of combined technology potential.	X	X	X	X
Industry capacity/training barriers				
Most manufacturers have low production volumes.	X	X	X	X
Limited number of distributors and of qualified and motivated installers.	X		X	X
Power storage as a means to obtain higher prices or manage time-of-day pricing has not been incorporated into most systems.			X	X
Market development/availability barriers				
Limited availability in many parts of the country.	X		X	X
Lack of quality assurance for consumers (e.g., CSA standards or installer warrantees).	X	X	X	X
Inadequate resource assessments in many parts of the country limit ability to predict performance.				X
Lack of performance measures and labeling limit consumers' ability to compare with conventional options.	X	X	X	
Distributed sources are seldom included in supply-side initiatives such as feed-in tariffs, Renewable Portfolio Standards, etc.			X	X
Discontinuity of supportive policies delivered by governments and utilities.	X	X	X	X
Inability to purchase all of a system's components as a single package.	X	X	X	X
Lack of aggregators that would allow users of small RE systems to take advantage of feed-in tariffs, certificate programs, etc.			X	X
Regulatory barriers				
Lack of regulatory consistency across jurisdictions (e.g., utility regulations, building permits, zoning requirements, etc.)	X	X	X	X
Inconsistency across jurisdictions on net metering and interconnection protocols.			X	X
Difficult and costly interconnection rules/process, where customers are often faced with multiple step transactions to connect systems to the grid.			X	X
Cost/price barriers				
Competing conventional distributed generation options (e.g., diesel) often highly subsidized.			X	X
Low production rates and long transportation distances lead to higher than necessary costs.	X		X	X
Life-cycle costs are dominated by capital costs, making systems unaffordable to many consumers.	X	X	X	X

Barrier Description	Solar Hot Water	Ground Source Heat Pumps	Solar PV	Small Wind
Life-cycle costs (excluding externalities) for renewable energy can be higher than conventional energy costs.	X	X	X	X
Environmental benefits are not reflected in the price of systems or in the cost of conventional energy.	X	X	X	X
Lack of time-of-day pricing that would encourage larger systems.			X	X
Technology limitation barriers				
Variations in greenhouse gas intensity of electricity production causes a wide variation in environmental benefits.		X		
Minimum size of technology makes it unsuitable for meeting small heating/cooling loads.		X		
Technology is not well-suited to retrofits to existing buildings.		X		
Performance of some off-the-shelf inverters not good with variable voltage.			X	X
Visual impact of technologies is not appealing to some consumers.	X		X	X
Size and noise constraints lead consumers in urban areas to favour small less efficient units.				X

4 Economic Instruments in Canada and Abroad

4.1 Review of Relevant Support Programs in Canada

As part of this analysis, a brief review of federal and provincial support programs for renewable energy in Canada's residential and farm sectors was conducted. In general, most provinces have some support for renewable energy and, with the exception of regulatory policy covering net metering, almost all of the programs reviewed were incentives to reduce the capital cost of the renewable energy system (Ontario's Standard Offer Program being a notable exception). Table 26 lists the financial incentives in place federally and provincially, while Table 27 lists the net metering policy in each jurisdiction. Appendix E provides a more comprehensive description of the programs listed in Table 26.

Table 26: Federal and provincial programs supporting residential and farm renewable energy

Jurisdiction	Solar Hot Water	GSHP	Solar PV	Small Wind
Federal Government	CMHC Mortgage Insurance Refund ecoENERGY for Renewable Heat (announced)	CMHC Mortgage Insurance Refund	CMHC Mortgage Insurance Refund	
			ecoEnergy for Retrofit (announced)	ecoEnergy for Retrofit (announced)
British Columbia		Fortis Heat Pump Incentive		
	BC Sales Tax Exemption	BC Sales Tax Exemption	BC Sales Tax Exemption	BC Sales Tax Exemption
Alberta	SunRidge BuiltGreen Rebate	SunRidge BuiltGreen Rebate	SunRidge BuiltGreen Rebate	
Saskatchewan		Sales Tax Exemption		
Manitoba		Manitoba Hydro Earth Power Loan		
Ontario			Ontario Standard Offer Program	Ontario Standard Offer Program
	Retail Sales Tax Rebate	Retail Sales Tax Rebate	Retail Sales Tax Rebate	Retail Sales Tax Rebate
	Cambridge Hydro EarthWise Program	Cambridge Hydro EarthWise Program		
Quebec		Energy Efficiency Fund		
New Brunswick	NB Efficient New Homes Program	NB Efficient New Homes Program		

Jurisdiction	Solar Hot Water	GSHP	Solar PV	Small Wind
Nova Scotia	Solar Hot Water Rebate			
Prince Edward Island	Provincial Sales Tax Exemption Alternative Heating Loan Program	Provincial Sales Tax Exemption Alternative Heating Loan Program	Provincial Sales Tax Exemption	Provincial Sales Tax Exemption
Newfoundland and Labrador		NF Power Electric Heat Financing		
Nunavut Territory				
Northwest Territories				
Yukon				

Source: www.incentivesandrebates.ca

Table 27: Summary of net metering policy in Canada

Utility	Comments
Yukon Energy Corporation	Yukon Energy Corporation has released a Comprehensive Green Power Initiative that includes development of a net metering policy. The policy is expected to be in place by 2007.
BC Hydro	Net metering has been available in BC Hydro's service area since April 2005. www.bchydro.com/info/ipp/ipp8842.html
Manitoba Hydro	Net metering is available. Customers are required to purchase a bidirectional meter.
Hydro One*	Net metering available. www.hydroone.com/en/electricity_industry/renewable_tech
Waterloo North*	Net metering under development.
Hydro Ottawa*	Net metering under development.
Toronto Hydro*	Net metering available. www.torontohydro.com/electricsystem /customer_care/cond_of_services/net_metering/index.cfm
Hydro Quebec	Net metering available. www.hydroquebec.com/autoproduction/fr/index.html (French)
New Brunswick Power	Net metering proposed.
Newfoundland and Labrador Hydro	Net metering under development.
Nova Scotia Power	Net metering announced. www.nspower.ca/RenewablesRFP/NetMetering.jsp
Maritime Electric	Net metering planned for Prince Edward Island.

* All local distribution companies in Ontario should now be following provincial net metering legislation, although not all of them may have worked out their internal procedures yet.

Source: www.pollutionprobe.org/whatwedo/greenpower/consumerguide/c2_4.htm

4.2 Types of Economic Instruments

Economic instruments for increasing the deployment and use of renewable energy systems can be divided into the following three main categories:

1. Instruments targeted at manufacturers, installers and distributors.
2. Instruments designed to decrease the initial capital cost of renewable energy systems.
3. Instruments that provide on-going financial benefits to owners of renewable energy systems.

It is possible for policies in each of the three categories to be used in combination. This section describes instruments from each of these three categories. For each instrument, information is provided on the potential jurisdictional application, the basis for use (the aspect of the market that the instrument is designed to change), the cost recovery source (the source of funding), enabling requirements or limitations (the changes that are required for the instrument to function properly), and examples of jurisdictions where the instrument has been implemented.

1. *Instruments targeted at manufacturers, installers and distributors* of renewable energy technologies are designed to decrease the costs of producing and marketing the technologies. The objective is to increase the supply of and access to relevant technologies and to reduce costs to consumers as manufacturers, installers or distributors pass their savings on in the form of reduced prices. Economic instruments targeted at these entities should be designed so that the value of the incentive increases with the amount of manufacturing, installing and distributing of technologies taking place. This is most easily achieved by applying the incentive on a per product basis. For the purposes of this study, we considered two types of economic instruments that can be offered to manufacturers, installers and distributors:
    - Income or corporate tax incentive — A tax credit, exemption or deduction, or an accelerated depreciation of capital expenditure for tax purposes. The incentive would offset a portion of costs incurred by the eligible entity and may be passed on to consumers in the form of reduced prices.
    - Rebate/refund to qualifying entities — A rebate or refund on a portion of costs incurred by qualifying entities. As is the case with a tax incentive, the refund/rebate may be passed on to customers in the form of reduced prices. Unlike the tax incentive, this instrument is not administered through the tax system.

Table 28: Economic instruments targeted at manufacturers, installers and distributors

Instrument	Jurisdictional Application	Basis for Use	Cost Recovery Source	Enabling Requirements and Limitations	Example Jurisdictions
Tax incentive (credit/exemption/CCA)	Federal, provincial or municipal	Increased supply of technologies	Tax base or budget appropriations	Tax rule changes – limited to size of tax	India, numerous U.S. states
Rebate/refund	Federal, provincial or municipal	Increased supply of technologies	Budget appropriations	None	Virginia, Pennsylvania

2. *Economic instruments can also be designed to decrease the initial capital cost* of renewable energy systems to consumers. These instruments reduce, or buy-down, the consumers purchase capital cost or finance the initial cost of the system so that it is spread over several years rather than incurred as one lump sum upfront. Eight different economic instruments that fall into this category were considered for this study:
   - Rebate/refund — Offsets a portion of the costs incurred in purchasing renewable energy technologies. This direct support is provided by a public authority (or utility).
   - Property or income tax credit — Provides a tax credit to individuals who purchase renewable energy technologies. The credit or refund for a portion or all costs incurred would reduce the amount of income or property tax due.
   - Sales tax rebate — Provides an exemption or refund from sales tax on qualifying renewable systems.
   - Low interest loans or loan guarantees — Decreases the cost of a renewable system for customers by decreasing the financing cost. These programs are generally offered through a cooperative program with government and a financial institution.
   - Lease or rental program for equipment through utility or private sector — Covers programs where: 1) a company leases or rents renewable energy systems allowing a customer to obtain renewable energy benefits without a long-term commitment; or 2) an energy service company entering a contract with a homeowner or group of homeowners to provide the energy service of the system while the ownership, installation and operation of the system remain with the energy service company provider.
   - Local improvement charges (LICs)— Long used by municipalities to help cover the costs of infrastructure improvements (roads, sidewalks, etc.) that are deemed to benefit a specific neighbourhood. The benefiting landowners are assessed the LIC on their property taxes until their share of the improvements have been paid for. By expanding this existing instrument, local improvement charges could be used to finance residential renewable energy systems.
   - Mortgage insurance reduction — Provides preferable mortgage terms for homeowners who have invested in renewable energy systems. For example, the incentive could provide a refund on premiums for high-ratio mortgages, or allow customers to take a longer term amortization (for example, up to 35 years) and pay the same premium as for a shorter term amortization (for example, 25 years).
   - Reduction in development and/or building permit charges/fees — Reduces the building or development permit fees for homeowners, developers, home builders or home renovators that are installing renewable energy systems.

Table 29: Economic instruments designed to decrease the initial capital cost of renewable energy systems

Instrument	Jurisdictional Application	Basis for Use	Cost Recovery Source	Enabling Requirements and Limitations	Example Jurisdictions
Rebate/refund	Federal, provincial or municipal	Increase deployment	Tax Base (government) or Rate Base (utility DSM)	Establishment of qualifying criteria	Quebec – Solar wall; Government of Canada – eco-ENERGY; Nova Scotia – Solar hot water heating; many others
Property or income tax credit	Federal or provincial (income), Municipal (property)	Increase deployment	Tax Base	Tax rule changes – limited to size of tax	U.S. – federal + at least 17 states
Sales Tax Rebate	Federal or provincial	Increase deployment	Tax Base	Sales Tax rule changes - limited to size of sales tax	Ontario, Prince Edward Island, British Columbia
Leasing, fee-for-service or rental schemes	Federal or provincial	Establish new markets	Revenue neutral	Agreements with financial institutions and leasing agents	Manitoba Hydro, Fortis BC Residential Heatpump, Homeworks Financing, VanCity Environmental Borrowing
Guaranteed / low interest loan	Federal or provincial	Establish new markets	Tax Base (for guarantee)	Agreements with financial institutions	Lifetime Energy from Waterloo North Hydro; Guaranteed Solar Results for Eastern Europe
Financed as local improvement	Municipal	Meet municipal goals	Revenue neutral – uses Municipal Property Tax Base	Provincial municipal directives and approval from provincial government	LICs have been used for RE/EE in the Yukon, but otherwise an untested concept
Mortgage insurance reduction	Federal	Consolidate markets	Tax Base	Mortgage rules changes – limited to size of insurance fees	CMHC (program for energy efficiency); California and Japan
Reduction of development charges and fees	Municipal	Increase deployment	Municipal Tax Base	By-law rule changes – limited by size of fees	No examples

3. Four key policies were considered as part of the third category of economic instruments, those that provide on-going financial benefits to owners of renewable energy systems by paying qualifying owners on the basis of energy or other benefits produced. These incentives are linked to the performance of the energy system. If the system does not perform, no payment is made.

   - Feed-in tariffs (also called advanced renewable tariffs or standard offers) — A price-based instrument that specifies the premium price to be paid to producers of renewable energy for the energy they produce. Feed-in laws offer renewable energy producers a guaranteed power sales price (the feed-in tariff), coupled with a purchase obligation by utilities.[39] Feed-in-tariffs have primarily been used for electricity-producing renewable energy technologies, but could be used to pay premium prices for heat from renewable sources that replace gas, or even energy savings.
   - Tradable renewable energy certificates — Under a Renewable Portfolio Standard (RPS), utilities demonstrate compliance with necessary standards for renewable energy production using a market-based system of tradable renewable energy certificates (RECs). Every megawatt-hour of renewable energy produced is awarded an REC. Retail electric suppliers are then responsible for securing a quantity of RECs sufficient to meet their annual RPS compliance target.[40]
   - Greenhouse gas emissions (carbon) offset — Emissions offsets and associated trading is a way in which entities can meet their obligations under regulated emissions trading programs. Greenhouse gas emissions (GHG) offsets are typically measured in carbon dioxide equivalents (CO_2e), referred to as carbon offsets. Carbon offsets can be generated from a variety of project types and can originate from anywhere in the world. Before offsets can be sold and traded in regulated systems, the amount of reductions needs to be quantified against relevant standards (termed "protocols").
   - Production incentive — A production incentive provides the investor or owner of qualifying technologies with payments based on the amount of electricity generated from those technologies. A production tax credit does the same, but the incentive is provided as a credit against annual tax payments.[41]

[39] Ryan Wiser, Mark Bolinger and Troy Gagliano, *Analyzing the Interaction Between State Tax Incentives and the Federal Production Tax Credit for Wind Power* (National Conference of State Legislatures, 2002).

[40] www.boell.org/Pubs_read.cfm?read=161

[41] Fred Beck and Erin Martinot, "Renewable Energy Policies and Barriers," *Encyclopedia of Energy* (Academic Press/Elsevier Science, 2004).

Table 30: Economic instruments that provide on-going financial benefits to owners

Instrument	Jurisdictional Application	Basis for Use	Cost Recovery Source	Enabling Requirements and Limitations	Example Jurisdictions
Feed-in tariff/standard offer	Provincial	Increase deployment	Rate/Tax Base	Feed-in tariff regulations	Most European Union members and Ontario
Tradable renewable energy certificates	Provincial	Meet targets Value environment benefits	Rate Base	RPS and certificate regulations	U.S. States
Emissions offset	Federal or provincial	Value environment benefits	Regulated or voluntary emitters	LFE regulations	Clean Development Mechanism and United Kingdom
Production incentive	Federal or provincial	Increase deployment	Rate/Tax Base	Tax rule changes if tax credit	U.S. and Canada (WPPI and ecoEnergy)

4.3 Key Examples of Economic Instruments

To provide additional information on experience with different economic instruments, this section summarizes seven examples from various regions. The examples cover a range of economic instruments for renewable energy technologies. Since the effectiveness of economic instruments often depends on the economic and policy environment for renewable systems, for each example we describe key factors that appear to have helped or hindered the effectiveness of the instruments. Table 31 summarizes these examples and the reasons for their inclusion in this analysis.

Table 31: Summary of key examples

Spain's Solar Photovoltaic Policies	
Key lessons learned	Spain was used as a benchmark for several categories of policy implementation in a recent European Best Practices report. In a relatively short time, Spain has significantly increased its deployment of solar PV with the support of several different but integrated policies.
Economic instruments covered	Feed-in tariffs, low interest loans and rebates
Canada's Solar Energy Demonstration Program	
Key lessons learned	This example illustrates the potential downfalls of short-lived programs (this program was only in place from 1983–1987) coupled with a loss of other market drivers such as the increasing cost of conventional energy.
Economic instruments covered	Rebates, procurement and manufacturing support
Illinois' Small Wind Grant	
Key lessons learned	This short-term policy focused on a single technology, designed to test the use of technical specifications to avoid providing incentives to systems that have low performance. While it is too early to evaluate the effectiveness of this pilot program, its design reflects lessons learned from previous programs.
Economic instruments covered	Rebates, combined with technical specifications to avoid systems with poor performance
Japan's Solar PV	
Key lessons learned	This example demonstrates the positive results that can come from a long-term program (in this case, 10-plus years).
Economic instruments covered	Consumer rebates (reduced to zero in 2006), mortgage rate reductions and manufacturing support
California's Solar Energy Initiative	
Key lessons learned	California has strong support policies for solar, using capital cost reductions. To account for concerns of poor performance from poor installation, future rebates will be based on expected performance for smaller systems and actual performance for larger systems.
Economic instruments covered	Consumer rebates and federal tax rebates
Canada's Ground Source Heat Pumps	
Key lessons learned	These technologies have benefited from innovative financing programs and industry efforts at national training and certification for installers.
Economic instruments covered	Low interest loans and leasing programs
Germany's Feed-In Tariff	
Key lessons learned	The addition of feed-in tariffs has been critical in the strong increase in Germany's PV market. This example also demonstrates useful design features.
Economic instruments covered	Feed-in tariff and consumer rebate (ended in 2004)

Table 32: Spain's Solar Photovoltaic Policies

Spain's Solar Photovoltaic Policies	
Types of financial instruments:	Feed-in tariffs, low interest loans, rebates
Jurisdictional authority:	National with supporting policies at regional level
Important design features:	Several policies working in coordination to achieve national targets
Supporting policies:	Administration regulations to help fast track PV installations, national targets, effective monitoring systems
Lessons learned:	Integrated policies, including high level
For more information:	PV Policy Group, *European Best Practices Report Assessment of 12 National Policy Frameworks for Photovoltaics* (2006), www.epia.org/documents/PV_Policy_Group_European_Best_Practice_Report.pdf

Spain's approach to encouraging solar photovoltaics (PV) provides an example of the benefits of complementary policies for achieving significant market uptake.[42] As of 2004, Spain had the 2nd largest market in Europe for PV, with small systems making up much of its installed 37 MWp of capacity. Preliminary estimates indicate that the capacity increased to 58 MWp in 2005 with further projected increases to 74 MWp in 2006.[43] Most of this increase in PV systems has occurred since 2003.

Spain's PV policies include:

- National targets currently set at 400 MWp by 2010 (the 2010 target level has been increased twice since 1999 when it was first set at 144 MWp).
- National subsidy scheme that includes low interest loans and direct rebates — each investor can apply for loans of up to 7.000 €/kWp[44] or 90% of the investment, and there is a payment holiday of seven years. Direct financial support of solar technologies was also provided (up to 19% of investment costs) through 2005 but was phased out as feed-in tariffs were implemented.
- Specific administration regulations for PV installations.
- Feed-in tariffs, starting in 2004 — 41,44 €ct/kWh (< 100 kWp); 21,99 €ct/kWh (> 100 kWp); decreases after 25 years.

Spain's policies are designed to work together. The national targets provide the overall leadership and yardstick to measure progress. The loans and subsidies were merged into a single program. These financial incentives were phased out in 2006 for grid-connected systems as the feed-in tariff became sufficient for the market. Underlying all policies is a strong monitoring system to track renewable energy projects. The monitoring system was developed through

[42] PV Policy Group, *European Best Practices Report Assessment of 12 National Policy Frameworks for Photovoltaics* (European PV Policy Group, 2006), www.epia.org/documents/PV_Policy_Group_European_Best_Practice_Report.pdf

[43] EurObserv'ER, *Photovoltaic Energy Barometer* (Paris, France: Observ'ER, 2006), www.epia.org/03DataFigures/barometer/Barometer_2006_full_version.pdf

[44] On March 28, 2007, the conversion rate was 1.00 € = 1.54332 Canadian$, www.xe.com/ucc/convert.cgi

consensus of authorities and institutions at the national, regional and community levels. It has received highest recognition from the European community funded program, PV Policy Group.[45]

Table 33: Canada's Solar Energy Demonstration Program (1983-1987)

Canada's Solar Energy Demonstration Program (1983-1987)	
Types of financial instruments:	Rebates, procurement and manufacturing support
Jurisdictional authority:	National
Important design features:	4-year program of consumer rebates for solar domestic hot water systems
Supporting policies:	Programs for commercial and industrial sectors. This program replaced programs focused on government procurement or other policies to support industry development and manufacturing capacity that were assessed as having low impact on the market.
Lessons learned:	This example indicates that programs need to extend beyond four years and have an established gradual decrease in economic incentives or other support policies to ensure that the target industry does not collapse before a stable market has developed.
For more information:	Nitya Harris, "A National Framework for Solar Hot Water Systems" (report prepared for Greenpeace Canada, 2006).

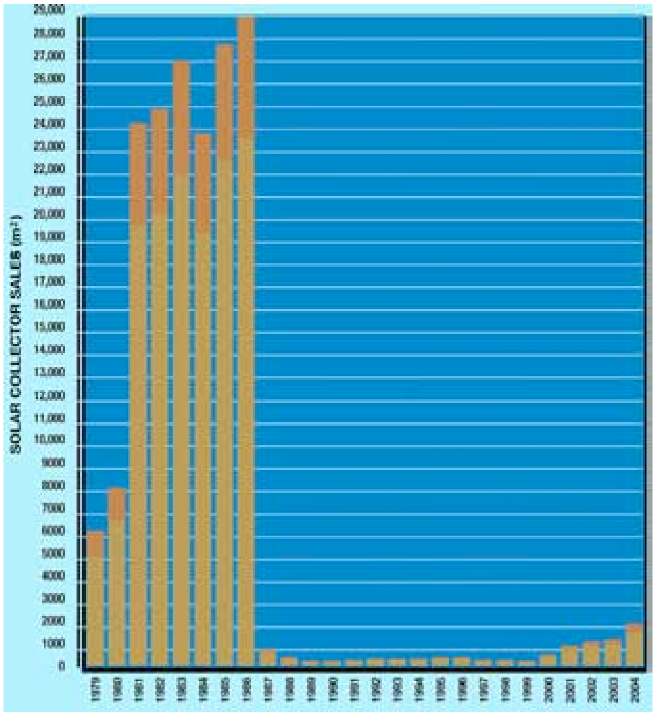
A recent report on solar hot water notes that "Solar energy programs have had a chaotic history in Canada."[46] One part of that history was the Solar Energy Demonstration Program (SEDP), which ran from 1983 to early 1987. This program, which replaced earlier programs that were focused on government procurement (PUSH) and solar companies (PASEM), provided rebates to consumers purchasing solar domestic hot water systems. An evaluation of the program indicated that while it was in place it was effective at increasing deployment of solar collectors. However, sales of solar hot water heaters collapsed with the end of the SEDP. As indicated in Figure 3, less than 500 square metres of solar collectors were installed in 1988, compared with 29,000 square metres in 1986. While many other aspects played a role in the drop in installations (decreased prices for fossil fuels and cancellation of other solar programs, for example), the end of the SEDP appears to have been a major contributor. As noted in the report, "the time frame for the SEDP program was too short to allow more development of the solar sector. A longer term program with gradual subsidy decline was needed for more sustainable results."[47]

[45] www.pvpolicy.org

[46] Harris, "A National Framework for Solar Hot Water Systems" (report developed for Greenpeace Canada, 2006).

[47] Ibid.

Figure 3: Sales of solar hot water systems in Canada, 1979–2004



Source: Nitya Harris, "A National Framework for Solar Hot Water Systems" (report prepared for Greenpeace Canada, 2006).

Table 34: Illinois' Small Wind Grant

Illinois' Small Wind Grant	
Types of financial instruments:	Rebates (funds collected by Illinois Renewable Energy Resources Trust Fund)
Jurisdictional authority:	State
Important design features:	Pilot program that includes specific technical guidelines
Supporting policies:	Renewable energy goal, net metering from largest utility
Lessons learned:	This program aims to help fund the most cost-effective systems by using technical guidelines to limit the sites
For more information:	William S. Haas, Illinois Department of Commerce and Economic Opportunity

This pilot program currently offers a maximum of $25,000, or 50% of the project's eligible costs for wind energy systems ranging from 1–50 kW DC.[48] A previous program was cancelled a few years ago when it was evaluated and determined that many of the projects that had been funded had very long paybacks.[49] The pilot is focused on developing wind projects in locations that have a strong likelihood of favourable economics. To achieve this goal, the funding has a number of specific technical requirements, such as:

[48] Database of State Incentives for Renewables & Efficiency, www.dsireusa.org/

[49] W. Hass, Illinois Department of Commerce and Economic Opportunity, personal communication, March 2007.

> The Department may support any new small wind energy conversion system with a nameplate capacity ranging from 1–50 kW mounted on a tower of at least 60 feet in height. Eligible systems must be sited on a parcel of land of 1 acre or greater and be mounted at least 30 feet above any structures or natural features within 300 feet of the installation that may adversely impact the wind resource. Additionally, the applicant must demonstrate that the project location is suitable for wind generation by providing documentation including, but not limited to, wind resource maps, airport or weather station data, and typographical maps.[50]

The pilot program was started in January 2007 and within two months the applications for funding had exceeded the available budget. A full assessment of this program will not be possible until the policy has been in place for a longer period of time.

Funding for this program comes from the Illinois Renewable Energy Resources Trust Fund, which began in January 1998 and is scheduled to expire in December 2007. This fund is supported by a surcharge on customers' electric bills and gas bills as follows:

- $0.05 per month per residential electric or gas service[51]
- $0.50 per month for nonresidential electric service with less than 10 MW of peak demand
- $0.50 per month for nonresidential gas service with less than 4 million therms of gas
- $37.50 per month for nonresidential electric service with at least 10 MW of peak demand
- $37.50 per month for nonresidential gas service taking at least 4 million therms of gas.

Approximately $100 million in revenue will be collected for the fund through 2007. [52]

Table 35: Japan's Solar PV

Japan's Solar PV	
Types of financial instruments:	Consumer rebates (reduced to zero in 2006), mortgage rate reductions, support for manufacturers
Jurisdictional authority:	National and local
Important design features:	Combination of national goals (leadership), long-term incentives for both consumers and manufacturers. Societal values and institutional structures also aided the effectiveness of the government programs. Local incentives complemented the national instrument.
Supporting policies:	Renewable portfolio standard,
Lessons learned:	Japan's on-going focus on PV has helped it become the world leader in production of this advanced technology
For more information:	Paul Parker, *Successful market stimulation in Japan's Photovoltaic Industry: Industrial Development, National Solar Energy Policies and Global Exports.* (Waterloo, Ontario: University of Waterloo, 2005). PV Policy Group, *European Best Practices Report Assessment of 12 National Policy Frameworks for Photovoltaics* (2006).

Japan's broad goals to reduce greenhouse gas emissions and increase national energy security helped set the context for programs to support renewable energy. The New Sunshine Program,

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[50] Illinois Department of Commerce and Economic Opportunity, *Renewable Energy Resources Small Wind Grant Program, Grant Application Guidelines,* Eligibility 2.3.1, 2007, www.commerce.state.il.us/NR/rdonlyres/CA5D08DE-F0AE-4A23-98AE-16400C6F622C/0/FY07SmallWindGrantGuidelines.pdf

[51] On March 28, 2007, the conversion rate was 1 US$ = 1.15882 Canadian$, www.xe.com/ucc/

[52] Database of State Incentives for Renewables & Efficiency, www.dsireusa.org/

started in 1993, highlighted PV technologies with targets for deployment levels by 2010. The current PV targets are 4.8 GW installed by 2010 and 100 GW by 2030. As of June 2004, Japan had installed 1,131,991 kW of solar PV, or 8.87 Watts per capita. Canada had 13,884 kW of PV capacity, or 0.44 Watts per capita.[53]

Japan developed a system of consumer rebates, starting with a small program in 1994 — offering a 50% rebate on capital cost for about 500 households — that was expanded with a much larger budget in 1997. While the budget for the program increased from 1994 through 2001, the amount of individual incentives declined. The capital costs of these systems have declined at a similar rate to the decrease in the incentives. The gradual decline of customer rebates from 1994–2005 and the end to them in 2006 is seen as indicating confidence in the maturity of the residential market.[54]

Japan is the leading PV producer in the world, apparently driven by national leadership, funding for research and development, and industrial development. In 2002, Japan implemented a renewable portfolio standard to help further support the renewable industry:

> In addition to the emission reduction and energy security goals, the international market for PV was recognized as an opportunity where the successful development of new energy technologies could not only help achieve national environmental goals, but also enable Japanese firms to play leading roles in growing international markets.[55]

Table 36: California's Solar Energy Initiative

California's Solar Energy Initiative	
Types of financial instruments:	Consumer rebates, federal tax rebates
Jurisdictional authority:	State
Important design features:	Separate programs (and separate administration institutes) for new and existing homes
Supporting policies:	National tax incentives, parallel New Solar Homes Partnership www.gosolarcalifornia.ca.gov/
Lessons learned:	California has strong support policies for solar using capital cost reductions. To account for concerns about poor performance from poor installation, future rebates will be based on expected performance for smaller systems and actual performance for larger systems.
For more information:	www.gosolarcalifornia.ca.gov/

California has had consumer rebate programs for solar energy systems since 1998. Total installed PV in California at the end of 2005 was 139,510 kW, or 3.86 Watts per capita.[56] Concerns that have been identified in evaluations of these programs have been a) poorly installed systems,

[53] International Energy Agency, *Trends in Photovoltaic Application in Select IEA Countries, 1992 and 2004* (International Energy Agency, IEA Photovoltaic Power Systems Programme, 2005), www.oja-services.nl/iea-pvps/isr/index.htm

[54] Paul Parker, *Successful Market Stimulation in Japan's Photovoltaic Industry: Industrial Development, National Solar Energy Policies and Global Exports* (Waterloo, Ontario: University of Waterloo, 2005).

[55] Ibid.

[56] For capacity, see www.energy.ca.gov/renewables/emerging_renewables/GRID-CONNECTED_PV.XLS; for population, see www.classbrain.com/artstate/publish/article_1226.shtml (accessed March 28, 2007).

since rebates were linked to system installation rather than the amount of energy produced (i.e., incentives are not performance-based);[57] and b) capital cost rebates leading to inflation of capital costs.[58]

These concerns have led, in part, to recent adjustments to the policies. On August 24, 2006, the California Public Utilities Commission (CPUC) issued a decision that calls for a transition of the California Solar Initiative to performance-based incentives that reward properly installed and maintained solar systems:

- Starting January 1, 2007, incentives for all solar energy systems greater than 100 kW in size will be paid monthly, based on the actual energy produced for a period of five years.
- Incentives for all systems less than 100 kW will initially be paid a one-time, up-front incentive based on expected system performance. Expected performance will be calculated based on equipment ratings and installation factors, such as geographic location, tilt and shading.
- Starting in 2010, incentives for all systems greater than 30 kW in size will be paid based on actual energy produced.

California's incentives per system depend on the total installation that occurs under the program. For example, residential systems will receive $2.50 per watt until 70 megawatts of systems have been installed across the state, then the incentive drops to $2.20 per watt.[59] For new homes, California has merged energy efficiency and renewable energy goals in the New Solar Homes Partnership program. This program, administered by the California Energy Commission, encourages the supply of homes with high-level energy efficiency and high performing renewable energy systems by offering capital cost rebates to builders and developers. This program is designed to last ten years, with incentives decreasing as levels of uptake increase. These programs complement the U.S. federal tax credit program, which offers 30% of the total system cost of a solar system, up to a maximum of $2000, per system through December 2008.

Table 37: Canada's Ground Source Heat Pump Programs

Canada's Ground Source Heat Pump Programs Manitoba Hydro and North Waterloo Hydro	
Types of financial instruments:	Loans and leasing program
Jurisdictional authority:	Utility
Important design features:	Financing programs to help counter high capital costs
Supporting policies:	Training for installers (Manitoba Hydro), direct partnership with installers (North Waterloo Hydro)
Lessons learned:	Installation training is important with this technology, but this barrier is being addressed through industry efforts. It is also important to set incentives to carefully manage the market. There may be opportunities to develop joint programs between government, utilities and installers/manufacturers.
For more information:	Manitoba Hydro: www.hydro.mb.ca/earthpower/loan.shtml

[57] Galen Barbose, Ryan Wiser and Mark Bolinger, *Supporting Photovoltaics in Market-Rate Residential New Construction: A Summary of Programmatic Experience to Date and Lessons Learned* (Berkeley, California: Lawrence Berkeley National Laboratory, 2006), www.cleanenergystates.org/library/Reports/LBNL-61643_Designing_PV-Incentive_Programs.pdf

[58] Ryan Wiser et al, *Letting the Sun Shine on Solar Costs* (Berkeley, California: Lawrence Berkeley National Laboratory, 2006), http://eetd.lbl.gov/ea/EMP/reports/59282.pdf

[59] On March 28, 2007, the conversion rate was 1 US$ = 1.15882 Canadian$, www.xe.com/ucc/

Lifetime Energy: www.lifetimeenergy.ca/Home.php

Both Manitoba Hydro and North Waterloo Hydro offer loans for ground source heat pumps, with payment occurring through consumers' electricity bills. Manitoba Hydro provides loans of up to $15,000 at a 6.5% fixed interest rate, to be paid off over 15 years. The North Waterloo Hydro program, called Lifetime Energy, is offered in partnership with a heat pump manufacturer, NextEnergy. Few details were available for the Lifetime Energy program, but it shows key potential to develop joint programs with technology developers.

Manitoba Hydro's program recognizes that this industry has been harmed in the past by installers with limited training and experience. A previous program in Ontario provided incentives that encouraged high interest in heat pumps, but it did not have requirements for the certification of installers. Approximately 5–10% of the systems failed or performed poorly, leading to strong customer distrust of the technology.[60]

The current program in Manitoba works with the International Ground Source Heat Pump Association to sponsor installer certification courses. Manitoba's geothermal industry has expanded by 40%, and Manitoba is now a Canadian leader in deploying this technology.[61] Manitoba Hydro staff report that awareness of heat pump technology has increased from 20% in 2001, prior to program inception, to 62% in 2005. Informal feedback to the staff on this program indicates that customers feel that heat pump technology provides personal and environmental benefits.[62]

Low interest loans are viewed as a highly appropriate instrument for this technology and market. The cost of a system is significant, and most customers need some form of financing. While capital cost rebates can be useful in spurring the market further, the concern of increasing the demand for the technology without sufficiently trained suppliers remains. Low interest loans may have a more moderate impact on customer demand. Another concern with capital cost rebates is that they can artificially raise costs (i.e., capital or installation costs). With few technology providers in the market, increasing demand can lead to increased costs in the short term. While these examples are being implemented by utilities, key opportunities could exist for government to work with utilities to provide additional financing to further lower the interest/leasing rates. [63]

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[60] Ted Kantrowitz, Canadian Geoexchange Coalition, personal communication, February 2007.

[61] www.ontarioenvirothon.on.ca/Pages/Modules/Special%20Topic/current%20issue%202007/pdfs/Manitoba%20Hydro%20and%20 Their%20GHP%20Incentive%20Program.pdf

[62] Dominic Marinelli, Manitoba Hydro, personal communication, March 2007.

[63] Marinelli, personal communication.

Table 38: Germany's Feed-In Tariff for Renewables

Germany's Feed-In Tariff for Renewables	
Types of financial instruments:	Feed-in tariff (EEG), consumer rebate (ended in 2004)
Jurisdictional authority:	National plus some local rebates
Important design features:	The feed-in tariff and consumer rebates overlapped from 2000 to 2004, prior to abolishment of rebates.
Supporting policies:	Green pricing policies from local utilities
Lessons learned:	As the PV Policy Group states, "only the combination between EEG and HTDP secured commercially oriented PV investors a full payback of their investment and the breakthrough of the market."
For more information:	PV Policy Group, *European Best Practices Report Assessment of 12 National Policy Frameworks for Photovoltaics* (2006), www.epia.org/documents/PV_Policy_Group_European_Best_Practice_Report.pdf

Solar energy in Germany has been extremely successful from a number of perspectives, including deployment levels, program cost-effectiveness and acceptance of the technology (by the public, industry, politicians). One of the keys to Germany's success has been its feed-in tariff (EEG) which was implemented in 2000, revised in 2004 and has no expiry date. Prior to the EEG, Germany had programs that provided consumer rebates. The first rebate program, the 1,000 Solar Roofs program, started in the early 1990s. This program was followed by the 100,000 Rooftops (HTDP) program which started in 1999. The EEG requires power grid operators to purchase photovoltaic system origin electricity according to the following tariffs:

- Free surfaces : 45.7 c€/kWh[64]
- Roofs < 30 kW: 57.4 c€/kWh
- Roofs between 30 and 100 kW: 54.6 c€/kWh
- Roofs > 100 kW: 54 c€/kWh
- Façades < 30 kW: 62.4 c€/kW
- Façades between 30 and 100 kW: 59.6 c€/kWh
- Façades > 100 kW: 59 c€/kWh[65]

These tariff values decrease by 5% each year, with a 20-year price guarantee.

According to the PV Policy Group, the following lessons can be gained from Germany's experience:

- An essential success factor for a feed-in-tariff system is the exact, country-specific calculation of the threshold for the profitable operation of PV plants (the break-even point). Market demand does not respond proportionally to the amount of the feed-in tariff, but does respond very sensitively to the smallest investment barriers.
- Subsidy programs can be very effective short-term measures to stimulate the market; however, a sustainable promotion strategy for PV should not depend on the usual

[64] On March 28, 2007, the conversion rate was 1.00 € = 1.54332 Canadian$, www.xe.com/ucc/convert.cgi

[65] EurObserv'ER, *Photovoltaic Energy Barometer* (Paris, France: Observ'ER, 2006), www.epia.org/03DataFigures/barometer/Barometer_2006_full_version.pdf

> budget constraints of subsidy schemes. Without the parallel introduction of the EEG, the German HTDP program definitely would not have been successful.[66]

The importance of the combination of the financing programs through the HTDP and the feed-in tariffs is illustrated by the following description:

> On the other hand, even in the year 2001 the soft loan under the HTDP programme led to specific electricity production cost of 51–62 €ct/kWh (depending on the size of the installation). Given an average electricity price in the liberalised energy market of 2,4 €ct/kWh (in 2002), there was still a financial gap of nearly 50 €ct/kWh to make PV electricity production profitable. The Renewable Energy Law (EEG) introduced a higher feed-in tariff for all investors in April 2000. The EEG feed-in tariffs were 50,6 €ct/kWh for PV plants installed during 2000 to 2001, and 48,1 or 45,7 Cent for plants installed from 2002 to 2003. The fact that the feed-in tariff was guaranteed for at least 20 years reassured investors of secure, long-term cash flows that ensured a full payback of the initial investment in combination with the HTDP loans. However, the EEG and HTDP were not only complementary; there were further synergies that contributed to overall market leverage. The guaranteed feed-in tariff reduced the credit risk of PV investments, which enticed commercial banks to offer 100 % financial coverage by means of the HTDP loans (that are never given directly by the public KfW bank, but via private banks). On the other hand, the public soft loan programme led to the introduction of commercial credit offerings for PV projects by the banks themselves. This is an important issue as previously the technology had been virtually unknown, which in itself denied access to economically feasible financing (due to prohibitively high interest rates, security requirements, etc). [67]

As of June 2004, Germany had installed 794,000 kW of Solar PV, or 9.62 Watts per capita. Canada had 13,884 kW of PV capacity, 0.44 Watts per capita.[68]

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[66] PV Policy Group, *European Best Practices Report Assessment of 12 National Policy Frameworks for Photovoltaics* (European PV Policy Group, 2006), www.epia.org/documents/PV_Policy_Group_European_Best_Practice_Report.pdf

[67] Ibid.

[68] International Energy Agency, *Trends in Photovoltaic Application in Select IEA Countries, 1992 and 2004* (International Energy Agency, IEA Photovoltaic Power Systems Programme, 2005), www.oja-services.nl/iea-pvps/isr/index.htm

5 Instrument Assessment

5.1 Assessment Criteria

A number of criteria are useful in assessing and comparing the economic instruments described in the preceding chapters. Table 39 describes a set of evaluation criteria that were used to evaluate each of the economic instruments. This is not intended to be a comprehensive set of evaluation criteria. Other situations may warrant consideration of additional criteria not presented here. The full and detailed results of the evaluation are included in Appendix F.

Table 39: Policy evaluation criteria

Criteria	Explanation
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?
	Can the policy be used to remove market limits (e.g., encourage power storage)?
	Can the policy apply to systems that sell into the grid as well as meet host load?
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?
	Is there a one-time cost or on-going costs?
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?
	Are the systems needed to support the policy already in place?
	Would the policy require monitoring and reporting systems that are not currently established?
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?
	Will renewable energy industries support the policy?
Fairness	Is there fairness with respect to level of income and the ability to benefit from the measure?
	How would the policy affect different income classes?
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?
	Are there any existing policies that might conflict with the proposed policy?
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?
	Will the same instrument be able to apply to new houses and retrofits of existing houses

Criteria	Explanation
	or will a different set of instruments be required for each?
	Is the instrument applicable to rental and owner-occupied units alike?
Flexibility to be Performance-Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?
Ability to Address Non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeking out the payback of a technology.
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?
	Will the policy be supported by urban and rural stakeholders?
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?
	Are there perverse incentives that come into play?
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal level or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology?
Flexibility to Respond to Unforeseen/Unexpected Results	How readily can the policy be adjusted if its goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?

5.2 Results of Instrument Assessment

Each of the policy instruments presented and described earlier was assessed according to the criteria identified above. In the sections that follow, we summarize some of the key conclusions drawn from this assessment.

5.2.1 Instruments Targeted at Manufacturers, Installers and Distributors

Relative to economic instruments that reduce up-front capital costs or provide on-going financial benefits, instruments targeted at manufacturers, installers and distributors of renewable energy technology are less common. Examples do exist, however, especially in the U.S. where all levels of governments have initiatives targeted at these entities. Table 33 highlights some conclusions about each of the instruments targeted at manufacturers, installers and distributors.

Table 40: Assessment summary for instruments targeted at manufacturers, installer and distributors

Instrument	Conclusions
Rebate/refund	A rebate or refund to manufacturers, installers or distributors can provide a flexible economic instrument for increasing the supply of and access to target technologies. It can provide flexibility with respect to target region and target technologies. Since it is paid for through budget appropriations, it may be vulnerable to budget cuts before policy objectives have been met. There are examples of this kind of a policy in place in the U.S.
Tax incentive	A tax incentive to manufacturers, installers or distributors can provide a flexible economic instrument for increasing the supply of and access to target technologies. It can provide flexibility with respect to target region and target technologies. It does not require a cash outlay but instead involves foregone tax revenue, making it less prone to annual budget cuts. It is relatively easy to administer given that the tax filing system is already well-established. Numerous examples of tax incentives exist in Canada and elsewhere.

A number of additional points from the assessment of tax incentives and refunds or rebates to manufacturers, installers and distributors are worthy of highlighting:

- Because economic instruments targeted at manufacturers, installers and distributors are geared toward increasing the supply of and access to renewable energy technologies, there is no guarantee that they will actually lead to increased renewable energy deployment or uptake or production of energy from renewable energy technologies. The cost savings experienced by these entities may or may not be passed onto consumers in the form of reduced costs. Economic instruments targeted at manufacturers, installers and distributors are thus best pursued as part of a comprehensive package of policies geared toward increasing renewable energy deployment and production.
- Experience has demonstrated that it is important to increase the supply of and access to renewable energy technologies at the same time as demand for such technologies increases. Policies geared toward the deployment of renewable energy technologies and renewable energy production need to be balanced with those targeted at increasing the supply of and access to relevant technologies.
- Economic instruments targeted at manufacturers, installers and distributors are relatively easy to administer and relatively inexpensive. There is likely to be high buy-in from stakeholders with little or no opposition, especially if this kind of policy is implemented as part of a broader set of policies targeted at renewable energy.
- Policies such as these in the U.S. have often been implemented at the state level as a means to entice companies working on renewable energy technologies to relocate. The objective of such initiatives is not only to increase the supply of and access to relevant renewable technologies, but also to achieve broader economic gains such as increased employment.
- From a design perspective, for such policies to be effective, they need to be guaranteed to be in place for a sufficient amount of time (5–10 years) and should be based on output rather than cost (i.e., they should be based on the number of units produced or installed).

5.2.2 Instruments to Decrease the Initial Capital Cost

Instruments that decrease the initial capital cost have a long history, and many examples are in effect today. The administrative ease of implementing these instruments as well as jurisdictional flexibility are two reasons for their popularity. Their cost-effectiveness is difficult to determine since each example brings unique design elements — size of incentive, length of program, and presence or lack of other support activities — that could play important roles in program effectiveness. Table 34 lists some conclusions for each of the instruments in this category. Full details of the policy assessment for instruments that reduce capital costs are available in Appendix F.

Table 41: Assessment summary for instruments that decrease the initial capital cost

Instrument	Conclusions
Rebate/refund for consumers	This instrument is simple to administer and flexible to adjustments for particular markets, technologies, income groups, regions, rural/urban locations and across time. It complements other instruments and policies well and many precedents exist. If this flexibility is over-used — if programs are repeatedly started and stopped, for example

	— the public will view this instrument negatively.
Property or income tax credit	This instrument has not been tested in Canada for renewables, but would likely be simple to administer. Precedents exist in the U.S. Depending on the design, the total incentive may be limited by the amount of tax paid by each consumer.
Sales tax rebate	This instrument is simple to administer, but there is less flexibility in design for focusing on specific markets or regions. It complements other instruments and policies well and many precedents exist. The incentive level is limited by amount of the sales tax.
Leasing, fee-for-service or rental schemes	This instrument could help expand the market to renters or other groups with limited access to capital. Its design would be based on partnerships between government, utilities and manufacturers — such partnerships could be beneficial for improving policy design and implementation. There are very few precedents for this instrument, and no examples that include government partnership.
Guaranteed / low interest loan	This type of instrument has precedents in Canada and elsewhere and is assessed as a useful complement to other instruments and policies, especially once consumers are aware of the benefits of renewable technologies. This instrument is limited to systems that require financing and to consumers that can qualify for the loans.
Financed as local improvement	Once a working system is set up, the market penetration for a targeted technology could be quite high relative to the administrative cost. Several municipalities are considering pilot programs to test this concept for increased energy efficiency. This instrument may have legal barriers. Like other financing instruments, it will likely require additional instruments to achieve large changes in deployment.
Mortgage insurance reduction	This instrument has not been used in Canada for renewables but has been used to incent increased energy efficiency. It may not be sufficient on its own to promote significant update of renewable energy systems but could provide an effective instrument for the new home market.
Reduction of development charges and fees	Some municipalities in Canada are providing reductions in building permit charges for energy efficient homes; this instrument could complement and expand these efforts. It may not be sufficient on its own to promote significant uptake of renewable energy systems. Municipalities would need to justify the decreased charges, and rural and existing homes would not have access to this instrument.

A number of additional points from the assessment of economic instruments to decrease capital costs are worth highlighting:

- Rebates/refunds, tax incentives (income, property and sales), mortgage rate decreases and low interest loans can be important support instruments. Simple to administer, they can be targeted to particular technologies, markets or regions, and they have the flexibility to be adjusted based on the market's reaction. However, governments need to be wary of unplanned changes to these instruments. Experience shows that premature cancellation of these instruments can swiftly erode market gains and public confidence in investing in renewable energy systems. Programs need to be maintained for 5–10 years and reductions in financial incentives should decline gradually.
- The size of the incentives provided by tax credits/exemptions, mortgage rate decreases and low interest loans are limited, and these instruments are unlikely to provide significant market change without other supporting policies. These instruments are less

easily accessed by low income groups that pay little or no income or property tax, since the value of the incentive is limited to the total tax that can be reduced. Low income groups will have less access to mortgages and loans but government support can help lower that barrier.

- Leasing programs, local improvement charges through municipalities, and rebates on municipal development fees are relatively new avenues for promoting renewable energy systems. Experience with these instruments is limited but they may offer innovative opportunities to transform the renewable energy market by focusing on homeowners who anticipate that their occupancy will be shorter than the payback period of the system and on developers who can have an important influence on the supply of renewable systems in new homes (which are often a more cost-effective opportunity for renewables).
- Experiences in other jurisdictions have raised concerns that instruments that decrease capital costs may:
  - encourage the uptake of renewable energy systems that are not the lowest-cost systems from a lifecycle cost-benefit approach;
  - encourage the uptake of renewable energy systems that are not installed properly to achieve the greatest renewable energy generation, nor ensure that the system continues to produce energy once installed;
  - promote the development of a service industry that is interested only in short-term benefits resulting from the installation of the systems;
  - limit market-based capital cost savings that would occur with economies of scale or additional production experience; and/or
  - be perceived as unfairly providing additional benefits to higher income groups.

  These concerns can be addressed in many ways. Governments can maintain staff resources to evaluate changing market conditions and ensure that the most appropriate technologies are given appropriate incentives (see Illinois Small Wind, for example). Capital cost rebates can be split between an up-front rebate and amounts paid after the system has met performance criteria standards following system installation and use. Incentives should not be based entirely on a fraction of system cost — for example, providing 50% of the installation cost may encourage installers and manufacturers to keep capital costs high. Incentives may need to be adjusted to ensure that lower income groups have fair access to the programs.

5.2.3 Instruments that Provide On-going Financial Benefits

Economic instruments that provide on-going financial benefits to qualifying entities have been implemented around the world. They have been credited with facilitating significant increases in renewable energy production in leading countries — in Germany, for example. These instruments provide a direct link to the performance of the technologies by providing incentives based on the amount of energy or heat produced from qualifying technologies. If well-designed and properly implemented, performance-based instruments such as these provide a strong incentive to increase renewable energy and heat production. Table 35 summarizes some of the conclusions for each instrument. Full details of the policy assessment for instruments that provide on-going performance-based financial benefits are available in Appendix F.

Table 42: Assessment summary for instruments that provide on-going financial benefits

Instrument	Conclusions
Feed-in Tariffs	Feed-in tariffs are rated as the most effective instrument in rapidly developing renewable energy supply — especially for technologies that are still in the early days of market development. However, without special rules for small scale power or heat systems, feed-in-tariffs are not easily accessible to small-scale renewable energy system users. A feed-in tariff is primarily designed to support renewable power systems that sell to the grid, but could be used for heat-producing technologies like solar water heaters as long as natural gas distributors were required to purchase the heat. The only cost to government of a feed-in tariff is the cost of managing the contracting process, although this too can be recovered through the rate base. The federal government could buy down the cost to a province's consumers through annual transfers to any province that chooses to use feed-in tariffs, or could provide complementary assistance though other instruments. Innovative financing schemes would have the greatest positive impact on the use of feed-in tariffs as they would allow pay-down of capital from the revenue received.
Tradable Renewable Energy Certificates	Because of the complexity of selling into an REC market, this instrument is only effective in increasing the rate of deployment of small-scale residential renewables if effective brokers or aggregators are available to purchase green attributes from homeowners. The RECs approach is by definition dependent on regular increases in the renewables target set by a renewable portfolio standard (RPS). RECs are not easily varied by technology. Each jurisdiction using the REC approach would need to establish a legal RPS and set up market rules for RECs along with the market regulatory/administrative system and verification systems for each REC. RECs have mostly been used to support renewable power sources — including solar water heaters that displace electricity. With an RPS for gas utilities, RECs could also be used to support renewable heat that displaces natural gas. The federal government currently does not have the jurisdictional authority to set legal targets for renewable power and heat like it can for renewable fuels.
Production Incentives	Production incentives or tax credits are fairly easy to take advantage of after the initial investment in appropriate/qualifying technologies. A production incentive or production tax credit is primarily designed to support systems that sell to the grid, but it could be used for technologies like solar water heaters which meet host load but reduce demand from the grid or natural gas system. This could be independent but complementary to provincial incentives. To be effective for small-scale systems, production incentives would need to be accompanied by financing schemes that allow use of the incentive to help pay down capital costs.
Offsets	An offset system can only be implemented as part of a greenhouse gas regulation and compliance regime — most likely only at the federal level. The size of the payment is limited by the price of carbon. The use of an offset system is also complicated for the user. There is no financial contribution to the renewable energy system by government as this comes from the greenhouse gas emitter purchasing the offset. On the other hand, the government must manage the offset system and would also likely need to provide capacity building support to small users of the offset system. Offsets could be used at the same time as other instruments — most easily with other performance-based instruments that need to estimate the same power or heat output of the system. Offsets automatically favour those regions where greenhouse gas emissions per household are higher. It cannot, therefore, be used to address other regional differences.

A number of additional points from the assessment of these instruments are worth highlighting:

- Economic instruments that provide on-going financial benefits like feed-in tariffs (FIT) and RPS/tradable certificates are becoming the instruments of choice for incenting renewable power in jurisdictions that can regulate power utilities. Both of these instruments help provide the long-term investment environment needed to establish a strong market, and provide either a regulatory (RPS) or price (FIT) basis for orderly market development. FITs are now seen as the most effective economic instrument: they provide guaranteed access to new renewable power sources and tend to deliver power at lower costs than an RPS because of the higher risk and complexity of the certificate approach. Because the cost of the incentive is shared among all rate payers, the incentive can be higher and more permanent than one paid out of a tax base.
- RPS and FIT approaches are less easy to apply to renewable sources of heat because of the need for a heat meter and also because heat is not a marketable energy source that can be sold to a utility. Low cost heat meters are becoming available, however (i.e., $150 to $300),[69] and there are proposals for a standard offer for gas utilities that require them to pay for heat produced by customers using renewable sources like solar water heaters. To date, this approach has only been tried in certain states in the U.S.[70]
- In federal jurisdictions that do not have authority over utilities (as is the case in Canada), economic instruments that provide on-going financial benefit are often provided through the tax system. The U.S. production tax credit is one example. These kinds of instruments can also be provided outside the tax system — as is the case with the Wind Power Production Incentive and the new ecoENERGY Renewable Energy initiative in Canada. While not provided through the tax system, this policy still requires appropriations in the annual budget, making it very susceptible when governments change and budgetary priorities shift.
- Offset systems that use a baseline and credit approach are subject to a different set of challenges. For example, payment for emissions reductions can only be made to projects that would not have gone ahead without the offset system in place — the so-called additionality requirement. This means that a validation step is necessary to establish additionality before the project is implemented and any payments for emission reductions from renewable power and heat can occur. A further problem is that in provinces that have high hydroelectric power fractions, very low credit payments would be made for renewable power projects. Finally, a credit price of at least $20 per tonne is necessary to make participation in this type of program worthwhile due to the transaction costs that are incurred by the project developer/energy generator.
- When applying an economic instrument for providing on-going benefits to small residential renewable systems, there are a number of additional points to consider:
  - Incentives targeted at production do not offset the high up-front costs associated with purchasing renewable energy technologies. Thus, production-based

[69] Rob McMongale, Canadian Solar Industries Association, personal communication, February 2007.

[70] In Florida and Connecticut, for example.

incentives such as these should be used in combination with initiatives targeted at reducing or spreading out the initial capital cost of relevant technologies.

- Homeowners and farmers are likely to be hesitant to sign the long-term contracts associated with many of these instruments.
- Two-way meters for power or heat meters need to be purchased and installed for these instruments to be effective.
- Small amounts per payment can mean relatively high administrative costs for a program.

Some of these issues can be addressed by combining incentives for reducing up-front capital costs with incentives for production into a one-time payment for the purchase of qualifying technologies. The payment would reflect both the initial capital cost as well as the expected production of renewable energy or heat from the technology over its lifetime. Mortgage and local improvement charges financing could also be used in combination with production-based instruments to spread the up-front costs over a greater period of time. Local improvement charges could also address the long-term contracting issue as the cost would be passed on to future owners. The use of aggregators to allow a large number of homeowners to purchase renewable systems together and take advantage of performance-based instruments would also help spread costs more thinly and reduce resistance to long-term contracts.

5.3 Policy Assessment Conclusions and Additional Considerations

The sections above provide key conclusions for each set of economic instruments considered for this study. Appendix F provides the comprehensive results for the policy assessment in which 40 different evaluation questions were answered for 14 different economic instruments. In the series of bullets listed in Sections 5.3.1 through 5.3.4 below, we draw conclusions related to maximizing the effectiveness of economic instruments for increasing deployment and production of renewable energy in the residential and farm sectors in Canada through appropriate policy design and implementation. We make links between the choice of economic instrument and a) stage of market development; b) type of renewable energy technology; and c) size of renewable energy system. We also draw conclusions about how to implement a mix of policies at different levels of government so that the policies reinforce and complement each other to overcome barriers related to renewable energy deployment.

5.3.1 Policy Design Considerations

- Regardless of the type of economic instrument, to be effective the incentive provided by the instrument must be of sufficient size to significantly establish or move the market for the renewable energy technology forward. It must also be in place long enough to make market growth self-sufficient. This means creating an economic environment using economic and other instruments that provides a reasonable return on investment for manufacturers, homeowners, farmers or third-party investors. Based on the analysis in Section 2, Table 43 illustrates the size of incentive (as a reduction in capital costs or life-cycle cost) needed to make the cost of renewable energy equivalent to the cost of conventional energy.

Table 43: Size of incentive required to make cost of renewable energy equal to conventional energy

	Incentive expressed as reduction in capital cost ($)		Incentive expressed as reduction in life-cycle cost (cents / kWh)	
Technology	Low	High	Low	High
Solar Hot Water Heating	$256	$2,941	0.7	10.0
Ground Source Heat Pumps*	NA	NA	NA	NA
Solar PV	$21,348	$25,553	33.0	53.8
Small Wind Turbines (2kw)	$5,996	$9,357	17.0	92.7

* Ground source heat pumps are not amenable to this type of calculation because they produce energy for space and water heating, and cooling. For example, the range of incentives required to produce a simple 7-year payback for heat pumps would be between $3,134 and $16,842.

- Policy consistency is the key. There needs to be a commitment from government to maintain the policy over a sufficient length of time (a minimum of 5–10 years) to provide certainty and long-term support to potential investors.[71]
- Some of the instruments reviewed in this study are limited in terms of the impact they can have on the cost differential between conventional and renewable technologies. Providing complementary instruments (capital cost rebates and financing) or providing systems where customers can pool their renewable resource to apply for performance credits could help overcome these limitations.

5.3.2 Stage of Market Development

- There may be a need for greater support (and a different instrument) in the early stages of market development for a particular technology when the retail price is still high because of small production volumes and long distribution chains. The size and type of support at this stage should be geared toward providing a premium to early investors and to establishing a national supply network. A capital buy-down instrument complemented by incentives for manufacturers would be most appropriate at this stage of market development.
- Once more of a mass market has been established, support levels should be set to provide a permanent advantage for the renewable energy technology that is based more on its environmental benefits. This can be best achieved by providing an on-going financial benefit based on performance, or a capital cost buy-down that takes into consideration not only the up-front capital cost but also the expected production benefit from the technology over its lifetime.

[71] See, for example, G. Barbose, R. Wiser and M. Boliner, *Supporting Photovoltaics in Market-Rate Residential New Construction: A Summary of Programmatic Experience to Date and Lessons Learned,* (2006), www.cleanenergystates.org/CaseStudies/CESA-LBL_PV_in_new_homes_FINAL_3.15.06.pdf

5.3.3 Size of Renewable Energy System

- For larger systems where investors can provide their own financing, performance incentives based on energy delivered — especially feed-in tariffs — can be an effective means of establishing and growing a market for renewable electricity producing technologies. This may not be the case for smaller systems.
- The effectiveness of performance-based instruments for small-scale systems increases significantly if it is combined with an economic instrument that reduces or spreads out the up-front capital costs. A refund or rebate on the cost of the equipment or a financing scheme (local improvement charges or mortgage financing, for example) that spreads the cost out over a longer period of time used in combination with a performance-based incentive would be appropriate. Some form of aggregation would also make it much easier for small system owners to participate in performance-based incentives.

5.3.4 Appropriate Policy Mix

- To maximize the deployment of renewable energy technologies and the production of renewable energy, a comprehensive set of policies implemented by all levels of government is needed. It is important that as the local market for renewable energy technologies is developed, the supply of and access to these technologies also increases. An appropriate policy mix will provide incentives to manufacturers and consumers and will address the need to reduce up-front capital costs and provide on-going financial benefits.
- The federal government is limited in the type of instruments it can implement because of restrictions on jurisdictional authority. However, it can implement instruments to effectively complement the best provincial and municipal instruments, and also encourage these other levels of government to use the most effective policy tools. For example, feed-in tariffs are one of the most appropriate tools for a provincial government to use to support small-scale power systems (solar PV and wind, for example). Municipal governments can complement this policy by serving as aggregators, with financial institutions, community investors and municipalities providing financing. Then the federal government could provide incentives for manufacturers, installers and distributors as well as a capital cost incentive for customers.[72] The value of these incentives could be reduced over time as market penetration of relevant technologies grows.
- For heat producing technologies, such as solar water heaters and ground source heat pumps, complementary federal and provincial buy-down rebates might work best. This could involve, for example, a short-term (5-year) federal buy-down based on reducing the cost to establish a market, and a long-term provincial buy-down based on aggregated environmental benefits over the life of the system. This latter policy would serve as a surrogate to a feed-in tariff system for heat technologies.

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[72] The ability of the federal government to provide support for manufacturers, installers and developers may be limited by the North America Free Trade Agreement (NAFTA). Policies targeted at these entities should be vetted through any legal requirements associated with NAFTA. Any resulting policy would need to comply with NAFTA rules or obtain an exemption due to environmental imperatives.

6 Next Steps

To help advance the process of supporting renewable energy technologies in the residential and farm sectors, three next steps have been identified:

1. *Select a mix of technologies.* At present, the specific technologies that are going to be supported have not been selected. This analysis helps initiate that discussion by providing information about the market potential, economics and environmental benefits of different technologies across the country. As the first next step, those characteristics need to be weighed against one another to determine what mix of technologies will be supported. That mix needs to reflect the extent to which costs, benefits and potential vary significantly from one region to another.
2. *Prioritize instruments.* Although a mix of capital cost reductions and capital financing has been recommended, that recommendation does not prioritize the specific instruments within those categories (e.g., rebates versus tax credits, or loans versus local improvement charges). Making this selection is an important next step, and the decision will depend on: 1) the size of the incentive available through the instrument versus the size required to spur market change; 2) the segment(s) of market being focused on; 3) the level of government implementing the policy; and 4) the relationships between governments and other partners (e.g., financial institutions, utilities and leasing agents).
3. *Choose the amount of the incentive.* This critical action will ideally be based on the expected lifetime performance benefits (energy produced, emission reductions) of the system so as to be large enough to encourage the desired level of market uptake. This analysis has provided some insight into the economics of these technologies to help make this decision; however, additional challenges that relate to how consumers make investment decisions also need to be accounted for.

In moving forward on these next steps, it is important to remember that the choice of economic instruments is just one piece of the puzzle. Two other key considerations also need to be addressed in any strategy to develop a market for renewable energy technologies in the residential and farm sectors:

- Since the variety of barriers present in the current market extends beyond cost, a mix of policy tools (i.e., not only economic instruments) will be needed to overcome them.
- To succeed, any policy instrument needs to have clear long-term commitments. Incentives can decrease over time, but the timing and scale of decreases need to be widely communicated in advance to maintain a strong investment environment.

Appendix A: Housing Stock

Details on Canadian housing stock:

Table 44: Canadian housing stock

Canadian Housing Statistics		Average Size (m^2)	Number of Housing Units	% of total
By Type				
	Single Detached	139	7,474,000	57.6%
	Single Attached	118	1,349,000	10.4%
	Apartments	83	3,877,000	29.9%
	Mobile Homes	97	266,000	2.1%
By Vintage				
	Before 1946	116	1,832,000	14.1%
	1946–1960	102	1,278,000	9.9%
	1961–1977	106	3,353,000	25.9%
	1978–1983	119	1,544,000	11.9%
	1984–1995	130	3,019,000	23.3%
	1996–2000	139	1,002,000	7.7%
	2001–2004	142	938,000	7.2%
Totals		**119**	**12,967,000**	

Appendix B: HOT2 XP Models

Details of typical house was modeled in HOT2 XP for each region:

- Year built: 1980 (National Energy Use Database (OEE), Canadian Housing Statistics)
- One storey (bungalow)
- Rectangular shape
- 15% glass (mostly front and back)
- Flat ceiling
- Full Basement (concrete, 100% insulated with R12, RSI 2.1)
- South orientation
- 1460 ft2, 135 m2 (National Energy Use Database (OEE), Canadian Housing Statistics)
- Attic R28 (RSI 4.9)
- 2x4 wood frame with R12 batt (RSI 2.1)
- Double glazed windows with wood frame
- Average air tightness (4.55 ACH @ 50 Pa pressure difference)
- Heating temperature set-point 70 F (21°C)
- Occupancy of 4 (default)
- Heating system – varies by region
- Air-conditioning was included (with a COP of 3) for each house to calculate the expected electricity consumption of the A/C system in each region (varies with weather data).

Sample output (Winnipeg)

HOT2XP Version 2.73

```
**************************************
*                                    *
*            HOT2XP                  *
*          Version 2.73              *
*            CANMET                  *
*     Natural Resources CANADA       *
*          Jul 22, 2005              *
**************************************
```

Application type : General

Weather Data for WINNIPEG, MANITOBA

*** ANNUAL SPACE HEATING SUMMARY ***

Design Heat Loss at -33.0 C = 24.12 Watts/m3	= 15635. Watts
Gross Space Heat Loss	= 155427. MJ
Gross Space Heating Load	= 153641. MJ
Usable Internal Gains	= 29826. MJ
Usable Internal Gains Fraction	= 19.2 %
Usable Solar Gains	= 17983. MJ
Usable Solar Gains Fraction	= 11.6 %
Auxiliary Energy Required	= 105832. MJ
Space Heating System Load	= 106379. MJ
Furnace/Boiler Seasonal efficiency	= 69.3 %
Furnace/Boiler Annual Energy Consumption	= 151511. MJ

*** ANNUAL SPACE COOLING SUMMARY ***

Design Cooling Load for Jul at 30.0 C	= 7286. Watts
Design Sensible Heat Ratio	= .769
Estimated Annual Space Cooling Energy	= 1462. kWh
Seasonal COP (Jan to Dec)	= 1.853

*** ANNUAL DOMESTIC WATER HEATING SUMMARY ***

Daily Hot Water Consumption	= 225.0 Litres /day
Hot Water Temperature	= 55.0 C
Estimated Domestic Water Heating Load	= 17065. MJ
PRIMARY Domestic Water Heating Energy Consumption	= 30011. MJ
PRIMARY System Seasonal Efficiency	= 56.9 %

*** BASE LOADS SUMMARY ***

	kwh/day	Annual kWh
Interior Lighting	2.9	1056.7
Appliances	13.5	4931.2
Other	2.9	1056.7
Exterior use	4.0	1460.0
HVAC fans		
HRV/Exhaust	.2	87.6
Space Heating	1.5	562.4

Space Cooling	.4	143.4
Total Average Electrical Load	25.5	9297.9

*** FAN OPERATION SUMMARY (kWh) ***

Hours	HRV/Exhaust Fans	Space Heating	Space Cooling
Heating	62.4	562.4	.0
Neither	1.8	.0	.0
Cooling	23.4	.0	143.4
Total	87.6	562.4	143.4

*** ENERGY CONSUMPTION SUMMARY REPORT ***

Estimated Annual Space Heating Energy Consumption = 153536. MJ = 42648.8 kWh
Ventilator Electrical Consumption: Heating Hours = 0. MJ = .0 kWh
Estimated Annual DHW Heating Energy Consumption = 30011. MJ = 8336.3 kWh

ESTIMATED ANNUAL SPACE + DHW ENERGY CONSUMPTION
= 183546. MJ = 50985.1 kWh

Estimated Greenhouse Gas Emissions 14878. kg/Year

*** ESTIMATED ANNUAL FUEL CONSUMPTION SUMMARY ***

Fuel	Space Heating	Space Cooling	DHW Heating	Appliances	Total
Natural Gas (m3)	4066.4	.0	805.5	.0	4871.9
Electricity (kWh)	624.8	1462.1	.0	8506.3	10593.2

****
Energy units: MJ = Megajoules (3.6 MJ = 1 kWh)

The calculated heat losses and energy consumptions are only estimates, based upon the data entered and assumptions within the program. Actual energy consumption and heat losses will be influenced by construction practices, localized weather, equipment characteristics and the lifestyle of the occupants.

Appendix C: Sources for Energy Rates

Sources on energy rates:

The following fuel utilities' most recent rates were accessed:

- Irving Oil (Heating Oil, Maritimes). www.irvingoil.com/pr_home/can
- Blue Wave Energy (Heating Oil, Nova Scotia). www.bluewaveenergy.ca
- GazMetro (Natural Gas, Quebec). www.gazmetro.com
- Enbridge (Natural Gas, Ontario). www.enbridge.ca
- Direct Energy (Natural Gas, Ontario). www.directenergy.com/EN/Ontario/Pages/RegionalHomepage.aspx
- Manitoba Hydro (Natural Gas, Manitoba). www.hydro.mb.ca
- SaskEnergy (Natural Gas, Saskatchewan). www.saskenergy.com
- Direct Energy (Natural Gas, Alberta). www.directenergy.com/EN/Alberta/Pages/RegionalHomepage.aspx
- Terasen Gas (Natural Gas, BC). www.terasengas.com

The following electricity utilities most recent rates were accessed:

- Nova Scotia Power (electricity, Nova Scotia). www.nspower.ca
- NewBrunswick Power (electricity, New Brunswick). www.nbpower.com
- Maritime Electric (electricity, PEI). www.maritimeelectric.com
- Newfoundland Power (electricity, Newfoundland and Labrador). www.newfoundlandpower.com
- HydroQuebec (electricity, Quebec). www.hydroquebec.com
- Toronto Hydro (electricity, Toronto, Ontario). www.torontohydro.com
- Manitoba Power (electricity, Manitoba). www.hydro.mb.ca
- SaskPower (electricity, Saskatchewan). www.saskpower.com
- Epcor (electricity, Edmonton, Calgary). www.epcor.ca
- Direct Energy (electricity, Alberta). www.directenergy.com/EN/Alberta/Pages/RegionalHomepage.aspx
- BC Hydro (electricity, BC). www.bchydro.com

Appendix D: Solar Hot Water and Heat Pump Quotes

Solar hot water heating quotes

Component	Low	High	Detail
Labour	$1,000		2-3 people, $65/hour, 2 days
Equipment	$600	$800	Copper pipe run on outside of building (if retrofit pipes through building, up to 4-5 days labour instead of 2)
2nd water tank	$350		
Flat Plate Collectors	$3,400		
Vacuum Tube		$4,300	Better in shoulder seasons, up to 25% better on bright sunny winter day, but problems in winter because snow doesn't slide off easily.
Total range	**$5,350**	**$6,450**	
Potential savings if accessible roof (i.e., bungalow)			
Labour	$400		
Equipment (copper)	$100		
Bungalow Install	**$4,850**	**$5,950**	
Potential Savings for New Buildings – Plumbing already fitted up to roof, both tanks in.			
Estimate if new house already has pipes/tank	$500	$700	
Bulk purchase/install savings potential	15%		labour, large purchase of collectors, etc.

Ground Source Heat Pumps Price Quotes

Source: RadiantHeat (Kingston)		
3000 sq.ft, 3 floors w/ radiant in-floor	**Low**	**High**
Radiant Floor Cost		$ 18,000
Lake-loop	$ 18,000	
Cost of forced air system (instead of in-floor)	$ 5,000	
cost increase for trenching	30-40%	
Total Range	**$ 23,000**	**$ 36,000**
Source: EdenEnergy (Guelph). Allan Zacher		
Heating, Cooling, 40% DHW	**Low**	**High**
Heat Exchange Unit (top of the line)		$ 11,050
Basic Exchange Unit	$ 8,000	
Triple Function unit		$ 11,870
Earth-loop system (trenching)	$ 6,500	
Vertical loop (for equivalent house		$ 12,000
Retrofit to fit existing duct system	$ 400	
200 AMP electrical service	$ 1,500	$ 1,800
In-floor heating ($/sq.ft)	$ 7	
Heat Pump (if ONLY using hot-water in-floor)	$ 8,600	
Total Cost Range Estimate (not in-floor)	**$ 16,400**	**$ 25,250**
Source: NextEnergy (Tim Weber)		
2300 sqft	**Low**	**High**
Vertical Loop Cost	$ 7,980	$ 9,600
Horizontal Loop (all-in, hooked up to house)	$ 5,500	
Forced Air system	$ 8,000	$ 9,000
Controls, duct hook-up, misc	$ 1,000	$ 1,000
Total - vertical loop	**$ 16,980**	**$ 19,600**
Total - horizontal loop	**$ 14,500**	**$ 15,500**
Added Costs For Retrofit Application		
upgrade to 4 tonne unit (for lesser insulated homes)	$ 1,000	
add another bore hole ($12/$13 per sq.ft)	$ 2,160	$ 2,700
add modification to duct work	$ 1,000	
Extra Cost Total (for vertical)	$ 4,160	$ 4,700
Total cost for Retrofit Application (vertical)	**$ 21,140**	**$ 24,300**
Total cost for Retrofit Application (horizontal)	**$ 16,500**	**$ 17,500**

Appendix E: Federal and Provincial Programs

Federal and Provincial Programs to support residential scale renewable energy.

Source: www.incentivesandrebates.ca

Federal

Name	Canada Mortgage and Housing Corporation (CMHC) Mortgage Loan Insurance Refund
Jurisdiction	Federal
Technology	Solar hot water, Ground source heat pumps, and solar PV can be installed to achieve points towards BuiltGreen certification.
Description	10% of the cost of CMHC mortgage insurance (e.g., approximately $275 for a $100,000 mortgage with a 5% down payment, or approximately $85 for a $20,000 mortgage for renovation) CMHC offers a 10% premium refund on its mortgage loan insurance premiums, as well as extended amortization to a maximum of 35 years (subject to lender availability), to individuals who use CMHC-insured financing to purchase an energy efficient home, purchase a home and make energy-saving renovations, or renovate their existing home to make it more energy efficient. The refund is a one-time payment. For home buyers, the refund and extended amortization are available • when a house meets the requirements of one of the following programs: R-2000 (national), Built Green Gold label, Power Smart New Home Program (Manitoba), ENERGY STAR® for New Homes (Ontario) or Novoclimat (Quebec); • when a house has an EnerGuide for Houses rating of 77 or above; • when a house with an EnerGuide for Houses rating of less than 77 is renovated to increase the rating by at least five points and to a value of at least 40; or • when, for a condominium unit, the building meets the requirements of the federal Commercial Building Incentive Program (in which case a letter attesting to this must be obtained from Natural Resources Canada or the project engineer).
Time Horizon	Extended amortization is available through participating lenders for all new CMHC mortgage insurance applications approved as of January 2005.

Name	ecoENERGY for Renewable Heat (announced)
Jurisdiction	Federal
Technology	Solar hot water
Description	Incentives will be made available for investments in renewable energy and renewable heat. Eligible renewable energy will include energy from wind, biomass, small hydro and ocean energy. Renewable thermal technologies for

	water and space heating will also be eligible. An incentive will be offered to purchasers of solar heating systems in the industrial, commercial and institutional sectors. The incentive will be set at 25 percent of the purchase, installation and certain other costs of a qualifying system.
Time Horizon	Commence April 2007 (details to be released)

Name	ecoENERGY for Retrofit (announced)
Jurisdiction	Federal
Technology	Solar PV and Small Wind
Description	Available to owners of single family homes including detached, semi-detached and low rise multi-unit residential buildings. Property owners can qualify for federal grants by improving the energy efficiency of their homes, and reducing their home's impact on the environment. The maximum grant one can receive per home or multi-unit residential building is $5,000
Time Horizon	Commence April 2007 (details to be released)

Alberta

Name	SunRidge BuiltGreen homeowner rebate
Jurisdiction	Alberta
Technology	Solar PV and Solar Heat are applicable in the BuiltGreen standards. Ground Source Heat Pumps (GSHP) systems also applicable. The BuiltGreen standard also recognizes purchase of renewable electricity during the construction process.
Description	The City of Lethbridge is offering homebuyers in the SunRidge development rebates for houses that meet environmental performance targets. For houses that meet the “gold” standard for environmental achievement, homeowners will receive a rebate of $3,500. For houses that meet the “silver” standard for environmental achievement, homeowners will receive a rebate of $2,500. Environmental standards are based on the EnerGuide rating for houses, which takes into consideration energy efficiency and energy consumption in the home. Up to $3,500 per house. Contact the City of Lethbridge Real Estate and Land Development Department at 910-4th Avenue, South, Lethbridge, Alberta or call 403-320-3905. : Web site. Web site for useful resources related to the program.
Time Horizon	

British Columbia

Name	Fortis PowerSense Heat Pump Incentive
Jurisdiction	British Columbia
Technology	Home heating/cooling system purchase/replacement. GSHP eligible.
Description	Fortis customers can choose between a reduced-interest loan and a cash grant when they install a ground or air source heat pump. For a qualifying project, a loan is available up to $5,000 at 4.9% interest and with a 10-year term. Alternatively, participants can receive a one-time grant of $0.05 for each kilowatt-hour in reduced annual electricity consumption.

	This incentive is available for ground source (geothermal) heat pumps meeting criteria including Canadian Standards Association standards and installed by a Fortis-approved contractor in homes where electricity is the primary source of space heating. Air source heat pumps must have a Seasonal Energy Efficiency Ratio (SEER) of 13 or greater. This program is not available to Fortis customers in Alberta. Per home: reduced-interest loan up to $5,000 or $0.05 per kWh of reduced annual consumption (typically $200–400) For more information: Web site. Phone: 800-363-3330. Call the PowerSense hotline at 800-363-3330.
Time Horizon	No expiry for program noted.

Name	Exemption for Material and Equipment Used to Conserve Energy (alternative energy sources).
Jurisdiction	British Columbia
Technology	Home renewable energy generation (wind, solar PV, solar heat, micro-hydro).
Description	The following renewable energy generating materials and equipment are exempt from provincial sales tax (Social Service Tax): wind-powered generating equipment; solar photovoltaic collector panels; solar thermal collector panels; and micro-hydro turbines and generators rated up to 150 kilowatts. In most cases, associated and necessary components of these systems, such as wiring, controllers, inverters, pumps, tubing and intake pipes (but not batteries) are also tax-exempt when purchased as part of the systems. For more information: Web site. Phone: 604-660-4524, or 877-388-4440 outside Vancouver. E-mail: CTBTaxQuestions@gov.bc.ca
Time Horizon	For GSHP – from Feb 16th, 2005 until March 31, 2009.

Name	Exemption for Material and Equipment Used to Conserve Energy (energy efficient residential furnaces, boilers and heat pumps)
Jurisdiction	British Columbia
Technology	Home heating/cooling system purchase/replacement. GSHP are eligible.
Description	Furnaces, boilers and heat pumps are exempt from the provincial sales tax (Social Service Tax) if they are ENERGY STAR® qualified or, in the case of oil-fired forced air furnaces, if they have a Seasonal Energy Utilization Efficiency (SEUE) rating of at least 85%. To qualify for the exemption, the equipment must be purchased or leased (where the lease period began on or after February 16, 2005) for installation in a residential dwelling. The exemption applies to all parts of the equipment, including piping and refrigerant solutions integral to heat pump systems, but excluding duct work used to circulate air in a house, generic thermostats or supplementary heating systems not integral to a heat pump system. For more information: Web site. Phone: 604-660-4524, or 877-388-4440 outside Vancouver. Web site listing the models of furnaces, boilers and heat pumps that qualify for the exemption. Web site explaining ENERGY STAR guidelines.

	7% of the purchase price of furnaces, boilers and heat pumps, automatically received at the time of purchase.
Time Horizon	

Manitoba

Name	Manitoba Hydro Earth Power Loan
Jurisdiction	Manitoba
Technology	GSHP eligible
Description	This reduced-interest loan is available to homeowners purchasing a geothermal heat pump system. Both new installations and heating system replacements are eligible, regardless of previous fuel source. To qualify for the loan, a new geothermal heat pump must be tested and rated under CSA Standard C-13256. Note that geothermal heat pump systems must be installed to meet the specifications of CSA C448, Canada's national design and installation standard for heat pump systems. The maximum loan is $15,000. The annual fixed interest rate is 6.5%. The maximum term is 15 years, and additional payments can be made at any time after the first six months with no interest penalty. Monthly installments are included on the customer's energy bill. The maximum term of the loan is 15 years at a fixed interest rate of 6.5 per cent. The loan is paid off on your Manitoba Hydro energy bill. To qualify for a Residential Earth Power Loan, you must be: • A customer of Manitoba Hydro, and • Approved for credit from Manitoba Hydro, and • Owner of the home where the heat pump will be installed. The loan is available through participating contractors who will look after the paperwork. For more information: Web site. Phone: 888-MBHYDRO (888-624-9376).
Time Horizon	

New Brunswick

Name	New Brunswick Energy Efficient New Homes Program
Jurisdiction	New Brunswick
Technology	GSHP, solar air heating, solar water heating.
Description	The New Homes Program provides financial assistance to homeowners of new homes if their home is R-2000 certified or has an EnerGuide for Houses rating of 80 or more. There are three levels of financial incentives available: • The basic grant of $1,000 for new EnerGuide 80 or R-2000 certified homes regardless of the heating system type • The Central Heating – Electric Grant of $2,000 for new EnerGuide 80 or R-2000

	certified homes that have an electric boiler, furnace or ENERGY STAR® rated (or equivalent) air source heat pump as the primary source of heating • The Central Heating – Non-Electric Grant of $3,000 for new EnerGuide 80 or R-2000 certified homes that have an eligible non-electric central heating system such as a natural gas, oil or wood furnace or boiler or a geothermal heat pump. For more information: Web site. Contact Efficiency NB toll free: 1-866-643-8833. Web site explaining ENERGY STAR guidelines. Web site explaining the R-2000 standard. Efficiency NB offers a $100 coupon that can be applied against the cost of the EnerGuide for Houses evaluations Efficiency NB offers a grant of up to $2000 or an interest-free loan of up to $10,000 to eligible New Brunswick homeowners who make energy efficiency upgrades to their home as recommended in their EnerGuide "Evaluation A" report The grant will be calculated at 20% of actual costs incurred (including HST), to a maximum grant of $2000 per applicant per eligible home. The minimum loan amount is $1000, and loans will not exceed the total cost of home upgrades (including HST). Once approved, applicants will be required to sign a Personal Loan Agreement and a Promissory Note. Loan terms of up to 6 years are available, based on the amount borrowed. Automatic payments are to be made monthly, and will range from $83.33/month for loans up to $6000, to $138.89/month for larger loans. *Application Guidelines*: Only upgrades recommended in an EnerGuide "Evaluation A" report are eligible for assistance under the Upgrades Program. Must be owners of single-family homes, row houses and side-by-side duplexes that have gone through the EnerGuide for Houses evaluations are eligible for assistance under the Upgrades Program. Landlords are eligible, provided their dwelling meets eligibility criteria. Vacation properties and cottages are not eligible under the program.
Time Horizon	Re-launched in January 2007. No set expiry.

Newfoundland

Name	Newfoundland Power Electric Heat Financing Program
Jurisdiction	Newfoundland and Labrador
Technology	GSHP are eligible.
Description	Newfoundland Power offers homeowners up to $10,000 in financing for the purchase and installation of electric home heating systems. This includes wiring, thermostats, amperage and voltage upgrades, energy efficient heat recovery ventilation systems and electric fireplaces. Specific technical requirements apply to the equipment to be installed. Loan payments are made through monthly electric bills, with repayment schedules up to 60 months. The interest rate available from January 1 to March 31, 2007 is 10.0%. For more information: Web site. Phone: 709-737-2802 or 800-663-2802.
Time Horizon	No expiry date listed.

Nova Scotia

Name	Renewable Energy Incentive / Solar Hot Water Rebate
Jurisdiction	Nova Scotia
Technology	Solar Water heating.
Description	Nova Scotia homeowners who purchase and install a new solar water heating system are eligible for a rebate from the provincial government of 10% of the total installed cost (up to a maximum rebate of $5,000). The rebate applies to systems designed for year-round operation purchased between October 12, 2005 and August 31, 2007. 10% of the total installed cost of solar water heating systems (e.g., $500 for a system costing $5,000) For more information: Web site. Phone: 800-670-4636.
Time Horizon	

Name	Energy Efficient Wood Heating Equipment Rebate
Jurisdiction	Nova Scotia
Technology	Biomass (wood and pellet)
Description	Nova Scotia homeowners who purchase and install a new EPA-certified wood stove or wood pellet stove are eligible for a $200 rebate from the provincial government. The rebate applies to stoves purchased between October 12, 2005 and August 31, 2007. For more information: Web site. Phone: 800-670-4636. Web site listing EPA-certified wood stoves.
Time Horizon	

Northwest Territories

-nothing-

Nunavut Territory

-nothing-

Ontario

Name	Ontario Standard Offer Program
Jurisdiction	Ontario
Technology	Renewable Power Generation.
Description	Ontario's Standard Offer Program provides a standard pricing regime for small renewable energy electricity generation projects. Eligible projects include those that produce electricity from wind, solar, photovoltaics, thermal electric solar, renewable biomass, biogas, biofuels, landfill gas or water power. Projects must have an installed capacity of less than 10 MW and be connected to an eligible

	electricity distribution system. Generators must enter into a 20-year contract with the Ontario Power Authority. All generators except photovoltaics will be paid an initial base price of 11 cents per kilowatt hour. After May 1, 2007 the price will increase annually with inflation. Projects that are able to operate reliably during peak hours will be paid an additional 3.52 cents per kilowatt hour for electricity delivered during those hours. Photovoltaics will be paid a fixed price of 42 cents per kilowatt hour for the full term of the contract.
Time Horizon	No expiry set.

Name	Retail Sales Tax Rebate for Wind, Micro Hydro-Electric and Geothermal Energy Systems for Residential Premises
Jurisdiction	Ontario
Technology	All renewable electricity or renewable mechanical power systems. GSHP are eligible.
Description	Owners of residential premises, including multi-residential buildings, can claim a refund of the 8% Retail Sales Tax (provincial sales tax) paid on new wind, micro hydro-electric and geothermal energy systems and on any expansions or upgrades to existing systems installed in their premises. Eligible wind and hydro-electric systems may produce electrical or mechanical energy. Eligible geothermal systems are those designed to absorb heat from solar-heated ground. Systems include generators, controllers, wiring, devices that convert direct current into alternate current, the first batteries used to store the energy produced, the tower and associated works for wind energy, pipes and associated works for hydro-electric and geothermal energy, and pumps and heat exchangers for geothermal energy. The rebate does not cover the internal heat distribution system (i.e., ducts). Eligible systems, expansions and upgrades must be purchased and incorporated into residential premises on or after March 28, 2003, and on or before November 25, 2007. In the case of a new building that incorporates one of these systems, the tax rebate can be claimed by the owner only if the contract is with the owner. 8% of the purchase price. For more information: Web site. Phone: 877-482-9329. TO obtain the incentive the applicant must complete and submit a "General Application for Refund of Retail Sales Tax" form.
Time Horizon	No expiry set.

Name	Retail Sales Tax Rebate on Solar Energy Systems
Jurisdiction	Ontario
Technology	Home renewable energy generation
Description	Owners of residential premises, including multi-residential buildings, can claim a refund of the 8% Retail Sales Tax (provincial sales tax) paid on new solar energy systems and on any expansions or upgrades to existing systems installed in their

	premises. Eligible systems include solar photovoltaic systems that convert solar energy into electricity, or solar thermal systems that convert energy into heat. Systems include wiring, controllers, devices that convert direct current into alternate current, the first battery used to store the energy produced, thermal collector panels, pumps, tubing, heat exchangers and insulated energy storage tanks. Eligible systems, expansions and upgrades must be purchased and incorporated into residential premises on or after November 26, 2002 and on or before November 25, 2007. In the case of a new building that incorporates a solar energy system, the tax rebate can be claimed by the owner if the owner has purchased the system, and the builder has not claimed the rebate. 8% of the purchase price For more information: Web site. Phone: 877-482-9329.
Time Horizon	

Name	Cambridge and North Dumfries Hydro EarthWise program
Jurisdiction	Ontario
Technology	Solar Water Heating, GSHP.
Description	Cambridge and North Dumfries Hydro customers can obtain a range of incentives to encourage home energy efficiency. These incentives are available through the EarthWise program, a partnership between Cambridge and North Dumfries Hydro and the Residential Energy Efficiency Project (REEP): • a reduction in the price of an EnerGuide for Houses evaluation undertaken by REEP to $100; • for electrically heated homes, a grant of up to $500 for implementing the EnerGuide for Houses recommendations; • a free report on the energy efficiency of a home's major appliances, comparing them to the most efficient models; • two free compact fluorescent lights; • up to $1,500 of incentives for installing ground source (geothermal) heating/cooling systems; • for homes with electric water heaters, up to $1,500 for installing a solar water heating system. For more information: Web site. Phone: 519-744-9799.
Time Horizon	

PEI

Name	Provincial Sales Tax Exemption on small-scale renewable energy equipment
Jurisdiction	Prince Edward Island
Technology	Wind, biomass, GSHP, solar heat, solar PV.
Description	Small-scale renewable energy equipment with a rating of 100 kilowatts or less is exempt from the provincial sales tax. The following items are eligible for this

	exemption: • wind energy generating systems • biogas energy generating systems • ground-source or geothermal heat pump energy generating systems • solar thermal energy collection systems • solar photovoltaic energy collection systems • drain water heat recovery energy collection devices. 10% of the purchase price of eligible equipment. For more information: Web site. Phone: 902-569-7542.
Time Horizon	The exemption applies only to purchases made on or after April 8, 2005.

Name	Alternative Heating Loan Program
Jurisdiction	Prince Edward Island
Technology	Biomass (wood, pellet), solar air heating, soarl water heating, GSHP.
Description	Loans at a rate of 6% are available to Price Edward Island homeowners for the purchase and installation of alternative heating systems that reduce oil consumption. Eligible alternative heating systems include • wood burning appliances that comply with Canadian Standards Association (CSA) codes or have EPA certification; • wood pellet burning appliances that comply with CSA codes or have EPA certification; • solar air heating systems that comply with CSA codes or have EPA certification; • solar water heating systems that comply with CSA codes or have EPA certification; • ground or water source heat pump systems that are ENERGY STAR® qualified; and • drain water heat recovery systems. Loans can also cover accessories (e.g., a new chimney) needed to safely operate a new alternative heating system. Applicants must be full-time residents of Prince Edward Island. Reduced-interest loan up to $5,000 per home For more information: Web site. Phone: 902-368-5990 or 888-893-4333. Web site listing EPA-certified wood stoves. Web site explaining ENERGY STAR guidelines.
Time Horizon	

Quebec

Name	Energy Efficiency Fund / Gaz Métropolitain Solar Wall
Jurisdiction	Quebec
Technology	Solar Air Heating

Description	Homeowners using natural gas heating are eligible to receive $400 in financial assistance towards the installation of a solar wall. A solar wall installed on the south side of a building uses sunlight to warm air drawn into the building through a heat recovery vent. The rebate is provided by Québec's Energy Efficiency Fund to Gaz Métropolitain customers, and is applicable to both new and existing homes. For more information: Web site. Phone: 514-529-2216, or 866-529-2216 outside Montreal.
Time Horizon	

Saskatchewan

Name	Sales Tax Exemption for New ENERGY STAR® qualified furnaces, boilers and ground and air source heat pumps
Jurisdiction	Saskatchewan
Technology	Ground Source Heatpumps
Description	New ENERGY STAR qualified forced-air furnaces and boilers purchased on or after November 9, 2005 and until March 31, 2007 are exempt from the 7% provincial sales tax. New ENERGY STAR ground and air source heat pumps purchased on or after July 1, 2006 and until March 31, 2007 are exempt from the 7% provincial sales tax. The exemptions also apply to new appliances leased for at least one year. The exemption applies to all parts and equipment that form part of the new furnace, boiler, or ground or air source heat pump as supplied at the time of purchase or installation, but does not apply to heating distribution systems such as ductwork. 7% of the purchase price (e.g., $280 for a furnace costing $4,000), automatically received at the time of purchase. For more information: Web site. Phone: 306-787-6645, or 800-667-6102 outside Regina. Web site explaining ENERGY STAR guidelines.
Time Horizon	

Yukon

- nothing -

Appendix F: Economic Instrument Assessment

Manufacturers, Installers & Distributors: Rebate / Refund

Factor	Explanation	Rebate/Refund for Manufacturers and Distributors
Definition	Brief description of the policy	**An incentive provided to manufacturers, distributors and/or installers of renewable energy technologies. The incentive takes the form or a rebate or refund of costs incurred. The refund/rebate may be passed on to customers in the form of reduced prices for them.**

Factor	Explanation	Rebate/Refund for Manufacturers and Distributors
Description	Can the policy be implemented by the federal, provincial or municipal government?	**This type of policy could be implemented by the federal, provincial or municipal government.**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase supply of renewable energy technologies by reducing or offsetting costs at the manufacturer, distributor or installer level.**
	Cost recovery source-Tax base/rate base/Other	**This kind of a program is generally funded through appropriations made in annual budgets. This makes these types of programs more prone to being discontinued or temporarily suspended from one year to the next.**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**None.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**The state of Pennsylvania has implemented a number of incentive programs targeted at manufacturers in the renewable energy field in an effort to increase manufacturing of target technologies in the state. The incentives include grants for alternative fuels, renewable energy, and energy efficiency. Virginia provides substantial grants to solar photovoltaic manufacturers in the state.**
	Key example	**Virginia's Solar Manufacturing Incentive Program provides grants to manufacturers of solar photovoltaic panels. A total of $4.5 million was made available for this program. The grant is paid at a rate of up to 75 cents per watt for panels sold in a calendar year, up to six megawatts. Companies can receive this benefit for a maximum of five years.**

	Important design considerations	**Providing certainty that the program will be in place for a minimum number of years will increase confidence in the initiative, which will therefore increase the uptake and the effectiveness of the policy. This type of an initiative can be designed to encourage certain technologies in particular regions to take advantage of comparative advantages with respect to resources or market potential in the region. The policy should be designed so that the value of the incentive increases as the amount of manufacturing, installing or distributing of renewable energy technologies increases. The incentive is best linked to quantity rather than costs. If the incentive covers 50% of costs, manufacturers, installers or distributors may want to keep costs high to maintain high compensation. It is more appropriate for the incentive to be based on the number of installations, or the number of units manufactured or distributed.**

Factor	Explanation	Rebate/Refund
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**This policy could be implemented at any level of government. It would have the biggest impact if they applied all across the country encouraging new plants and distribution systems to be set up to serve a national market. It would therefore be best if they were federal. They could be supplemented by provincial and municipal incentives to encourage more rapid regional markets. Trade rules established under the North American Free Trade Agreement (NAFTA) may limit the federal government's ability to implement support programs for manufacturers, installers and distributors. Any such instruments must be vetted through NAFTA prior to implementation.**

Factor	Explanation	Rebate/Refund for Manufacturers and Distributors
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**This policy would be targeted at increasing the availability of renewable technologies and also reducing manufacturing and installation costs with the ultimate hope that some of the cost savings would be passed on to investors. There is no guarantee that this policy would lead to increased deployment of renewable technologies. It would be best combined with other policies as a complementary policy tool. Unlike tax credits, the size of the incentive is not limited to the value of the tax avoided. The effectiveness of this policy is thus determined by the size of the incentive (refund/rebate) provided. It could have a greater impact for technologies like solar water heaters which have a smaller price premium to be addressed.**
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**Impacts on renewable energy production as a result of this initiative would be indirect. By increasing the availability of renewable technologies and/or reducing the costs associated with those technologies, increased penetration could result which would lead to increased renewable energy production and improved environmental conditions.**
	Can the policy be used to remove market limits (e.g., encourage power storage)?	**The value of the rebate/refund could vary by technology and therefore address market limits.**

	Can the policy apply to systems that sell into the grid as well as meet host load?	**Yes, this policy can be used for both host load and grid connected systems.**

Factor	Explanation	Rebate/Refund for Manufacturers and Distributors
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**Since this type of policy would not be implemented through the tax system, it would require separate reporting and verification. Companies would have to fill out an application for the refund or rebate and submit it to the appropriate government body to receive their funds. To ensure that the reporting was accurate, some kind of verification by government (through submission of receipts for example) would be required.**
	Is there a one time cost or on-going costs?	**This policy involves on-going cost that would require a direct outlay of cash and be awarded according to a pre-determined set of criteria such as the value of manufacturing output or the number of systems installed.**
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**This policy could be quite cost-effective as it is easier to administer than a consumer targeted instrument and the size of rebate can be tailored to maximize potential impact.**

Factor	Explanation	Rebate/Refund for Manufacturers and Distributors
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**A rebate/refund is relatively more complex as it involves regular and multiple payments to qualifying entities (without the established reporting support of a tax framework).**
	Is it an extension of an existing program?	**No.**
	Are the systems needed to support the policy already in place?	**There are certainly numerous examples of refund or rebate policies in Canada so there are plenty of examples from which to learn. The systems needed to support this kind of a policy are rather straightforward, a set of eligibility criteria would need to be established, an application process determined and potential recipients would need to be made aware of the program.**
	Would the policy require monitoring and reporting systems that are not currently established?	**While this exact policy is currently not in place in Canada, there are numerous refund programs in place which could inform the establishment of the necessary monitoring and reporting systems. Given that the target sector for this policy is well defined and accessible, setting up the necessary systems would not be difficult.**

Factor	Explanation	Rebate/Refund for Manufacturers and Distributors
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**While not specifically targeted at manufacturers, distributors or installers, there are numerous examples of refund programs in place in Canada, especially at the municipal and provincial level. There are, for example, refunds for purchases of efficient vehicles, appliances, heating equipment, renewable energy equipment and energy efficient products. In addition, the market incentive program was a somewhat similar program that provided funds to support electricity distributors promoting renewable energy options.**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**This kind of a policy on its own will not be sufficient to spur significant investments in renewable energy technologies or increases in renewable energy production. Thus, the public may not be satisfied with pursuit of this initiative alone. It will, however, provide an appropriate complement to other policies targeted directly at renewable energy technology deployment and renewable energy production. Government financing of the incentive means that rate payers do not see an increase in their electricity costs as a result of the policy. Thus, direct opposition to the policy should be slight or non-existent.**
	Will renewable energy industries support the policy?	**Manufacturers, distributors and installers of renewable energy technologies stand to directly benefit from this initiative. They would thus be supportive of such a policy.**

Factor	Explanation	Rebate/Refund
Fairness	Fairness with respect to level of income/ability to benefit from the measure.	**Equity/fairness concerns are minimal with this policy as it is targeted at manufacturers, distributors and installers rather than individuals and homeowners.**
	How would the policy affect different income classes?	

Factor	Explanation	Rebate/Refund
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**This policy would be an excellent complement to other consumer targeted instruments. Combining this type of policy with others targeted at consumers would create a more balanced and comprehensive set of policy initiatives. If demand increases, so too should supply and access to meet the increase in demand. This policy would facilitate increases in supply and access.**
	Are there any existing policies that might conflict with the proposed policy?	**It does not conflict with other policies.**

Factor	Explanation	Rebate/Refund

Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**This incentive can be made available to manufacturers, distributors and installers regardless of the type of renewable energy technologies they focus on.**

Factor	Explanation	Rebate/Refund
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**Not targeted at, but applicable to all market segments.**
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**Not targeted at, but applicable to both new houses and retrofits of existing houses.**
	Is the instrument applicable to rental and owner occupied units alike?	**Not targeted at, but applicable to both rental and owner occupied units.**

Factor	Explanation	Rebate/Refund
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**Yes, the policy can be made broadly available to a host of environmental technologies and can be designed to provide a higher incentive to those technologies with the greatest market potential while still providing incentives to a range of technologies.**

Factor	Explanation	Rebate/Refund
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, Local Improvement Charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**This policy has a direct impact on high capital costs if the value (or portion of) the incentive is passed on to consumers in the form of reduced costs.**

Factor	Explanation	Rebate/Refund
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**The instrument choice need not vary by region. This kind of incentive can be made available across the country and provided that multiple technologies qualify for the incentive, the technologies incented in a particular region will reflect the comparative advantage of that region with respect to available resources and technologies.**
	Will the policy be supported by urban and rural stakeholders?	**Because the policy is targeted explicitly at manufacturers, distributors and installers there is no need to distinguish between impacts on urban versus rural stakeholders. Both will benefit indirectly from reduced installation, distributor and manufacturing costs should the savings be passed on to them by those benefiting from the incentive.**

Factor	Explanation	Rebate/Refund
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**Yes, this kind of a policy could also be made available to manufacturers, distributors and installers of energy efficient equipment.**
	Are their perverse incentives that come into play?	**If poorly designed, this type of a policy could provide incentive to manufacture, distribute and install renewable technologies that are not suited to the local region. This would hinder the long-term development of renewable energy due to the importance of linking technology development with local markets. Experience has shown that it is more difficult to develop a strong domestic industry without also developing a strong domestic market. The design of the policy should take into account the potential for various technologies within the local market.**

Factor	Explanation	Rebate/Refund
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**Any consumer based instrument would be complementary. Experience has shown that it is difficult to develop a strong domestic industry without also developing a strong domestic market. Thus, this kind of policy should be implemented along with policies specifically targeted at developing the local market.**

Factor	Explanation	Rebate/Refund
Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if it's goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**Historically, pricing policies have been criticized for being inflexible because once prices are established, they can be difficult to adjust. However, it is possible to set up a system such that payments can be adjusted on a regular basis to reflect changes in technologies and market conditions. These changes should take place on a pre-determined timeline to still provide certainty to investors.**

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Manufacturers, Installers & Distributors: Tax Incentive

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Definition	Brief description of the policy	**Tax incentive (credit, exemption, deduction, accelerated depreciation) provided to manufacturers, distributors and/or installers of renewable energy technologies. The incentive offsets costs incurred by the eligible entity and may be passed on to customers in the form of reduced prices for them.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Description	Can the policy be implemented by the federal, provincial or municipal government?	**A tax incentive can be offered by any level of government that levies taxes. Thus, it could be offered against property taxes at the municipal level or income or sales taxes at the provincial or federal levels.**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase supply of renewable energy technologies by reducing or offsetting costs at the manufacturer, installer or distributor level.**
	Cost recovery source-Tax base/rate base/Other	**Expenses associated with tax incentives come from general government revenues. Tax incentive programs require no cash outlay which makes them less prone to annual budgetary pressures (appropriations).**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**The introduction of tax incentives would require changes to the tax rules to allow those eligible to apply for the incentive against taxes due.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**India has an excise tax exemption for manufacturers of solar photovoltaic systems. The US offers tax incentives for manufacturers of Energy Star qualified appliances (dishwashers, clothes washers, refrigerators). A number of US states also offer tax incentives for manufacturers, including, for example, Arkansas, Texas, California and Virginia.**
	Key example	**The state of Texas provides an exemption from the states franchise tax (business tax). There is no maximum value to the exemption so it is considered a significant incentive.**
	Important design considerations	**Depending on the design of the policy, the ability of manufacturers, distributors and installers to take advantage of tax incentives may be limited by the amount of tax liability they have. Allowing tax credits to be refundable and/or carried forward will help address this concern. This type of an initiative can be designed to encourage certain technologies in particular regions to take advantage of comparative advantages with respect to resources or market potential in the region. The policy should be designed so that the value of the incentive increases as the amount of manufacturing, installing or distributing of renewable energy technologies increases. The incentive is best linked to quantity rather than costs. If the incentive covers 50% of costs, manufacturers, installers or distributors may want to keep costs high to maintain high compensation. It is more appropriate for the incentive to be based on the number of installations, or**

		the number of units manufactured or distributed.

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**This policy could be implemented at any level of government. In the U.S. where examples of this type of policy are more prominent, municipal governments have offered property tax incentives while federal and provincial governments have offered income tax incentives. This kind of incentive would have the biggest impact if they applied all across the country encouraging new plants and distribution systems to be set up to serve a national market. It would therefore be best if they were federal. There are several options for implementing this policy at the federal level. Incentives can be offered against income tax due or through exemptions from sales tax to the extent that the eligible entity (manufacturer, distributor or installer) is liable for such taxes. A federal policy could be supplemented by provincial and municipal incentives to encourage more rapid regional markets.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**This policy would be targeted at increasing the availability of renewable technologies and also reducing manufacturing, distribution and installation costs with the ultimate hope that some of the cost savings would be passed on to investors. There is no guarantee that this policy would lead to increased deployment of renewable technologies. It would be best combined with other policies as a complementary policy tool. The value of the incentive may also be limited to the amount of liable tax (unless it is refundable). The effectiveness of this polity would increase if targeted at technologies such as solar water heaters where price premiums over other conventional technologies are lower.**
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**Impacts on renewable energy production as a result of this initiative would be indirect. By increasing the availability of renewable technologies and/or reducing the costs associated with those technologies, increased penetration could result which would lead to increased renewable energy production and improved environmental conditions.**
	Can the policy be used to remove market limits (e.g., encourage power storage)?	**Tax credits could be varied by technology and provide higher credits for those that remove market limits.**
	Can the policy apply to systems that sell into the grid as well as meet host load?	**Yes, this policy can be used for both host load and grid connected systems.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**Tax incentives are not an administratively complex policy to introduce. The value of the incentive (the cost to government) corresponds to value being obtained over time and are thus justifiable. While it is difficult to know upfront what the total cost of this kind of a program will be (as it depends on enrollment), regular adjustments to the value of the incentive can be made to control cost issues.**
	Is there a one time cost or on-going costs?	**On-going cost that results in a reduction in taxes paid by the qualifying entity on an annual bases when taxes are due or at the time of purchase in the case of sales tax.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Cost-Effectiveness	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**This is one of the simplest policies to apply, but given that the value of the incentive may be limited by the size of the tax, it may not be as cost-effective as some other policies.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**In general, this kind of a policy instrument is relatively easy to administer and enforce. The introduction of a tax incentive would require adding this credit to tax forms or exempting eligible goods/services from sales tax/es at the time of purchase.**
	Is it an extension of an existing program?	**Somewhat, because the tax reporting framework is already established and would just need to be amended to incorporate this type of policy. At the same time, sales tax exemptions are already common in Canada. One advantage of using the tax system to provide incentives to manufacturers, distributors and installers is that the tax reporting/collecting framework is already established and can be amended to include desired incentives.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Administrative Simplicity	Are the systems needed to support the policy already in place?	**The systems needed to implement this kind of a tax incentive are already in place. Numerous tax incentives are already in place in Canada at both the federal and provincial levels. Since taxes are already filed on an annual basis, the introduction of this incentive would not increase the number of customer interactions.**
	Would the policy require monitoring and reporting systems that are not currently established?	**This kind of a tax incentive would require eligible participants to report on qualifying expenditures through their annual tax filings. In the case of exemptions from sales tax/es, the exemption could be awarded at the time of purchase.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**While not specifically targeted at manufacturers, distributors or installers, there are numerous examples of tax incentives in place in Canada. There are for example, tax incentives related to the purchase of efficient vehicles, appliances, heating equipment, renewably energy equipment and energy efficient products.**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**This kind of a policy on its own will not be sufficient to spur significant investments in renewable energy technologies or increases in renewable energy production. Thus, the public may not be satisfied with pursuit of this initiative alone. It will however, provide an appropriate complement to other policies targeted directly at renewable energy technology deployment and renewable energy production. Government financing of the incentive means that rate payers do not see an increase in their electricity costs as a result of the policy. Thus, direct opposition to the policy should be slight or non-existent.**
	Will renewable energy industries support the policy?	**Manufacturers, distributors and installers of renewable energy technologies stand to directly benefit from this initiative. They would thus be supportive of such a policy.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Fairness	Fairness with respect to level of income/ability to benefit from the measure.	**Manufacturers with significant tax liability will be in the best position to benefit from a production tax credit. Allowing the incentive to be carried forward or making it refundable will increase the ability of qualifying entities to benefit from this initiative.**
	How would the policy affect different income classes?	

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**This policy would be an excellent complement to other consumer targeted instruments. Combining this type of policy with others targeted at consumers would create a more balanced and comprehensive set of policy initiatives. If demand increases, so too should supply and access to meet the increase in demand. This policy would facilitate increases in supply and access.**
	Are there any existing policies that might conflict with the proposed policy?	**This policy should not conflict with any other instrument.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**A tax incentive can be made available to manufacturers, distributors and installers regardless of the type of renewable energy technologies they focus on.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**Not targeted at, but applicable to all market segments.**
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**Not targeted at, but applicable to both new houses and retrofits of existing houses.**
	Is the instrument applicable to rental and owner occupied units alike?	**Not targeted at, but applicable to both rental and owner occupied units.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**Yes, the policy can be made broadly available to a host of environmental technologies and can be designed to provide a higher incentive to those technologies with the greatest market potential while still providing incentives to a range of technologies.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**This policy has a direct impact on high capital costs if the value (or portion of) the incentive is passed on to consumers in the form of reduced costs.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**The instrument choice need not vary by region. A tax incentive can be made available across the country and provided that multiple technologies qualify for the incentive, the technologies incented in a particular region will reflect the comparative advantage of that region with respect to available resources and technologies.**
	Will the policy be supported by urban and rural stakeholders?	**Because the policy is targeted explicitly at manufacturers, distributors and installers there is no need to distinguish between impacts on urban versus rural stakeholders. Both will benefit indirectly from reduced installation, distributor and manufacturing costs should the savings be passed on to them by those benefiting from the incentive.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**Yes, this kind of a policy could also be made available to manufacturers, distributors and installers of energy efficient equipment.**
	Are their perverse incentives that come into play?	**If poorly designed, this type of a policy could provide incentive to manufacture, distribute and install renewable technologies that are not suited to the local region. This would hinder the long-term development of renewable energy due to the importance of linking technology development with local markets. Experience has shown that it is more difficult to develop a strong domestic industry without also developing a strong domestic market. The design of the policy should take into account the potential for various technologies within the local market.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology?	**Any consumer based instrument would be complementary. Experience has shown that it is difficult to develop a strong domestic industry without also developing a strong domestic market. Thus, this kind of policy should be implemented along with policies specifically targeted at developing the local market.**

Factor	Explanation	Tax Incentive for Manufacturers and Distributors

Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if it's goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**Historically, pricing policies have been criticized for being inflexible because once prices are established, they can be difficult to adjust. However, it is possible to set up a system such that payments can be adjusted on a regular basis to reflect changes in technologies and market conditions. These changes should take place on a pre-determined timeline to still provide certainty to investors.**

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State tax incentives for manufacturers: http://www.serconline.org/RenewableEnergyIncentives/greenIndustryRecruitmentIncentives.html

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Decrease Initial Capital Cost: Rebate/Refund for Consumers

Factor	Explanation	Rebate/refund for Consumers
Definition	Brief description of the policy	**A rebate or refund offered to consumers to offset a portion of the costs incurred in purchasing renewable energy technologies. This direct support is provided by a public authority (or utility).**

Factor	Explanation	Rebate/refund for Consumers
Description	Can the policy be implemented by the federal, provincial or municipal government?	**Any jurisdiction, also utility application.**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase demand of renewable technologies.**
	Cost recovery source-Tax base/rate base/Other	**Funding source is required but the source of funding is flexible - governments tax base, utilities rate base.**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**No enabling requirements or limitations.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**This type of instrument had been applied in many jurisdictions.** **Quebec - Solar wall** **Government of Canada - proposed funding for renewables, details have not been released** **Nova Scotia - Solar hot water heating**
	Key example	**Spain, Japan, California (see section on Key Examples in Main Report).**
	Important design considerations	**Effective use requires verification that the systems are installed properly and adjusted to maximize renewable output before providing payment. Programs that have run on short term have led to public distrust. Size of rebate/refund needs to be based on either a) amount needed to make system (more) cost-effective, b) estimated societal benefits over the life of the system (e.g., lifetime energy savings x carbon value), or c) capital equivalent of feed-in tariff (lifetime savings x tariff).**

Factor	Explanation	Rebate/refund for Consumers
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**Federal would be best to provide national consistency.**

Factor	Explanation	Rebate/refund for Consumers

Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**While there are no inherent limitations to this instrument, experiences of using this instrument in Canada and US have shown limited impact on the deployment rate compared with deployment achieved in countries. German experience indicates that rebates were most effective when combined with a feed-in tariff.**
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**This program does not directly support renewable energy production (rebates are based on the system purchase or installation, not on the use of the system). However, several jurisdictions, including California, have been designing rebates to be split with part being paid at time of installation and a part being paid after the system performance has been demonstrated.**

Factor	Explanation	Rebate/refund for Consumers
Ability and Capacity to Accelerate Deployment	Can the policy be used to remove market limits (e.g., encourage power storage)?	**The buy-down can be targeted to any technologies that remove market limits.**
	Can the policy apply to systems that sell into the grid as well as meet host load?	**Yes, this instrument could support systems that sell into the grid, it is blind to system use.**

Factor	Explanation	Rebate/refund for Consumers
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**Potentially simple administration, but more complex if verification of successful installation is required.**
	Is there a one time cost or on-going costs?	**On-going: one-time cost per customer that occurs at the purchase of the equipment, but experience indicates that the effectiveness of programs is enhanced by continuity over many years (at least 5).**
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**Given the flexibility of this instrument to achieve both environmental and market development goals, and its ability to be piggy backed on to other programs (e.g., EnerGuide for Houses) it has the potential to be quite cost-effective.**

Factor	Explanation	Rebate/refund for Consumers
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**Most basic requirement for administration is a system that provides money on proof of purchase, additional complexity may be desired to assure quality installation.**
	Is it an extension of an existing program?	**This could be an extension of the current programs (Manitoba Hydro, Fortis BC, REDI) or a new program that is more comprehensive.**
	Are the systems needed to support the policy already in place?	**Systems are in place to provide financial rebates, and some complimentary policies, such as training for geothermal installation, are in development -- could be added to EnerGuide for Houses).**

	Would the policy require monitoring and reporting systems that are not currently established?	**New monitoring and reporting systems are not required, but would be advantageous to audit contribution to renewable energy generation (rather than technology purchases).**

Factor	Explanation	Rebate/refund for Consumers
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**Yes, many examples.**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**The public may lack confidence in this program since many similar programs have been started and stopped in the past. Public is less willing to put effort into determining the best system for their home or farm if they are uncertain about how long rebates may be available (ESTIF paper, Bill Eggertson interview).**
	Will renewable energy industries support the policy?	**Renewable energy industry will have same concerns about program continuity as the public and will likely not support programs that offer rebates that are too low (need source).**

Factor	Explanation	Rebate/refund for Consumers
Fairness	Fairness with respect to level of income/ability to benefit from the measure. How would the policy affect different income classes?	**This instrument could be used to tailor rebate/refund by income class.**

Factor	Explanation	Rebate/refund for Consumers
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**This policy would complement and build on other consumer targeted renewable energy and energy efficiency programs.**
	Are there any existing policies that might conflict with the proposed policy?	**Might conflict with performance-based instruments, or the public might perceive renewables as "over subsidized" if applied in conjunction with feed-in tariffs, for example.**

Factor	Explanation	Rebate/refund for Consumers
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**This instrument can offer benefits to a mix of technologies, one challenge is to determine the appropriate rebate to offer different technologies.**

Factor	Explanation	Rebate/refund for Consumers
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**This instrument is most beneficial to markets where the purchasers of the technology also benefits from energy bill reductions from the technology.**
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**This instrument applies equally to new and existing houses.**
	Is the instrument applicable to rental and owner occupied units alike?	**This instrument does not apply equally to rental units where technology purchasers does not pay energy bill or maintain system.**

Factor	Explanation	Rebate/refund for Consumers
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**The incentive is based on technology purchase not on environmental performance, but the incentive could be based on an estimate of the environmental benefits of the system over its lifetime (e.g., lifetime savings or revenue x carbon value).**

Factor	Explanation	Rebate/refund for Consumers
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**No, this incentive is directed at reducing capital cost, additional policies would be required to address other barriers.**

Factor	Explanation	Rebate/refund for Consumers
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**This instrument can be varied by region but does not need to be.**
	Will the policy be supported by urban and rural stakeholders?	**There should be no difference in the support for refunds between urban and rural stakeholders.**

Factor	Explanation	Rebate/refund for Consumers
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**This instrument would work very well with energy efficiency programs like EnerGuide for Houses.**
	Are their perverse incentives that come into play?	**Energy efficiency measures might reduce the cost-effectiveness of host load renewable energy systems like solar water heaters, alternatively energy efficiency measures could help decrease the size requirements of the renewable energy system thus lower the cost of the renewable energy system.**

Factor	Explanation	Rebate/refund for Consumers
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**Training and accreditation for technology installers.**

Factor	Explanation	Rebate/refund for Consumers
Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if it's goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**While the level of incentive can be adjusted up or down in response to usage, it would be unwise to do so. Oversubscription should be seen as a sign of success not free ridership, and therefore the program should not be capped for this reason.**

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Decrease Initial Capital Cost: Tax Credit (Property, Income)

Factor	Explanation	Tax Credit (property, income)
Definition	Brief description of the policy	**A tax credit or refund provided to individuals who purchase renewable energy technologies. The credit or refund for a portion or all costs incurred would reduce the amount of income or property tax due.**

Factor	Explanation	Tax Credit (property, income)
Description	Can the policy be implemented by the federal, provincial or municipal government?	**Income tax - provincial or federal** **Property – municipal**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase demand of renewable technologies.**
	Cost recovery source-Tax base/rate base/Other	**Tax base (in other words, all taxpayers).**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**Income or property tax rule change, incentive is limited by the income or property taxes paid by individuals.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**USA** **Federal** **Alabama, Arizona, California, Hawaii, Idaho, Iowa, Maryland, Massachusetts, Montana, New Mexico, New York, North Carolina, North Dakota, Oregon, Rhode Island, South Carolina, Utah**
	Key example	**California solar (federal tax credit).**
	Important design considerations	**To be effective and equitable, the incentive should be in place for at least 5 years.**

Factor	Explanation	Tax Credit (property, income)
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**A property tax credit is best implemented at the municipal level, while an income tax credit can be implemented by the provincial or federal government. The public is likely to see a larger direct impact on municipal taxes. Income tax credits tend to be less transparent.**

Factor	Explanation	Tax Credit (property, income)
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**Depending on the design of the credit, the size of the incentive may be limited by the size of the tax paid. If the taxes paid by the group that is targeted for this instrument are zero or low, a non-refundable tax credit would provide a low level of financial benefit. It is therefore best implemented as a refundable tax credit or used where incentives needed are small.**

	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**This program does not directly support renewable energy production (Tax Credits are based on the system purchase or installation, not on the use of the system)**
	Can the policy be used to remove market limits (e.g., encourage power storage)?	**This policy can be targeted at individual technologies that remove market limits.**
	Can the policy apply to systems that sell into the grid as well as meet host load?	**Yes, this instrument could support systems that sell into the grid, it is blind to system use.**

Factor	Explanation	Tax Credit (property, income)
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**Income Tax systems can be set up relative easily, but may need other instruments to produce a high uptake and make them cost-effective.**
	Is there a one time cost or on-going costs?	**There is a cost to setting up the tax credit system but the one-time cost per customer that occurs at the purchase of the equipment will be low. Experience indicates that the effectiveness of programs is enhanced by continuity over many years (at least 5).**
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**For technologies where the incentive needed is less than the tax this would be a more cost-effective instrument than buy-down rebate/refund.**

Factor	Explanation	Tax Credit (property, income)
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**Tax system will need to be changed to allow for this exemption, but most tax systems include some provisions to account for particular technologies.**
	Is it an extension of an existing program?	**For Canada, this would be a new program.**
	Are the systems needed to support the policy already in place?	**No.**
	Would the policy require monitoring and reporting systems that are not currently established?	**New monitoring and reporting systems are not required, but would be advantageous to audit contribution to renewable energy generation (rather than technology purchases).**

Factor	Explanation	Tax Credit (property, income)
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**There are many precedents in the U.S., but none in Canada for renewables. The federal government program of tax credits for public transit could provide basic information as a precedent.**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**Yes, depending on the level of the tax credit.**
	Will renewable energy industries support the policy?	**Less likely as it is dissociated from the sale.**

Factor	Explanation	Tax Credit (property, income)
Fairness	Fairness with respect to level of income/ability to benefit from the measure. How would the policy affect different income classes?	**This policy would favour those with higher incomes and higher property values.**

Factor	Explanation	Tax Credit (property, income)
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**While this would be a new program and the interactions with existing programs are uncertain, it could provide additional support to instruments such as sales tax rebates.**
	Are there any existing policies that might conflict with the proposed policy?	**No.**

Factor	Explanation	Tax Credit (property, income)
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**This instrument can offer benefits to a mix of technologies, one challenge is to determine the appropriate tax credit to offer different technologies.**

Factor	Explanation	Tax Credit (property, income)
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**This instrument is most beneficial to markets where the purchasers of the technology also benefits from energy bill reductions from the technology.**
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**This instrument applies equally to new and existing houses.**
	Is the instrument applicable to rental and owner occupied units alike?	**This instrument does not apply equally to rental units where technology purchasers does not pay energy bill or maintain system.**

Factor	Explanation	Tax Credit (property, income)
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**The incentive is based on technology purchase not on environmental performance, but the incentive could be based on an estimate of the environmental benefits of the system over its lifetime (e.g., lifetime savings or revenue x carbon value).**

Factor	Explanation	Tax Credit (property, income)
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**No, this incentive is directed at reducing the capital cost, additional policies would be required to address other barriers.**

Factor	Explanation	Tax Credit (property, income)
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**Will not need to vary by region.**
	Will the policy be supported by urban and rural stakeholders?	**There should be no difference in the support for tax credits between urban and rural stakeholders.**

Factor	Explanation	Tax Credit (property, income)
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**Yes, this instrument could be designed to promote both renewable and energy efficiency systems.**
	Are their perverse incentives that come into play?	**Energy efficiency measures might reduce the cost-effectiveness of host load renewable energy systems like solar water heaters, alternatively energy efficiency measures could help decrease the size requirements of the renewable energy system thus lower the cost of the renewable energy system.**

Factor	Explanation	Tax Credit (property, income)
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**This policy would work well with financing instruments like LICs and mortgage financing because of its association with the property.**

Factor	Explanation	Tax Credit (property, income)
Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if it's goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**It would not be advisable to change the size of the credit but it could be done. Ideally any changes to incentives should provide public and the market ample opportunity to adjust to new financial set-up.**

Sources

Database on State Incentives for Energy Efficiency and Renewable Energy (DSIRE) http://www.dsireusa.org/index.cfm?EE=0&RE=1

Decrease Initial Capital Cost: Tax Rebate (sales)

Factor	Explanation	Tax Rebate for consumers (sales)
Definition	Brief description of the policy	**This financial incentive allows the capital cost of the renewable system to be exempt from sales tax.**

Factor	Explanation	Tax Rebate for consumers (sales)
Description	Can the policy be implemented by the federal, provincial or municipal government?	**Provincial (those with sales tax) or federal (GST).**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase demand of renewable technologies.**
	Cost recovery source-Tax base/rate base/Other	**Tax base (in other words, all taxpayers).**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**Sales tax rule change, incentive is limited by the amount of the sales tax. Alberta and the Territories do not have provincial sales tax. Other provinces' sales tax rates range from 5% to 10%. The Federal Goods and Services tax is 6%.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**Ontario (8%), Prince Edward Island (10%), British Columbia (7%).**
	Key example	
	Important design considerations	**To be effective and equitable, the incentive should be in place for at least 5 years.**

Factor	Explanation	Tax Rebate for consumers (sales)
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**Provincial, for provinces with sales tax.**

Factor	Explanation	Tax Rebate for consumers (sales)
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**Sales taxes are 10% or less and therefore the impact of their removal is limited. This instrument should therefore be used only for technologies where a 5-10% incentive will make a difference.**
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**This program does not directly support renewable energy production (tax exemptions are based on the system purchase or installation, not on the use of the system).**

	Can the policy be used to remove market limits (e.g., encourage power storage)?	**This policy can be targeted at individual technologies that remove market limits.**
	Can the policy apply to systems that sell into the grid as well as meet host load?	**Yes, this instrument could support systems that sell into the grid, it is blind to system use.**

Factor	Explanation	Tax Rebate for consumers (sales)
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**Sales tax credits are relatively simple to administer but may not provide a high impact without other instruments to increase uptake.**
	Is there a one time cost or on-going costs?	**Sales tax credits cost little to set up and the one-time cost per customer that occurs at the purchase of the equipment is mostly borne by the retailer. Experience indicates that the effectiveness of programs is enhanced by continuity over many years (at least 5).**
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**For technologies where the incentive needed is less than the tax this could be a more cost-effective instrument than buy-down rebate/refund. This instrument is used very effectively to incent the purchase of Energy Star appliances.**

Factor	Explanation	Tax Rebate for consumers (sales)
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**Sales tax system will need to be changed to allow for this exemption, but most provinces have systems to account for exemptions for qualifying goods and services.**
	Is it an extension of an existing program?	**Three provinces have sales tax exemptions, this could be seen as extensions to other provinces, or extensions to other technologies as applicable.**
	Are the systems needed to support the policy already in place?	**Yes.**
	Would the policy require monitoring and reporting systems that are not currently established?	**New monitoring and reporting systems are not required, but would be advantageous to audit contribution to renewable energy generation (rather than technology purchases).**

Factor	Explanation	Tax Rebate for consumers (sales).
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**Precedents exist in Prince Edward Island, Ontario and British Columbia.**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**The sufficiency of this instrument will depend on the technology and the region (tax levels and energy prices).**
	Will renewable energy industries support the policy?	**Yes.**

Factor	Explanation	Tax Rebate for consumers (sales)
Fairness	Fairness with respect to level of income/ability to benefit from the measure. How would the policy affect different income classes?	**This would likely be more accessible to higher income levels that are more likely able to afford energy systems with higher capital costs. For those with lower incomes that are able to purchase the renewable energy systems, this instrument provides a larger benefit in relative household expense than higher income households.**

Factor	Explanation	Tax Rebate for consumers (sales)
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**Could build on other sales tax credit schemes and work well with other instruments.**
	Are there any existing policies that might conflict with the proposed policy?	**No.**

Factor	Explanation	Tax Rebate for consumers (sales)
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**This instrument can offer benefits to a mix of technologies.**

Factor	Explanation	Tax Rebate for consumers (sales)
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**This instrument is most beneficial to markets where the purchasers of the technology also benefits from energy bill reductions from the technology.**
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**This instrument applies equally to new and existing houses.**
	Is the instrument applicable to rental and owner occupied units alike?	**This instrument does not apply equally to rental units where technology purchasers does not pay energy bill or maintain system.**

Factor	Explanation	Tax Rebate for consumers (sales).
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**The incentive is based on technology purchase not on environmental performance, but the incentive could be based on an estimate of the environmental benefits of the system over its lifetime (e.g., lifetime savings or revenue x carbon value).**

Factor	Explanation	Tax Rebate for consumers (sales)
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**No, this incentive is directed at reducing capital cost, additional policies would be required to address other barriers.**

Factor	Explanation	Tax Rebate for consumers (sales).
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**Will not need to vary by region – but benefits will depend on the tax rate in each province. Not useful in Alberta and Territories.**
	Will the policy be supported by urban and rural stakeholders?	**There should be no difference in the support for this instrument between urban and rural stakeholders.**

Factor	Explanation	Tax Rebate for consumers (sales)
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**Yes, this instrument could be designed to promote both renewable and energy efficiency systems.**
	Are their perverse incentives that come into play?	**Energy efficiency measures might reduce the cost-effectiveness of host load renewable energy systems like solar water heaters, alternatively energy efficiency measures could help decrease the size requirements of the renewable energy system thus lower the cost of the renewable energy system.**

Factor	Explanation	Tax Rebate for consumers (sales)
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**This policy would work well with performance-based instruments as it will reduce first cost and therefore improve the overall economics of the renewable energy system.**

Factor	Explanation	Tax Rebate for consumers (sales)
Flexibility to Respond to Unforeseen/Unexpected Results	How readily can the policy be adjusted if its goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**It would not be advisable to change the size of the credit but it could be done.**

Sources

Environment Canada Database on Rebates and Incentives
http://www.incentivesandrebates.ca/gc_fi_search.asp?jurisdiction=0&actionArea=6&keyword=&submit=Search&lang=en

Decrease Initial Capital Cost: Low Interest Loans or Loan Guarantees

Factor	Explanation	Low interest loans or loan guarantees
Definition	Brief description of the policy	**Low interest loans or loan decrease the cost of a renewable system for customers by decreasing the financing cost. These programs are generally offered through a cooperative program with government and a financial institution.**

Factor	Explanation	Low interest loans or loan guarantees
Description	Can the policy be implemented by the federal, provincial or municipal government?	**Any jurisdiction could develop a relationship with a financial institution to transfer funds to customers.**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase demand of renewable technologies.**
	Cost recovery source-Tax base/rate base/Other	**Funding source is flexible and a revolving fund could be established. Usually the source is the tax base.**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**No particular limitations - a relationship must be established with a financial institution, the total incentive per customer is limited to the financing charges needed to acquire the system.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**Manitoba Hydro offers homeowners Residential Earth Power Loans of up to $15 000 to cover the additional cost of installing a geothermal heat pump compared to a conventional heating and cooling system. Fortis BC has a Residential Heatpump incentive. Financing is available through Homeworks and VanCity. There are many examples in the US, such as Oregon's Energy Loan Program, which has run continuously since 1980.**
	Key example	**Manitoba Hydro.**
	Important design considerations	**Loan term is important as it needs to be long enough to allow loan payments to pay out savings or income. Since the average residential loan is expected to be relatively low for some technologies (e.g., solar DHW), governments could instead consider offering low interest loans to companies that serve as energy service companies for customers - the ESCO builds, owns and operates the system and the customer pays for the energy service provided.**

Factor	Explanation	Low interest loans or loan guarantees.
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**Provincial governments probably have the most flexibility and access to funding to develop a relationship with financial institution and help ensure quality of system installation.**

Factor	Explanation	Low interest loans or loan guarantees
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**From ETSIF report, "So far, such loan schemes alone have not had a significant impact on the development of the solar thermal market in any European country."**
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**This program does not directly support renewable energy production (loans are based on the system purchase or installation, not on the use of the system).**
	Can the policy be used to remove market limits (e.g., encourage power storage)?	**This policy can be targeted at individual technologies that remove market limits.**
	Can the policy apply to systems that sell into the grid as well as meet host load?	**Yes, this instrument could support systems that sell into the grid, it is blind to system use.**

Factor	Explanation	Low interest loans or loan guarantees
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**The complexity of this instrument depends on the setting up a program with a financial institution. Many governments have already developed these relationships.**
	Is there a one time cost or on-going costs?	**On-going costs to the financial institute for the length of the loan, government costs could be set up as either one-time incentive to the financial institution or longer term financial payments. The Oregon State Energy Loan Program is self-supporting and uses no tax dollars. Oregon general obligation bonds provide the funds for the loan.**
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**Experience in Europe with solar hot water systems in Germany and PV in Spain indicates that low interest loans are not sufficient to significantly increase the demand for renewable energy systems.**

Factor	Explanation	Low interest loans or loan guarantees
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**Relationship must be developed with financial institution to deliver loans.**
	Is it an extension of an existing program?	**Similar systems exist for other low interest loans, several programs exist currently in Canada.**
	Are the systems needed to support the policy already in place?	**Similar systems exist for other low interest loans, several programs exist currently in Canada.**
	Would the policy require monitoring and reporting systems that are not currently established?	**Yes, some monitoring of loan payments will be required, also it would be advantageous to audit the contribution of the systems to renewable energy generation.**

Factor	Explanation	Low interest loans or loan guarantees
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**Manitoba Hydro offers homeowners Residential Earth Power Loans of up to $15 000 to cover the additional cost of installing a geothermal heat pump compared to a conventional heating and cooling system. Fortis BC Residential Heatpump http://fortisbc.com/energy_efficiency/residential/heat_pump.html**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**Manitoba Hydro has success in expanding knowledge of geothermal systems through its low interest loans. Staff feel that public perceive the technology positively. Sufficiency will depend on savings in loan rate.**
	Will renewable energy industries support the policy?	**Yes, especially is the institution providing the loan also provides listing of installers.**

Factor	Explanation	Low interest loans or loan guarantees
Fairness	Fairness with respect to level of income/ability to benefit from the measure. How would the policy affect different income classes?	**This instrument would generally favour those with higher incomes and financial situations that favour loans. But it could be designed to adjust rebate/refund by income class or allow additional access to financing for those with weaker financial situations.**

Factor	Explanation	Low interest loans or loan guarantees
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**This policy would complement and build on other consumer targeted renewable energy and energy efficiency programs.**
	Are there any existing policies that might conflict with the proposed policy?	**No.**

Factor	Explanation	Low interest loans or loan guarantees
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**This instrument can offer benefits to a mix of technologies - best suited to systems with large capital costs.**

Factor	Explanation	Low interest loans or loan guarantees
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**This instrument is most beneficial to markets where the purchasers of the technology also benefits from energy bill reductions from the technology.**
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**This instrument applies equally to new and existing houses – new homes may be able to obtain more favourable financing through including renewable energy systems in their mortgages.**
	Is the instrument applicable to rental and owner occupied units	**This instrument does not apply equally to rental units where technology**

	alike?	**purchasers does not pay energy bill or maintain system.**

Factor	Explanation	Low interest loans or loan guarantees
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**The incentive is based on technology purchase not on environmental performance, but the incentive could be based on an estimate of the environmental benefits of the system over its lifetime (e.g., lifetime savings or revenue x carbon value).**

Factor	Explanation	Low interest loans or loan guarantees
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**No, this incentive is directed at reducing capital cost, additional policies would be required to address other barriers.**

Factor	Explanation	Low interest loans or loan guarantees
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**This instrument can be varied by region but does not need to be.**
	Will the policy be supported by urban and rural stakeholders?	**There should be no difference in the support for low interest loans between urban and rural stakeholders.**

Factor	Explanation	Low interest loans or loan guarantees
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**Yes, this instrument could be designed to promote both renewable and energy efficiency systems.**
	Are their perverse incentives that come into play?	**Energy efficiency measures might reduce the cost-effectiveness of host load renewable energy systems like solar water heaters, alternatively energy efficiency measures could help decrease the size requirements of the renewable energy system thus lower the cost of the renewable energy system.**

Factor	Explanation	Low interest loans or loan guarantees
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**This policy could work well with performance-based instruments as it will reduce first cost and therefore improve cash flow - but public perception might be that renewables are receiving too much subsidy.**

Factor	Explanation	Low interest loans or loan guarantees
Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if its goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**This instrument requires long-term participation between financial institution and public so it is relatively inflexible. If necessary the rates of the loan could be changed or the program could stop providing new loans.**

Sources

Alliance to Save Energy website for Oregon State Energy Loan Program http://www.ase.org/content/article/detail/1335

Dominic Marinelli. 2007. Personal communication. Manitoba Hydro Earth Energy Program

European Solar Thermal Industry Federation (ETSIF). 2006. *Financial Incentives for Solar Thermal Guidelines on best practice and avoidable problems.*

http://fortisbc.com/energy_efficiency/residential/heat_pump.html

Homeworks Financing www.homeworks.ca

Decrease Initial Capital Cost: Lease or Rental Program for Equipment

Factor	Explanation	Lease or rental program for equipment
Definition	Brief description of the policy	**This incentive-type can cover programs where 1) a company leases or rentals for renewable energy systems - allowing a customer to obtain renewable energy benefits without a long-term commitment or 2) an energy service company (ESCO) entering a contract with a homeowner or group of homeowners to provide the energy service of the system while the ownership, installation and operation of the system remain with the ESCO. The high installation costs of most renewable energy systems lead to limited applications for the former type of incentive. While these programs do not require financial incentives, additional funding from governments can make the systems more desirable by lowering the customer's rates and encouraging companies to offer these programs.**

Factor	Explanation	Lease or rental program for equipment
Description	Can the policy be implemented by the federal, provincial or municipal government?	**Any jurisdiction could develop a relationship with equipment suppliers that allow government financial support for lease/rental/ESCO contracts with customers, Financial institutional could also be included in relationship to provide funding for private company.**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase demand of renewable technologies.**
	Cost recovery source-Tax base/rate base/Other	**Funding source is flexible and a revolving fund could be established. Usually the source is the tax base.**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**No particular limitations - a relationship must be established with a company that provides renewable energy systems and possibly with a financial institution.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**Lifetime Energy - a partnership between NextEnergy and Waterloo North Hydro provides geothermal systems to homeowners that are paid for through electricity bills. EAST-GSR (Guaranteed Solar Results for Eastern Europe) is a contract between the owner or user of a solar system and an organization who takes the responsibility for the solar system implementation and the guaranteed solar energy to be supplied http://www.solareast-gsr.net/GSRPresent.htm.**
	Key example	**Lifetime Energy http://www.lifetimeenergy.ca/**
	Important design considerations	**To the consumer this instrument would be invisible - the lease or rental would be through a utility or other agent in the same way they would rent or lease a conventional energy system. Any government support would be provided to the rental/leasing agent - e.g., buying down the capital or installation costs.**

Factor	Explanation	Lease or rental program for equipment
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**Provincial government would have best ability to develop program with both utilities for program administration and to provide additional funding to decrease lease rates.**

Factor	Explanation	Lease or rental program for equipment
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**This instrument has strong potential to increase deployment but depends on the relationships between all partners - the government, equipment company, public and possibly the financing institution, if involved. There are limited experiences with this type of instrument.**
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**This instrument could strongly support renewable energy production if the financial benefits to the equipment provider are based on the performance of the equipment.**
	Can the policy be used to remove market limits (e.g., encourage power storage)?	**This policy can be targeted at individual technologies that remove market limits.**
	Can the policy apply to systems that sell into the grid as well as meet host load?	**Yes, this instrument could support systems that sell into the grid, it is blind to system use.**

Factor	Explanation	Lease or rental program for equipment
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**The complexity of this instrument depends on the setting up a program with a company to supply the equipment. In general, these relationships have not yet been developed so time and resources would need to be allocated to this aspect.**
	Is there a one time cost or on-going costs?	**On-going costs to the company providing the equipment for the length of the lease, government costs could be set up as either one-time incentive to the equipment company or longer term financial payments.**
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**The limited experience with this type of instrument for renewable energy is insufficient to draw conclusions on its effectiveness.**

Factor	Explanation	Lease or rental program for equipment
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**Relationship must be developed with the equipment company.**
	Is it an extension of an existing program?	**Similar program exists in Ontario between a utility and geothermal equipment company.**
	Are the systems needed to support the policy already in place?	**No.**

	Would the policy require monitoring and reporting systems that are not currently established?	**Yes, monitoring of any payments to equipment companies and installations of renewable energy systems would be required, also it would be advantageous to audit the renewable energy generation.**

Factor	Explanation	Lease or rental program for equipment
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**Utility/Equipment company precedent exists, but no government/equipment company programs were found.**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**Yes, although there are few precedents for this instrument, the public may see it much like a loan interest loan, which had favourable public response.**
	Will renewable energy industries support the policy?	**Yes, the example in Ontario is a direct partnership between a manufacturer/installer and a local utility.**

Factor	Explanation	Lease or rental program for equipment
Fairness	Fairness with respect to level of income/ability to benefit from the measure.	**This would be fair to all income levels since it does not require up-front capital.**
	How would the policy affect different income classes?	**Lower income groups could gain a relatively higher benefit compared with household income.**

Factor	Explanation	Lease or rental program for equipment
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**This policy would complement and build on other consumer targeted renewable energy and energy efficiency programs.**
	Are there any existing policies that might conflict with the proposed policy?	**No.**

Factor	Explanation	Lease or rental program for equipment
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**This instrument can offer benefits to a mix of technologies - best suited to systems with large capital costs.**

Factor	Explanation	Lease or rental program for equipment
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**Yes, this instrument is flexible in terms of the lease rates so it could be targeted to market segments.**
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**This instrument applies equally to new and existing houses – new homes may be able to obtain more favourable financing through including renewable energy systems in their mortgages.**

	Is the instrument applicable to rental and owner occupied units alike?	**This instrument could be designed to apply to rental units, since the renewable energy system is leased rather than owned. However it will more likely be designed to apply to owner-occupied units (likely using a lease-to-own program design).**

Factor	Explanation	Lease or rental program for equipment
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**In theory this instrument could be designed to account for expected environmental performance, but it might make the process unnecessarily complicated.**

Factor	Explanation	Lease or rental program for equipment
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**It removes the entire capital cost hurdle and the risk (to the residential/farm customer) of long paybacks.**

Factor	Explanation	Lease or rental program for equipment
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**This instrument can be varied by region but does not need to be.**
	Will the policy be supported by urban and rural stakeholders?	**There should be no difference in the support for this program between urban and rural stakeholders.**

Factor	Explanation	Lease or rental program for equipment
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**Yes, this instrument could be designed to promote both renewable and energy efficiency systems.**
	Are their perverse incentives that come into play?	**Energy efficiency measures might reduce the cost-effectiveness of host load renewable energy systems like solar water heaters, alternatively energy efficiency measures could help decrease the size requirements of the renewable energy system thus lower the cost of the renewable energy system.**

Factor	Explanation	Lease or rental program for equipment
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**Training and accreditation for technology installers.**

Factor	Explanation	Lease or rental program for equipment
Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if it's goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**This instrument requires long-term participation between equipment provider and public so it is relatively inflexible.**

Decrease Initial Capital Cost: Local Improvement Charges

Factor	Explanation	Local improvement charges
Definition	Brief description of the policy	**Local improvement charges (LICs) have long been used by municipalities to help cover the costs of infrastructure improvements (roads, sidewalks, etc.) deemed to benefit a specific neighbourhood. The benefiting landowners are assessed the LIC on their property taxes until their share of the improvements have been paid for. By expanding on this existing instrument, LICs could be used to finance residential renewable energy systems. The main advantage of using an LIC program over alternative methods of financing renewable energy systems is that it associates the repayment of the cost of the system with the building property rather than with the current building owner.**

Factor	Explanation	Local improvement charges
Description	Can the policy be implemented by the federal, provincial or municipal government?	**Municipal.**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase demand for renewable technologies.**
	Cost recovery source-Tax base/rate base/Other	**Funding source is flexible and a revolving municipal fund could be established. The source of seed funds could be municipal tax base, private lending (e.g., CorpFinance), or public lenders (e.g., FCM).**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**Local improvement charges are long-standing municipal policy tools that allow the city to pay for improvements and have the cost of that improvement charged as a tax to the benefiting property owners. The appeal of the policy is that it can help overcome the capital cost hurdle and remove the risk of not realizing payback because the LIC is tied to the property and not the owner.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**LICs have been used for RE/EE in the Yukon, but this is an otherwise untested concept for encouraging RE. Several municipalities in Canada are considering pilots and a recent legal opinion in BC has confirmed that it is within municipal power (in that province)**
	Key example	**Yukon rural renewable energy system and City of Whitehorse.**
	Important design considerations	**LIC set at level that provides positive cash flow. Well defined set of technologies supported. Certified assessors and verifiers (could be same as EnerGuide for Houses).**

Factor	Explanation	Local improvement charges
Jurisdictional	At what level of government would the implementation of the policy	**Municipal.**

Authority and Fit	have the greatest impact?	

Factor	Explanation	Local improvement charges
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**On its own it is not an incentive, so without coupling incentives, it would only help those people that aren't purchasing a system because they can't cover capital costs (but can cover LIC), or those that are worried that they may be moving before they have paid off the investment.**
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**By providing a means of financing over the life of a system if coupled with a performance incentive could have a major impact.**
	Can the policy be used to remove market limits (e.g., encourage power storage)?	**Can be used to target specific technologies that could remove market limits.**
	Can the policy apply to systems that sell into the grid as well as meet host load?	**Yes, this instrument could support systems that sell into the grid, it is blind to system use.**

Factor	Explanation	Local improvement charges
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**The complexity depends on if the municipality already is familiar with LICs. For those that are very familiar with the process, this represents a new, but not significant challenge. For those that don't use LICs much, then this would represent a significant investment in staff time.**
	Is there a one time cost or on-going costs?	**Staff would be required to administer the collection of LIC payments and approve the granting of new LICs. There would also need to be an ongoing marketing campaign and education with homeowners/developers.**
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**Once a working LIC system is set up the market penetration for a targeted technology could be quite high relative to the administrative cost.**

Factor	Explanation	Local improvement charges
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**The city will need to decide what types of improvements qualify, what loans and repayment periods will be acceptable, how to approve applications, and how to collect payments.**
	Is it an extension of an existing program?	**For municipalities that already run LIC programs, it would operate in exactly the same way, so much of the administrative systems would already be in place**
	Are the systems needed to support the policy already in place?	**See above.**

	Would the policy require monitoring and reporting systems that are not currently established?	**The city would need to establish an evaluation/monitoring program to know how many systems were approved. If they wanted to monitor actual performance/impact of the systems, it would be a more complex endeavor.**

Factor	Explanation	Local improvement charges
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**The policy is in place in the Yukon and has been operating for over a decade. It has been under consideration over the past several years in the following Canadian cities: Ottawa, Toronto, Winnipeg, Hinton, Smithers, Saanich, and Vancouver.**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**Based on the Yukon experience the staff time is small and the default rate on LICs is very low, so given this doesn't actually involve a subsidy, it would probably be considered an effective use of dollars if it encouraged adoption.**
	Will renewable energy industries support the policy?	**One of the issues raised in the legal opinion that Central Saanich commissioned was that the City may want to be involved in the certification and/or maintenance of systems - depending on the complexity of this arrangement, the industry may have some concerns.**

Factor	Explanation	Local improvement charges
Fairness	Fairness with respect to level of income/ability to benefit from the measure.	**This would be similar to a low interest loan.**
	How would the policy affect different income classes?	**This would be similar to a low interest loan.**

Factor	Explanation	Local improvement charges
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**It could easily complement provincial/federal incentives because it would make the amount of the LIC smaller. It could also complement existing municipal LIC programs and existing municipal CC initiatives.**
	Are there any existing policies that might conflict with the proposed policy?	**No.**

Factor	Explanation	Local improvement charges
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**Well suited to the four technologies being considered.**
Flexibility to Address Multiple Market Segments	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**In theory yes. Given this is a relatively untested concept, the municipalities that are considering pilots are all focusing on relatively narrow scopes to limit the complexity.**

and Applications	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**Same as above.**
	Is the instrument applicable to rental and owner occupied units alike?	**It would be applicable to both (with same caveats as above), but only the property owner could access the LIC.**

Factor	Explanation	Local improvement charges
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**In the discussions that have happened to date, the idea of differentiating by environmental benefit has not come up. In theory you could do this, but it might make the process unnecessarily complicated.**

Factor	Explanation	Local improvement charges
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, Local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**It deals with the entire capital cost hurdle (not just lowering the CC), and it also deals with the risk of not realizing paybacks due to people moving on a relatively frequent basis. The policy does allow the LIC to be extended for a longer period to finance other building improvements.**

Factor	Explanation	Local improvement charges
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**By its nature, this policy would be specific to municipalities and they could set it up to focus on the building types and technologies that are most beneficial to them. You would need significant changes in legislation to let utilities or provinces take on this type of property tax policy on a broader scale - it would be possible though.**
	Will the policy be supported by urban and rural stakeholders?	**There may be barriers to getting this started in smaller communities due to the economies of scale in program administration.**

Factor	Explanation	Local improvement charges
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**It could also be designed to provide financing for EE, although based on discussions with municipalities, the likely starting point is simply with RE (and probably only one technology for a pilot).**
	Are their perverse incentives that come into play?	**Energy efficiency improvements might lower the cost-effectiveness of renewable energy and therefore require a longer LIC term.**

Factor	Explanation	Local improvement charges
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**Seems like most of the policies in the other categories that make a system cheaper or pay for the power would be beneficial. A production incentive in particular might be a powerful complement because it could be directly subtracted from LIC.**

Factor	Explanation	Local improvement charges
Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if it's goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**The ability to accelerate pickup of the policy is probably limited to increasing the amount marketing. There might be some flexibility in the rate of return required by the municipality, but this doesn't seem like something would be changed on a regular basis.**

Sources

Pembina's two reports on LICs

Peters, Roger, Johanne Whitmore and Matt Horne. 2005. *Using Local Improvement Charges to Finance Energy Efficiency Improvements: Applicability Across Canada.* http://www.pembina.org/pubs/pub.php?id=197

Peters, Roger and Matt Horne. 2004. *Using Local Improvement Charges to Finance Energy Efficiency Improvements: A Concept Report.* http://www.pembina.org/pubs/pub.php?id=170

Decrease Initial Capital Cost: Mortgage Insurance Reduction or Financing

Factor	Explanation	Mortgage insurance reduction or financing
Definition	Brief description of the policy	**This incentive provides preferable mortgage terms for homeowners who have invested in renewable energy systems. For example, the incentive could provide a refund on premiums for high-ratio mortgages, or allow customers to take a longer term amortization (for example up to 35 years) and pay the same premium as for a shorter term (for example, 25 year) amortization. Examples are based on the Canadian Mortgage and Housing Corporation program for energy efficient homes. Financing an RE system through a mortgage without penalty also provide a means of paying for the system from the savings/revenue stream.**

Factor	Explanation	Mortgage insurance reduction or financing
Description	Can the policy be implemented by the federal, provincial or municipal government?	**Any jurisdiction could develop a relationship with a financial institution to transfer funds to customers, or help them include RE systems in their financing**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase demand of renewable technologies.**
	Cost recovery source-Tax base/rate base/Other	**Funding source is flexible and a revolving loan could be established. Usually the source is the tax base.**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**None.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**CMHC has a program for energy efficiency improvements. The California solar initiative includes arrangements with mortgage companies to include the residual cost of solar PV in mortgages. In Japan, some house manufacturers offer interest reduced mortgages for homes with PV systems included. The reduction in interest rate is 1 to 2 percentage points and is not only available for the financing of the PV system, but often for the whole mortgage.**
	Key example	**California solar initiative.**
	Important design considerations	**To make this effective, arrangements would be made with mortgage companies to train their agents in including renewable energy system in mortgages without rate increases and exempt from insurance. Addition of the system would be seen as an asset that provides income or savings and not a liability.**

Factor	Explanation	Mortgage insurance reduction or financing
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**Provincial or federal working in connection with financial institution.**

Factor	Explanation	Mortgage insurance reduction or financing
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**As with low interest loans, this instrument may not be sufficient on its own to increase deployment, but it could be useful in conjunction with other policies.**
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**This program does not directly support renewable energy production (instrument is based on the system purchase or installation, not on the use of the system).**
	Can the policy be used to remove market limits (e.g., encourage power storage)?	**This policy can be targeted at individual technologies that remove market limits.**
	Can the policy apply to systems that sell into the grid as well as meet host load?	**Yes, this instrument could support systems that sell into the grid, it is blind to system use.**

Factor	Explanation	Mortgage insurance reduction or financing
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**The complexity of this instrument depends on the setting up a program with a financial institution. Many governments have already developed these relationships.**
	Is there a one time cost or on-going costs?	**On-going costs to the financial institute for the length of the mortgage, government costs could be set up as either one-time incentive to the financial institution or longer term financial payments.**
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**Like low interest loans, this instrument may not be sufficient to significantly increase the uptake of renewables but it could be a helpful component of a wider government policy.**

Factor	Explanation	Mortgage insurance reduction or financing
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**Relationship must be developed with financial institution to deliver low interest mortgages.**
	Is it an extension of an existing program?	**Yes, similar programs exist for energy efficiency.**
	Are the systems needed to support the policy already in place?	**Yes, see above.**
	Would the policy require monitoring and reporting systems that are not currently established?	**Yes, some monitoring of mortgage payments will be required, also it would be advantageous to audit the contribution of the systems to renewable energy generation.**

Factor	Explanation	Mortgage insurance reduction or financing
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**Precedents exist for energy efficiency but not for renewable energy systems.**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**The public may lack confidence in this program since many similar programs have been started and stopped in the past.**
	Will renewable energy industries support the policy?	**Renewable energy industry will have same concerns about program continuity as the public and will likely not support programs that offer rebates that are too low.**

Factor	Explanation	Mortgage insurance reduction or financing
Fairness	Fairness with respect to level of income/ability to benefit from the measure.	**This instrument would generally favour those with higher incomes and financial situations that favour mortgages. But it could be designed to adjust rebate/refund by income class or allow additional access to financing for those with weaker financial situations.**
	How would the policy affect different income classes?	

Factor	Explanation	Mortgage insurance reduction or financing
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**This policy would complement and build on other consumer targeted renewable energy and energy efficiency programs.**
	Are there any existing policies that might conflict with the proposed policy?	**No.**

Factor	Explanation	Mortgage insurance reduction or financing
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**This instrument can offer benefits to a mix of technologies.**

Factor	Explanation	Mortgage insurance reduction or financing
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**This instrument is targeted at new home buyers but would work for any type of new home.**
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**This policy applies to new homes.**
	Is the instrument applicable to rental and owner occupied units alike?	**This policy applies mostly to homeowners.**

Factor	Explanation	Mortgage insurance reduction or financing
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**The incentive is based on technology purchase not on environmental performance, but the incentive could be based on an estimate of the environmental benefits of the system over its lifetime (e.g., lifetime savings or revenue x carbon value).**

Factor	Explanation	Mortgage insurance reduction or financing
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**No, this incentive is directed at reducing capital cost, additional policies would be required to address other barriers.**

Factor	Explanation	Mortgage insurance reduction or financing
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**This instrument can be varied by region but does not need to be.**
	Will the policy be supported by urban and rural stakeholders?	**There should be no difference in the support for mortgage financing between urban and rural stakeholders.**

Factor	Explanation	Mortgage insurance reduction or financing
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**Yes, this instrument could be designed to promote both renewable and energy efficiency systems.**
	Are their perverse incentives that come into play?	**Energy efficiency measures might reduce the cost-effectiveness of host load renewable energy systems like solar water heaters, alternatively energy efficiency measures could help decrease the size requirements of the renewable energy system thus lower the cost of the renewable energy system.**

Factor	Explanation	Mortgage insurance reduction or financing
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**This policy would work well with performance-based instruments as it will reduce first cost and therefore improve the overall economics of the renewable energy system.**

Factor	Explanation	Mortgage insurance reduction or financing
Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if it's goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**This instrument requires long-term participation between financial institution and public so it is relatively inflexible. If necessary the rates of the mortgage could be changed or the program could be suspended.**

Sources

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Decrease Initial Capital Cost: Reduction in Development Permit Fees

Factor	Explanation	Reduction in development permit fees
Definition	Brief description of the policy	**Municipalities can help promote renewable energy systems by reducing the permit fees for developers, home builders or home renovators that are installing such systems.**

Factor	Explanation	Reduction in development permit fees
Description	Can the policy be implemented by the federal, provincial or municipal government?	**Only at Municipal level.**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase demand of renewable technologies.**
	Cost recovery source-Tax base/rate base/Other	**Municipal revenue.**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**Municipalities would need to change their permit policies. The administrative ease of doing these changes depends on the municipality and province. In British Columbia, municipalities only have authority to charge development fees for the capital costs of specific types of infrastructure: water, sewer, drainage, roads and parkland. Reduction in building permit fees would generally need to be tied to reductions in City costs for permitting.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**City of Calgary provides building permit rebates for homes built according to specific energy and environmental standards. Calgary is the first major city in Canada to offer incentives to builders who use sustainable building practices.**
	Key example	**See above.**
	Important design considerations	**Municipalities would need to justify the decreased charges. In Calgary, the justification was that builders who adopt the standards of a Green building program tend to build to a higher level of overall construction quality, which requires less effort from the City's plans examination and inspection processes to achieve acceptable construction standards. Additionally, homes built to these standards tend to cost more than conventionally constructed houses, and so therefore the rebate strategy rewards the builders for their forward-thinking efforts. This reasoning was based on the city's experience with Built Green homes; similar experience would need to be demonstrated for homes with renewable systems.**

Factor	Explanation	Reduction in development permit fees
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**Municipal.**

Factor	Explanation	Reduction in development permit fees
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**Depending on the level of the rebate, this instrument may not be sufficient on its own to increase deployment, but it could be useful in conjunction with other policies. The instrument provides incentives to building developers, who are excluded from other incentives, and could be a beneficial part of a policy aimed at a wide market transformation.**
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**This program does not directly support renewable energy production. Since development fees are paid based on building design, any rebates would not be tied to system performance.**
	Can the policy be used to remove market limits (e.g., encourage power storage)?	**This policy can be targeted at individual technologies that remove market limits.**
	Can the policy apply to systems that sell into the grid as well as meet host load?	**Yes, this instrument could support systems that sell into the grid, it is blind to system use.**

Factor	Explanation	Reduction in development permit fees
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**Relatively simple to administer once the municipality has changed their fee structure. City staff may need additional training to certify renewable energy system designs.**
	Is there a one time cost or on-going costs?	**One-time cost per building that occurs at the time of development application, but experience indicates that the effectiveness of programs is enhanced by continuity over many years (at least 5).**
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**This instrument would be limited by the size of the permit fees and may not be sufficient to significantly increase the uptake of renewables. Since it would be focused on developers rather than homeowners - but it could be a helpful component of a wider government policy.**

Factor	Explanation	Reduction in development permit fees
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**Changes to the municipal development fee policy - this could be a significant barrier.**
	Is it an extension of an existing program?	**Although programs exist in Calgary and Strathcona for homes meeting BuiltGreen standards, these are the only known programs in Canada currently.**
	Are the systems needed to support the policy already in place?	**Fee structure is in place in most municipalities, but will require changes to incorporate rebates for renewable energy systems.**
	Would the policy require monitoring and reporting systems that are not currently established?	**New monitoring and reporting systems are not required, but would be advantageous to audit contribution to renewable energy generation (rather than technology purchases).**

Factor	Explanation	Reduction in development permit fees
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**City of Calgary offers reductions on building permits for buildings that have been designed and constructed in accordance with specific energy and environmental design criteria.**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**Difficult to determine the public perception of this type of instrument due to limited application to date.**
	Will renewable energy industries support the policy?	**As with the local improvement charges, the renewable energy industry may see municipal involvement in certification as a barrier.**

Factor	Explanation	Reduction in development permit fees
Fairness	Fairness with respect to level of income/ability to benefit from the measure.	**This instrument would provide direct benefits only to new home purchasers.**
	How would the policy affect different income classes?	**The impact on different income classes would depend on the municipality's fee structure - are development fees proportionally higher or lower for different income classes? It may be possible to design the rebate structure to avoid negative distortions by income class.**

Factor	Explanation	Reduction in development permit fees
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**This policy would complement and build on other consumer targeted renewable energy and energy efficiency programs.**
	Are there any existing policies that might conflict with the proposed policy?	**No.**

Factor	Explanation	Reduction in development permit fees
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**This instrument can offer benefits to a mix of technologies.**

Factor	Explanation	Reduction in development permit fees
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**This instrument is targeted at new home buyers but would work for any type of new home.**
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**This policy applies to new homes.**
	Is the instrument applicable to rental and owner occupied units alike?	**This policy applies mostly to developers but savings could be passed on to home buyers.**

Factor	Explanation	Reduction in development permit fees
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**The incentive is based on technology purchase not on environmental performance, but the incentive could be based on an estimate of the environmental benefits of the system over its lifetime (e.g., lifetime savings or revenue x carbon value).**

Factor	Explanation	Reduction in development permit fees
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**This incentive is directed at developers so it could help lower the barriers in that industry.**

Factor	Explanation	Reduction in development permit fees
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**This instrument is specific to municipalities and they could set it up to focus on the building types and technologies that are most beneficial.**
	Will the policy be supported by urban and rural stakeholders?	**Rural communities might not have the same opportunities to charge or adjust development/permit fees.**

Factor	Explanation	Reduction in development permit fees
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**Yes, this instrument could be designed to promote both renewable and energy efficiency systems.**
	Are their perverse incentives that come into play?	**Energy efficiency measures might reduce the cost-effectiveness of host load renewable energy systems like solar water heaters, alternatively energy efficiency measures could help decrease the size requirements of the renewable energy system thus lower the cost of the renewable energy system.**

Factor	Explanation	Reduction in development permit fees
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**This policy would work well with performance-based instruments as it will reduce first cost and therefore improve the overall economics of the renewable energy system.**

Factor	Explanation	Reduction in development permit fees

Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if it's goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**While the level of incentive can be adjusted up or down in response to usage, it would be unwise to do so.**

Sources

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City of Calgary Building permit fee 2007 http://www.calgary.ca/portal/server.pt/gateway/PTARGS_0_2_347402_0_0_18/bldg_fee.pdf

Residential & Farm Instrument: Feed-in Tariffs

Factor	Explanation	Feed-in tariffs
Definition	Brief description of the policy	**A feed-in tariff is a price-based policy that specifies the price to be paid for renewable energy. Feed-in laws offer renewable energy developers a guaranteed power sales price (the feed-in tariff), coupled with a purchase obligation by electric utilities.**

Factor	Explanation	Feed-in tariffs
Description	Can the policy be implemented by the federal, provincial or municipal government?	**Provincial or municipality that operates a local utility. Feed-in tariffs are also known as standard offer contracts or advanced renewable tariffs.**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase in the supply and generation of energy from renewable sources. Mainly designed for distributed renewable power (or heat) sources that wish to sign long-term supply agreements. It is therefore less suitable as an instrument to support residential scale renewable systems unless they are aggregated together into a co-op ownership arrangement.**
	Cost recovery source-Tax base/rate base/Other	**The premium tariff is normally recovered through the rate base of the jurisdiction offering the feed-in tariff. In this way, all customers share in the cost of additional renewable energy capacity. In the case of a renewable energy system that sells power to the grid, the cost is recovered through the electricity rate base. In the case where a renewable energy system meets only host load (e.g., a solar water heater) but reduces demand on the power or natural gas grid, the cost is recovered from whichever rate base (gas or electric) is paying the feed-in tariff.**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**Requires regulation or legislation that sets the premium tariff for each technology, the length of time that the tariff will be paid (e.g., 10 years), access guarantees, and the process for reducing the premium over time. If the premium is for power generation, the rules also need to specify requirements for a generation license (usually waived for small systems). The rules also need to specify how power or heat production receiving the tariff will be measured and any interconnection requirements. If the policy were to be used for individual home systems, some waiving of rules would be needed.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**Most members of the European Union, including the leading users of renewable energy. Germany and Spain use the feed-in tariff approach to increase the supply of power from renewable sources. The Province of Ontario uses this instrument for renewable power and the Province of British Columbia intends to do so. Germany is piloting a feed-in-tariff for solar water heaters.**
	Key example	**Germany was the first jurisdiction to introduce a feed-in tariff in the 1990s. The legislation governing the current feed-in tariffs (the EEG) was passed in 2000. The tariffs are lowered over time to reflect improvements in technology but once a feed-in contract is signed, the revenue is fixed for 20 years. The tariffs also vary by technology. The EEG and its predecessor are responsible for the deployment of 19,000 MW of new renewable power in Germany as well as a strong wind and solar manufacturing industry, and significant local ownership and investment.**

Factor	Explanation	Feed-in tariffs
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**Feed-in tariffs must be implemented by an organization that purchases and then resells power or natural gas (for heat), so therefore the only jurisdictions are provincial or a municipality that operates a local utility. The federal government could buy down the cost to a province's consumers through annual transfers to any province that chooses to use feed-in tariffs.**

Factor	Explanation	Feed-in tariffs
Description	Important design considerations	**The key design components of a feed-n tariff that includes small-scale renewables are: i) a premium that makes the technology cost competitive and reflects its environmental and other non-market benefits; ii) guaranteed access to the grid or heat user; iii) no limit or cap; iv) a stable investment environment (long-term offering and process for reducing premium over time); v) waiving of some rules for small scale access and encouragement of aggregation of systems; and vi) financing schemes that allow small-scale users to finance their systems over the life of the technology. This includes setting a separate tariff for each technology and sometimes different variations of the same technology. For example, a solar PV system with storage that can provide power at any time would warrant a higher tariff than one without storage.**

Factor	Explanation	Feed-in tariffs
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**Feed-in tariffs are rated as the most effective instrument in rapidly developing renewable energy supply - especially for technologies that are still in the early days of market development without any local mass production to lower costs or means to reflect their environmental benefits. However, without special rules for small scale power or heat systems, feed-in-tariffs will not have a large impact on the deployment of residential renewable systems. Feed-in tariffs result in more rapid deployment and local manufacturing and investment/ownership than an RPS/certificate system. The average price paid for renewable energy under a RPS or quota system is often higher than the premium feed-in tariff. The long-term stable investment environment established by the feed-in tariff and its guaranteed access to the grid are seen as keys to success.**
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**Because of its open access without limits, the feed-in tariff can be used to maximize the market penetration of renewable technologies to the maximum market potential in each sector for each technology that can be produced at the premium price. For example a feed-in-tariff for solar PV systems would maximize the renewable energy production from systems that are cost-effective at that premium. A feed-in tariff therefore maximizes renewable energy production and the environmental benefits of a technology.**
	Can the policy be used to remove market limits (e.g., encourage power storage)?	**A feed-in-tariff is an ideal way of removing market limits as it can be tailored to support a technology variation that removes a market limit. For example, a high premium can be paid for a renewable power system that is dispatchable through the use of on-site power storage.**

	Can the policy apply to systems that sell into the grid as well as meet host load?	**A feed-in tariff is primarily designed to incent systems that sell to the grid, but it could be used for technologies like solar water heaters which meet host load but reduce demand from the grid or natural gas system.**

Factor	Explanation	Feed-in tariffs
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**The only cost to government of a feed-in tariff is the cost of managing the contracting process, although this too can be recovered through the rate base. A feed-in tariff is therefore very cost-effective. Note: While the federal government does not have the capability of using this instrument, it could buy down the cost to a provinces consumers through transfers to any province that chooses to use it (see below).**
	Is there a one time cost or on-going costs?	**If all costs are rate-based there are no one time or on-going costs.**

Factor	Explanation	Feed-in tariffs
Cost-Effectiveness	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**Given that all costs are rate based, a feed-in tariff provides high market penetration for low government costs. However, if the objective is to increase market penetration of small scale renewable energy systems, the uptake may be limited unless the feed-in tariff is coupled with incentives to reduce the up-front costs associated with purchasing the necessary technologies. In other words, unless individuals are able to invest in the technologies upfront, they will not be able to benefit from this policy.**

Factor	Explanation	Feed-in tariffs
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**Administration of a feed-in tariff system includes setting up contracting, measurement, and payment systems. This is normally run by the utility offering the feed-in tariff. However, a homeowner wanting to use the policy must be willing to finance their own system, sign a long-term power contract, and meet other criteria set by the jurisdiction offering the tariff.**
	Is it an extension of an existing program?	**Ontario offers a feed-in tariff as a standard offer for power generated by wind, biomass and solar.**
	Are the systems needed to support the policy already in place?	**Ontario has established a system for administering its standard offer contract system which other provinces could emulate.**
	Would the policy require monitoring and reporting systems that are not currently established?	**Each province or municipality using the feed-in tariff approach would need to make regulations and set up an administrative system similar to Ontario.**

Factor	Explanation	Feed-in tariffs
Public and Industry	Do any precedents exist where the type of policy is in place or under consideration?	**Feed-in tariffs are used throughout Europe and in Ontario.**

Appeal/Political Feasibility	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**Feed-in tariffs are popular with the public because they provide visible progress and rapid deployment - including job creation. The sharing of the cost among rate payers means no noticeable increase in rates. However, because feed-in tariffs are less easily accessed by individual homes, there may be some frustration on the part of homeowners.**
	Will renewable energy industries support the policy?	**The renewable energy industry likes the stable investment environment and permanent (no on\off) nature of feed-in-tariffs.**

Factor	Explanation	Feed-in tariffs
Fairness	Fairness with respect to level of income/ability to benefit from the measure.	**Feed-in tariffs do not differentiate among income levels and the instrument is less suitable for small systems/loads. Only those homeowners who are willing to sign long-term contracts and finance their systems themselves (or who join cooperatives operating renewable systems) will be able to benefit from the policy.**
	How would the policy affect different income classes?	

Factor	Explanation	Feed-in tariffs
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**Because feed-in tariffs are not easily accessible to individual homeowners, the policy does not complement other instruments targeting this market segment. The exception might be where home systems are aggregated into a larger project. Then the feed-in tariff could be used in conjunction with instruments designed to buy-down the capital cost of eligible technologies or in conjunction with a financing scheme that allows payment for the system from the revenue received from the tariff.**
	Are there any existing policies that might conflict with the proposed policy?	**Feed-in tariffs are not compatible with quota/RPS/certificate systems. The feed-in tariff by definition has no upset limit, while the certificate program is based on a limit.**

Factor	Explanation	Feed-in tariffs
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**Feed-in tariffs can be used for all renewable technologies and even variants within a technology type (e.g., dispatchable PV with power storage). At present, the policy does work better for technologies that produce electricity because metering system already exist. However, recent developments in low cost thermal metering make the policy as applicable to solar water heating and heat pump systems. Thermal feed-in tariffs or standard offers for solar water heaters and heat pumps might be the best application of this instrument for the residential market.**

Factor	Explanation	Feed-in tariffs
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**The same policy can be used for all market segments, although it could be varied to incent one segment more than another.**

	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**Feed-in tariffs can be used for systems in new houses or retrofits of existing houses.**
	Is the instrument applicable to rental and owner occupied units alike?	**In the case of rental units, the party paying the power or gas bill would have to be the owner of the renewable system being supported by a feed-in tariff.**

Factor	Explanation	Feed-in tariffs
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**Feed-in tariffs are technologically prescriptive but can easily be used to provide greater incentive to technologies with the highest benefits.**

Factor	Explanation	Feed-in tariffs
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**Feed-in tariffs provide only an annual contribution toward the cost of a renewable energy system. However, the long-term contract allows the user to negotiate good financing terms that would provide a positive cash flow from day one.**

Factor	Explanation	Feed-in tariffs
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**Feed-in tariffs are easily varied by region to reflect local needs/state of market, etc.**
	Will the policy be supported by urban and rural stakeholders?	**The policy treats rural and urban stakeholders in the same way.**

Factor	Explanation	Feed-in tariffs
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**Feed-in tariffs could actually be used to incent energy efficiency by offering a standard offer for verified energy savings achieved through efficiency improvements.**
	Are their perverse incentives that come into play?	**Energy efficiency measures would lower the heat or power demand supplied by the small renewable system and therefore reduce the impact of the instrument.**

Factor	Explanation	Feed-in tariffs

Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**Innovative financing schemes offered by any jurisdiction would have the greatest positive impact on the use of feed-in tariffs as they would allow pay down of capital from the revenue received. Tax credits (e.g., ACCA) would also complement this instrument well. Incentives for manufacturers, installers and distributors would also complement this policy.**

Factor	Explanation	Feed-in tariffs
Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if it's goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**Feed-in tariffs are not designed for frequent fine tuning, but the standard offer can be reviewed on a regular (and predetermined) basis and adjusted up or down in an open and transparent manner.**

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Residential & Farm Instrument: Tradable Renewable Energy Certificates (RECs)

Factor	Explanation	Tradable certificates (RECs)
Definition	Brief description of the policy	**Under a Renewable Portfolio Standard (RPS), utilities demonstrate compliance with the standard using a market-based system of tradable renewable energy credits (RECs). Every megawatt-hour of renewable energy produced is awarded an REC. Retail electric suppliers are then responsible for securing a quantity of RECs sufficient to meet their annual RPS compliance target. This supply and demand creates a market in which RECs are bought, sold, and traded. Note: RECs can also be sold into unregulated voluntary markets that satisfy consumer demand for renewable energy investments.**

Factor	Explanation	Tradable certificates (RECs)
Description	Can the policy be implemented by the federal, provincial or municipal government?	**Provincial. Renewable Energy Certificates (RECs) are also known as Green Tags.**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase in the supply and generation of energy from renewable sources. Tradable certificates must be used in conjunction with a renewable energy portfolio standard or quota system.**
	Cost recovery source-Tax base/rate base/Other	**Payment for RECs is made by the jurisdiction/utility required to meet the RPS or quota. This cost is recovered through the rate base, which means that all users share the cost. Regulated utilities normally purchase RECs from aggregators who assemble blocks from individual power generators, institutions or building owners that have installed renewable energy systems.**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**Requires enabling legislation that sets the RPS or quota and the rules governing the identification, sale and marketing of RECs. To be used as means to support residential scale renewable energy systems, the tradable certificate system must allow aggregators or brokers to purchase RECs from individual homeowners or farms.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**Most U.S. and Australian States and certain members of the European Union use the RPS or Quota system to increase renewable energy deployment. Some, but not all, of these use RECs as a compliance mechanism. There are only a few good examples of RECs systems that serve the individual residential market.**
	Key example	**A good example is the three New England states of Connecticut, Massachusetts, and Rhode Island where aggregators purchase RECs from individual renewable energy system users and sell them to utilities regulated by RPSs in each state.**
	Important design considerations	**Key design considerations for an REC system to be used to support deployment of small-scale renewable energy include: i) RPS targets that requires full use of an RECs market for compliance and provides a worthwhile price for each unit of renewable energy attribute sold; ii) an REC market that has a major role for aggregators that purchase RECs from individual homeowners; and iii) an REC system that is open to both residential power and heat renewable systems.**

Factor	Explanation	Tradable certificates (RECs)
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**Only provinces can set legal RPSs for renewable power. The federal government could set RPSs for RE heat set up a RE heat certificates program, but this also would be best done at the provincial level to allow transferability (e.g., solar water heating could sell RE power certificates if it displaced electric water heat. The federal government could also promote/facilitate national sale of RECs.**

Factor	Explanation	Tradable certificates (RECs)
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**Because of the complexity of selling into an REC market, this instrument is only effective in increasing the rate of deployment of small-scale residential renewables if effective brokers or aggregators are available to purchase green attributes from homeowners (local distribution utilities or private brokers could play this aggregator role). The disadvantage of RECs over a feed-in tariff is the uncertainty of price that will be obtained for the certificate. Few homeowners will invest in a renewable system if they do not know what revenue to expect from its green attributes.**

Factor	Explanation	Tradable certificates (RECs)
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**The RPS/RECs approach is by definition dependent on regular increases in the renewables target set by the RPS. If there is regular debate about these targets, then the impact on renewable deployment could stall. Studies have shown that having a long-term, permanent policy and investment environment is the most important determinant of renewable deployment.**
	Can the policy be used to remove market limits (e.g., encourage power storage)?	**RPS/certificates are less easy to vary by technology than feed-in tariffs or production incentives, and therefore less able to remove market limits, once a certificate market was established.**
	Can the policy apply to systems that sell into the grid as well as meet host load?	**RECs can be used to incent systems that feed into the grid or meet host load.**

Factor	Explanation	Tradable certificates (RECs)
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**Governments must administer the RPS compliance system and the REC market system.**
	Is there a one time cost or on-going costs?	**Most costs are on-going.**
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**While governments do not pay toward the cost of the renewable system itself, it may not be a cost-effective way of supporting small scale renewable power as the uptake may be low because of the complexity of the system. It may be more cost-effective for heat sources.**

Factor	Explanation	Tradable certificates (RECs)

Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**Each jurisdiction using the REC approach would need to establish market regulatory/administrative system and verification systems for each REC as part of RPS compliance.**
	Is it an extension of an existing program?	**No jurisdiction in Canada currently uses an RPS/REC approach.**
	Are the systems needed to support the policy already in place?	**No.**
	Would the policy require monitoring and reporting systems that are not currently established?	**Each jurisdiction using the REC approach would need to establish a legal RPS and set up market rules for RECs along with the market regulatory/administrative system and verification systems for each REC.**

Factor	Explanation	Tradable certificates (RECs)
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**This instrument is used throughout the U.S. and in certain European Union states.**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**Like feed-in tariffs, RPS and RECs show that governments are serious about renewable energy deployment, but there may be some frustration over ease of access and the complexities of RECs.**
	Will renewable energy industries support the policy?	**In general renewable energy industries support RPS and REC policies.**

Factor	Explanation	Tradable certificates (RECs)
Fairness	Fairness with respect to level of income/ability to benefit from the measure.	**RECs do not normally differentiate among different housing markets. Because of the complexities of the REC approach, and the likelihood that aggregators would prefer to purchase REC from larger systems, this approach might penalize lower income classes who have a more difficult time taking advantage of the incentive.**
	How would the policy affect different income classes?	

Factor	Explanation	Tradable certificates (RECs)
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**The creation of a REC is not very conducive for individual homeowners, so the policy does not complement other instruments targeting this market segment. If an effective brokering or aggregators system was in place, then instruments designed to buy-down the capital cost of a renewable energy system could complement the REC system. These policies would work together to make it more attractive for homeowners to invest in renewable energy systems and generate RECs from their investments.**
	Are there any existing policies that might conflict with the proposed policy?	**RECs are not compatible with feed-in tariffs as the enabling RPS sets limits on renewable energy requirements and uses a market approach instead of a fixed price.**

Factor	Explanation	Tradable certificates (RECs)

Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**RECs can be used to benefit a mix of technologies, but this instrument has mostly been used to support renewable power sources. Its application to heat sources is now being investigated in the U.S. and South Africa. If a heat source displaced electricity (as with a solar water heater in some provinces), it could sell RECs to meet renewable power requirements. Lakeland Electric in Lakeland, Florida sold approximately 334 MWh of RECS, valued at $0.02 to $0.03 per kWh, in late 2004, marking the first known transaction of RECs based on energy generated by solar water heating systems. Otherwise a separate Renewable Heat Portfolio standard is required with appropriate REC market structure. Using RECs for residential scale heat sources may be the best use of this instrument for small-scale renewables.**

Factor	Explanation	Tradable certificates (RECs)
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**The same policy can be used for all market segments. It would be difficult to incent one segment more than another using this instrument.**
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**RECs can be used for both new and retrofit houses.**
	Is the instrument applicable to rental and owner occupied units alike?	**In the case of rental units, the party owning the renewable system would be the one that could sell RECs.**

Factor	Explanation	Tradable certificates (RECs)
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**RECs do not normally differentiate among different technologies. Only when the RPS specifies set asides for different technologies could RECs be targeted for different technologies.**

Factor	Explanation	Tradable certificates (RECs)
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**RECs provide only an annual contribution toward the cost of a renewable energy system. A complementary financing scheme would be need to address high capital costs.**

Factor	Explanation	Tradable certificates (RECs)

Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**RECs can be used in any region.**
	Will the policy be supported by urban and rural stakeholders?	**The policy treats rural and urban stakeholders in the same way.**

Factor	Explanation	Tradable certificates (RECs)
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**RECs do not interfere with energy efficiency objectives. In fact in some jurisdictions (Connecticut, Italy, France) RECs include verified energy efficiency savings.**
	Are their perverse incentives that come into play?	**Energy efficiency measures would lower the heat or power demand supplied by the small renewable energy system and therefore reduce the impact of the instrument.**

Factor	Explanation	Tradable certificates (RECs)
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**RECs are not easily accessible to individual homeowners, so the policy could not easily be used to complement other instruments targeting this market segment. If an effective brokering or aggregators system was in place then instruments designed to buy-down the capital cost of a renewable energy system could complement the REC system. These policies would work together to make it more attractive for homeowners to invest in renewable energy systems.**

Factor	Explanation	Tradable certificates (RECs)
Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if it's goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**RPS targets can be modified as needed but not to adjust small markets like residential renewable systems.**

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Residential & Farm Instrument: Production Incentive / Tax Credit

Factor	Explanation	Production incentive/tax credit
Definition	Brief description of the policy	**A production incentive is a payment by an agency other than a utility that provides the investor or owner of qualifying technologies with payments based on the amount of electricity generated from specified RE technologies. A production tax credit does the same, but the incentive is provided as a credit against annual tax payments.**

Factor	Explanation	Production incentive/tax credit
Description	Can the policy be implemented by the federal, provincial or municipal government?	**A production incentive could be offered by any level of government as long as the necessary reporting/monitoring systems were established. A production tax credit could be offered by any level of government that levies taxes. Thus, it could be offered against property taxes at the municipal level or income, sales or excise taxes at the provincial/federal levels.**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Increase supply of renewable energy by providing a credit/incentive in proportion to the amount of energy generated.**
	Cost recovery source-Tax base/rate base/Other	**Expenses associated with tax credits come from general government revenues. Tax credit programs require no cash outlay which makes them less prone to annual budgetary pressures (appropriations). This is in contrast to a production incentive (such as Canada's wind power production incentive) which is more vulnerable given that it requires a direct outlay of cash in each annual budget.**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**A production tax credit would require changes to the tax rules to allow those eligible entities to apply for a credit against taxes due.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**Denmark provides DK 0.10/kWh (CAD 2.0 cents/kWh) for wind power. In the U.S., the Renewable Electricity Production Credit (PTC) provides a per-kWh tax credit for electricity generated by qualifying wind, closed-loop biomass, or poultry waste resources. Federal tax credits of US 1.5 cents/kWh (adjusted annually for inflation) are provided for the first ten years of operation for all qualifying plants that entered service from 1992 through mid-1999, later extended to 2001 and 2003.**
	Key example	**The United States Production Tax Credit (PTC) (above) has encouraged wind energy development, and has been credited with driving significant capacity increases in the late 1990s and early 2000s in the U.S. At the same time, the PTC has encouraged development only in those states with additional incentives.**

	Important design considerations	**A production incentive would need to be in place for an extended period of time to ensure stability for investors. To allow individuals without significant tax liability to still benefit from a production tax credit, tax credits can be made to be transferable to parties not directly related to the renewable investment, thus allowing third party investors to benefit from the tax credit, while leaving ownership with the original investor. Allowing tax credits to be carried forward will also help address this concern. One issue that has arisen in other regions (Germany) is that incentives such as these tend to encourage least cost investments, thus concentrating investments in regions with the highest potential. To ensure that investments (and associated environmental, economic and social benefits) take place across a broad geographic area, the size of the incentive can vary by region and reflect the cost of production in the particular region. This kind of a policy might also be designed to offer higher incentives during peak hours of electricity consumption.**

Factor	Explanation	Production incentive/tax credit
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**A production incentive can be offered by any jurisdiction through a direct payment from a budgeted program (such as the production incentive such as the Wind Power Production Incentive or the newer ecoENERGY Renewables Initiative). A federal production incentive helps spur investments where renewable energy technologies are already close to being competitive. A complementary provincial policy increases the competitiveness of renewable investments and can also account for regional differences in resources, technologies and load requirements.**

Factor	Explanation	Production incentive/tax credit
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**Production incentives or tax credits are fairly easy to take advantage of once the initial investment in appropriate/qualifying technologies has taken place. However, this policy alone may not lead to significant penetration of renewables in the residential and farming sector due to the prohibitive nature of the up-front costs associated with such investments. With this kind of a pricing system, it is not possible to know in advance how much generation or capacity will result, or if the share of renewable energy generation will increase overtime. The incentive would need to be adjusted up or down to encourage more or less investment, but such changes increase uncertainty from an investor perspective (Sawin). This kind of incentive protects against poor system design and installation and also poor long-term system performance (Margolis) and if well designed and introduced with complementary policies is likely to encourage optimum performance and a sustained industry.**
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**A production incentive or production tax credit is explicitly designed to be performance based. Unlike incentives that are targeted at buying-down the up-front capital costs associated with technologies yet do not ensure that the technology is actually employed and generates renewable electricity, only renewable energy projects that actually generate renewably energy benefit from a production-based incentive.**
	Can the policy be used to remove market limits (e.g., encourage power storage)?	**A production incentive or production tax credit can be designed to address other market limits such as those related to power storage. For example, the value of the incentive or credit could be larger if power storage is demonstrated to be taking place.**
	Can the policy apply to systems that sell into the grid as well as meet host load?	**A production incentive or production tax credit is primarily designed to incent systems that sell to the grid, but it could be used for technologies like solar water heaters which meet host load but reduce demand from the grid or natural gas system. It can also be used for own production but the production has to be metered and auditable.**

Factor	Explanation	Production incentive/tax credit
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**A production incentive or tax credit is not an administrative complex policy to introduce. It requires monitoring (metering) and verification of production. Payments correspond to value being obtained over time and are thus justifiable. While it is difficult to know upfront what the total cost of this kind of a program will be (as it depends on enrollment), regular adjustments to the value of the incentive or credit can be made to control costs. For small projects, the administrative requirements to verify production and provide periodical payments may be a costly burden.**
	Is there a one time cost or on-going costs?	**This kind of incentive involves multiple payments over time that are based on measured system output (kWh).**
	Which policy leads to the greatest market penetration for the least amount of money from a consumer or government perspective?	**This type of a policy requires a financial outlay from government so would be more expensive than a program such as feed-in tariffs in which the cost of the incentive is covered by rates. In addition, if the objective is to increase market penetration of small-scale renewable energy systems, the uptake may not be very high unless it is coupled with incentives to reduce the up-front costs associated with purchasing the necessary technologies. Unless individuals are able to invest in the technologies upfront, they will not be able to benefit from this policy.**

Factor	Explanation	Production incentive/tax credit
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**In general, this kind of a pricing scheme is relatively easy to administer and enforce. The introduction of a production tax credit would require adding this credit to tax forms. This is a relatively simple task. However, the tax credit claim should be verified to ensure it accurately reflects actual electricity production. A production incentive is relatively more complex as it involves regular and multiple payments to qualifying entities and would still require verification of actual energy production. This can be burdensome for small production levels.**
	Is it an extension of an existing program?	**There currently are not any production tax credits in place in Canada. The federal government recently announced the ecoENERGY for Renewable Power to provide a per kWh incentive for low-impact renewable energy power plants to follow up on the Wind Power Production Incentive which provides a per kWh payment to wind power producers.**
	Are the systems needed to support the policy already in place?	**The systems needed to implement a production tax credit are already in place. Numerous tax credits are already in place in Canada at both the federal and provincial levels. Since taxes are already filed on an annual basis, the introduction of this incentive would not increase the number of customer interactions.**
	Would the policy require monitoring and reporting systems that are not currently established?	**A production incentive or production tax credit would require eligible participants to report on annual electricity production. The amount of production should be verified by a third party to ensure accuracy. This can be an administrative and costly burden for small projects.**

Factor	Explanation	Production incentive/tax credit
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**The Wind Power Production Incentive in Canada is this kind of a policy. A new ecoENERGY for Renewable Power program has been announced to provide financial incentives for the generation of energy from low-impact renewable sources.**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**Production incentives and tax credits are supported by the public because they can result in renewable energy deployment and associated economic, social and environmental benefits. Government financing of the incentive also means that rate payers do not see an increase in their electricity costs as a result of the policy. Experience with pricing policies such as this in other regions (e.g., Germany) has created a constituency in favour of renewable energy such as farmers, lawyers, union workers, land owners, construction companies, renewable energy companies, financial institutions and others.**
	Will renewable energy industries support the policy?	**The renewable energy industry likes the stable investment environment and permanent (no on\off) nature of this kind of a policy.**

Factor	Explanation	Production incentive/tax credit
Fairness	Fairness with respect to level of income/ability to benefit from the measure.	**For production tax credit: Only those with sufficient tax liability will be able to benefit from a production tax credit. Individuals who do not pay taxes, will not be able to take advantage of this tax measure.** **For production incentive: Fair to all levels.**
	How would the policy affect different income classes?	

Factor	Explanation	Production incentive/tax credit
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**This kind of a policy at the provincial level could complement the federal government's ecoENERGY Renewables Initiative. Complementary provincial policies could take into account regional differences more difficult to incorporate at the federal level. This might include for example, having the incentive vary by technology type, geographic region, or peak load times.**
	Are there any existing policies that might conflict with the proposed policy?	**Production credits for small scale renewable energy would not conflict with any existing or proposed policies if applied at the federal level. At provincial levels it would conflict with RPS/certificate programs.**

Factor	Explanation	Production incentive/tax credit
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**A production incentive or production tax credit can be made available to a host of renewable energy technologies.**

Factor	Explanation	Production incentive/tax credit
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**Numerous market segments could benefit from this type of instrument. In fact, pricing initiatives such as this tends to favour smaller companies, individuals and cooperatives (provided they have sufficient tax base in the case of a credit) and incremental investment.**
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**Production incentives and tax credits can be used for both new houses and retrofits to existing houses.**
	Is the instrument applicable to rental and owner occupied units alike?	**The incentive would be awarded to the owners of the renewable technology, be that the property owner or the renter.**

Factor	Explanation	Production incentive/tax credit
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**Yes, since the incentive is awarded on a per kWh basis, technologies with the greatest potential to generate electricity will benefit the most from this incentive, without those technologies needing to be explicitly recognized by the policy.**

Factor	Explanation	Production incentive/tax credit
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**Production incentives or tax credits do not address high up-front capital costs associated with making renewable investments. However, the long-term certainty of such payments can help a potential investor negotiate more favourable financing terms for renewables investments which could lead to a net gain soon or immediately after the initial investment takes place.**

Factor	Explanation	Production incentive/tax credit
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**The instrument choice need not vary by region. A production incentive or production tax credit can be made available across the country and provided that multiple technologies qualify for the incentive, the technologies used in a particular region will reflect the comparative advantage of that region with respect to available resources and technologies.**

Factor	Explanation	Production incentive/tax credit
Flexibility to Address Regional Differences	Will the policy be supported by urban and rural stakeholders?	**The policy treats rural and urban stakeholders in the same way. In addition, because development is more geographically dispersed under a pricing scheme such as this (in contrast to a quota scheme for example), there is generally less opposition to projects at the local level.**

Factor	Explanation	Production incentive/tax credit
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**This kind of an incentive could also be designed to incent efficiency improvements where the value of the incentive is commensurate with the size of efficiency gains. This would require verification and monitoring of efficiency improvements and assurances that the improvements would not have taken place without the incentive being in place.**
	Are their perverse incentives that come into play?	**Some argue that pricing laws offer no inherent incentive for utilities to reduce institutional barriers to development of renewable energy. In fact, utilities can be driven to raise them, requiring the implementation of grid connection and charging standards.**

Factor	Explanation	Production incentive/tax credit
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**This policy can be complemented or combined with support for up-front costs.**

Factor	Explanation	Production incentive/tax credit
Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if it's goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**Historically, pricing policies have been criticized for being inflexible because once prices are established, they can be difficult to adjust. However, it is possible to set up a system such that payments can be adjusted on a regular basis to reflect changes in technologies and market conditions. These changes should take place on a pre-determined timeline to still provide certainty to investors.**

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Residential & Farm Instrument: GHG Emissions (Carbon) Offsets

Factor	Explanation	Emissions offsets
Definition	Brief description of the policy	**Purchase of GHG emissions offsets is a way in which entities such as corporations (private/crown) or governments (federal/provincial/municipal) can meet their obligations under regulated GHG emissions trading programs. Carbon offsets are the most common type and are typically measured in carbon dioxide equivalents (CO_2e). Carbon offsets can be generated from a variety of project types and can originate from anywhere in the world. Before offsets can be sold and traded in regulated systems, the amount of reductions needs to be quantified against relevant standards (termed 'protocols'). GHG reductions may or may not qualify for the term 'offset' depending on where the offset project is located, how it is quantified, and who is using it.**

Factor	Explanation	Emissions offsets
Description	Can the policy be implemented by the federal, provincial or municipal government?	**Most likely federal, as provincial and municipal governments are unlikely to implement an emissions trading scheme.**
	Basis for use-Increase supply of renewable technologies/increase demand of renewable technologies/increase energy generation	**Offsetting carbon emissions through increasing renewable energy substitution for fossil fuel generation.**
	Cost recovery source-Tax base/rate base/Other	**Payment by GHG emitters purchasing offsets on the basis of verified emissions reduced according to protocol that relates the production of renewable energy to a fossil fuel baseline emissions coefficient.**
	Enabling requirements and limitations-tax rule change/income tax change/property tax change	**Requires GHG emissions regulation and a compliance scheme that allows regulated GHG emitters to purchase offsets from an offsets market, or invest in a public body that purchases offsets. The regulation also needs to lay out rules for measuring (verifying) and registering offsets. The incentive is limited to renewable energy systems that offset fossil fuels and those that would not have been implemented without the offset being available (additionality). The size of payment is determined by the price of carbon, therefore not set or controlled by government. The policy is not really suitable for small systems because of relatively high transaction costs.**
	Examples in other jurisdictions-list of jurisdictions with this type of instrument	**The Clean Development Mechanism (CDM) is the only official regulated offset system. Many voluntary offset schemes exist but these are not regulated and should not be used as examples of a formal offset system.**
	Key example	**The CDM contains several examples of renewable energy projects, but all but one are wind farms and small hydro. The one example involving small renewable energy systems is a solar water heater project in South Africa that is part of a larger aggregated low-income housing upgrade project. The protocol used in this project to verify solar thermal output and estimate emissions reductions could be used as the basis for a Canadian offset system.**

	Important design considerations	**If an offset system were used to support small scale renewable energy systems, it would need to be designed with a simplified protocol for small systems similar to the CDM. It would also have to encourage the aggregation of individual systems into larger projects to make use of the system worthwhile. The system would need to be set up so that only projects that would not otherwise go ahead without the offset would be eligible. A single payment equivalent to expected lifetime GHG reductions might be preferable to annual verified reductions.**

Factor	Explanation	Emissions offsets
Jurisdictional Authority and Fit	At what level of government would the implementation of the policy have the greatest impact?	**A formal GHG emissions offset system can only be implemented as part of a GHG regulation and compliance regime - most likely only federal level.**

Factor	Explanation	Emissions offsets
Ability and Capacity to Accelerate Deployment	How much impact is a policy capable of having on the deployment rate of a technology?	**Given that an offset system can only benefit systems that reduce fossil fuels, the size of the payment is limited by the price of carbon, and the use of the offset system is complicated for the user, it is unlikely that this policy will have a major impact on the rate of small-scale renewable energy deployment.**
	How much impact is a policy capable of having on the renewable energy production and/or environmental benefits produced by technology deployment?	**An offset system by definition favours renewable energy deployment that also has climate change mitigation benefits. In the long run, if an offset system is fully established in Canada with a price of carbon that reflects all environmental costs associated with it, this policy could play a more significant role in small-scale renewable system deployment.**
	Can the policy be used to remove market limits (e.g., encourage power storage)?	**Because offsets are based only on GHG reductions and therefore energy produced, and the size of the incentive is based on the price of carbon, it is difficult to use this policy selectively to remove market barriers, incent specific technologies, or favour dispatchable systems.**
	Can the policy apply to systems that sell into the grid as well as meet host load?	**Offsets can be paid for any renewable energy production that displaces fossil fuels and therefore can apply to both on-site user displacement application and sale into the grid.**

Factor	Explanation	Emissions offsets
Cost-Effectiveness	How does the administrative complexity compare with the size of any financial contribution for government?	**There is no financial contribution to the renewable energy system by government as this comes from the GHG emitter purchasing the offset. On the other hand the government must manage the offset system and would also likely need to provide support to small users to use the offset system much like capacity building programs under the CDM.**
	Is there a one time cost or on-going costs?	**There would be an on-going cost of managing the offset system and capacity building.**
	Which policy leads to the greatest market penetration for the least amount of money from a	**Since the government does not contribute to the system itself, once the offset system is set up, the ratio of cost to impact is very low (i.e., the policy is cost-effective).**

	consumer or government perspective?	

Factor	Explanation	Emissions offsets
Administrative Simplicity	What is required from an administrative perspective to implement the particular policy?	**Management of a national offset system with access by small scale renewable energy system users.**
	Is it an extension of an existing program?	**No.**
	Are the systems needed to support the policy already in place?	**Protocols exist that could be used to verify the GHG reductions from small-scale renewable energy systems. No other systems are yet in place.**
	Would the policy require monitoring and reporting systems that are not currently established?	**Yes.**

Factor	Explanation	Emissions offsets
Public and Industry Appeal/Political Feasibility	Do any precedents exist where the type of policy is in place or under consideration?	**The CDM is in place. There have been discussions and draft plans for a Canadian offset system, but there is no consensus among stakeholders as to its design.**
	Is the policy likely to be perceived as an effective and sufficient initiative by the public?	**Offsets are not particularly well understood or liked by the public and there is a danger of implementing a system than only increases this skepticism (e.g., one that does not effectively consider additionality).**
	Will renewable energy industries support the policy?	**The renewable energy industry supports the concept of an offset system but not as the main driver of renewable energy system deployment.**

Factor	Explanation	Emissions offsets
Fairness	Fairness with respect to level of income/ability to benefit from the measure. How would the policy affect different income classes?	**The transaction costs associated with participation in an offset system make it more difficult for lower income Canadians to participate.**

Factor	Explanation	Emissions offsets
Ability to Complement and/or Build on Existing Programs	Does the policy complement or build on existing policies or programs at the same or a different jurisdictional level?	**Offsets could be used at the same time as other instruments - most easily with other performance-based instruments that would need to estimate the same power or heat output of the system. The issue of double counting arises in the case where the jurisdiction using these other instruments claims emissions reductions associated with the payment made. There would be less chance of these conflicts if buy-down measures were used to reduce the capital cost of the system.**
	Are there any existing policies that might conflict with the proposed policy?	

Factor	Explanation	Emissions offsets
Flexibility to Address Multiple Technologies	Does the policy offer benefits to a mix of technologies or is it mostly suited to a single technology?	**An offset system can be used to incent any renewable energy technology that reduces GHG emissions - i.e., heat producing technologies that displace natural gas and electricity displacing technologies in provinces with fossil fuel power generation.**

Factor	Explanation	Emissions offsets
Flexibility to Address Multiple Market Segments and Applications	Can the policy be targeted at numerous market segments and housing applications simultaneously or will the policy have to vary by market segment and housing application?	**Offsets can be targeted at all market segments.**
	Will the same instrument be able to apply to new houses and retrofits of existing houses or will a different set of instruments be required for each?	**It is easier to target offsets to existing houses as the baseline is easier to identify. Baselines for new housing may vary with location, size, current practices, etc.**
	Is the instrument applicable to rental and owner occupied units alike?	**Offsets would be more difficult to apply to rental housing since the ownership of the offsets would need to be carefully identified.**

Factor	Explanation	Emissions offsets
Flexibility to be Performance Based Rather than Prescriptive	Is the policy able to provide greater incentive to invest in the technologies with the greatest potential for environmental improvements and market potential without being technologically prescriptive?	**Offsets, by definition, provide a greater incentive for technologies that produce greater GHG reductions without being technologically prescriptive. It does not, however, provide a greater incentive for those technologies with a larger market potential.**

Factor	Explanation	Emissions offsets
Ability to Address non-Cost Barriers	Does the policy help address identified barriers in addition to those associated with high capital costs? For example, local improvement charges can help insulate homeowners from the risk of not seeing out the payback of a technology.	**Offsets only provide an annual contribution to life cycle cost.**

Factor	Explanation	Emissions offsets
Flexibility to Address Regional Differences	Is the policy able to recognize and account for differences in renewable energy resources and technology availability/cost across the country? Or will the instrument choice need to vary by region?	**Offsets automatically favour those regions where GHG emissions per household are higher. It cannot be used to address other regional differences.**
	Will the policy be supported by urban and rural stakeholders?	**There should be no difference in the support for offsets between urban and rural stakeholders.**

Factor	Explanation	Emissions offsets
Supports Energy Efficiency	Is the policy supportive of energy efficiency objectives?	**Energy efficiency measures could effectively be packaged with small scale renewable energy systems under an offset system, creating a higher income stream.**
	Are their perverse incentives that come into play?	**Energy efficiency measures would lower the heat or power demand supplied by the small renewable energy systems and therefore reduce the impact of the instrument.**

Factor	Explanation	Emissions offsets
Complementary Policies	Are there policies that could be implemented (i.e., that aren't already in place) at the federal or a different jurisdictional level that would complement/amplify the policy and increase the market penetration of the target technology? (for example a PV system could be: a) financed through a mortgage or local improvement charge, b) use a federal tax credit, and c) sell into a provincial feed-in tariff.	**Subject to the double counting issue raised above, offsets could be used with any of the other instruments reviewed here.**

Factor	Explanation	Emissions offsets
Flexibility to Respond to Unforeseen/ Unexpected Results	How readily can the policy be adjusted if it's goals are not being met? Alternatively, if the policy is over-subscribed, can the actions be decreased without overly weakening any market transformations?	**The basic offset system design would be difficult to change, but streamlined protocols and aggregation procedures could be introduced to increase participation. Since the government is not purchasing the offset, oversubscription is not an issue.**

Sources

Pembina REC and Offsets Discussion Paper

CDM web site: cdm.unfccc.int

Unpublished Canadian studies and discussions 2005-2007