

# Final Report

## Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2010)



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(SAIC Canada)  
Renewable Energy and Climate Change Program*

*Report presented to:*  
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September 2011

## ACKNOWLEDGEMENTS

The funding for this report was provided by Natural Resources Canada. Dr. Reda Djebbar was the technical authority for this work.

We gratefully acknowledge the contributions of Doug McClenahan and Bruce Sibbitt, along with Dr. Djebbar, all of Natural Resources Canada, who provided invaluable assistance to this project. We also acknowledge the cooperation and assistance of the staff of the Canadian Solar Industries Association, who assisted in promoting and distributing the survey document.

Most importantly, we acknowledge all of those people within the Canadian solar thermal industry who took the time to complete the survey questions. Without your ongoing cooperation, this survey would be impossible.

Any reference to trade names or commercial products in this document does not constitute a recommendation or endorsement for use by Natural Resources Canada.

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## EXECUTIVE SUMMARY

This report is a summary of a survey of the Canadian solar thermal industry conducted in the period December 2010 to February 2011, covering the 2010 calendar year.

The survey results show continued growth in the Canadian solar thermal industry, with 2010 total revenue (domestic plus export) of \$37.4 million, an increase of 76% over the \$21.3 million reported in 2009. This is the eighth consecutive year that this survey has indicated that the total revenue earned by the Canadian solar thermal industry has grown over the previous year. In 2010 all five solar thermal collector types experienced sales growth from 2009 values, with three types growing near or above 100% (air glazed and unglazed, and liquid evacuated).

Total (domestic plus export) collector sales in 2010 were 252,146 m<sup>2</sup>, the first time that the 200,000 m<sup>2</sup> figure has been exceeded. 2010 also ended with an estimated 1,033,864 m<sup>2</sup> of solar collectors operating in Canada, the first time that this value has exceeded one million square meters (see Figure 10).

Ontario continued as the total market leader, reporting 55% of sales (by revenue), a slight increase on the 53% reported in 2009 (see Figure 8). British Columbia experienced the highest growth rate in 2010, exceeding 250%.

For the first time the sale of air collectors (used primarily for space heating) has exceeded the sale of unglazed liquid collectors (used primarily for pool heating), when measured by collector area (refer to Figure 5).

Industry optimism has dropped rapidly in the past year. While several companies are still projecting strong future growth, the average prediction for future sales, weighted by respondents' current sales, is for a *decline* of 5%. This contrasts strongly with the 31% growth predicted a year ago in the 2009 survey. Refer to section 3.5 for further details.

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## 1 INTRODUCTION

This report provides results of a survey of active solar thermal collectors, industry and markets in Canada. The survey was commissioned by Natural Resources Canada (NRCan), and was undertaken by SAIC Canada. The survey covered the 2010 calendar year. This survey is a continuation of a series of surveys going back to 2002.

NRCan's Renewable Energy Deployment Initiative (REDI) was launched in April 1998 to stimulate the demand for cost-effective renewable energy heating and cooling systems, and to help create a sustainable market for those systems. In 2006, the REDI program was superseded by the ecoENERGY for Renewable Heat program. Active solar thermal systems, including air and water heating, represent two of the types of renewable energy technologies presently supported by Natural Resources Canada's ecoENERGY program<sup>1</sup>. Solar thermal systems have the potential to play a considerable role in the implementation of a greenhouse gas emission reduction plan for Canada.

In part, this survey was undertaken in support of Canadian contributions to the solar heating market survey of the Solar Heating and Cooling Program of the International Energy Agency (IEA).

Solar thermal collectors are the key component of active solar energy systems. These collectors absorb energy from the sun's rays and convert it into thermal energy that can be used for water and space heating and cooling. Collectors are designed to meet the specific temperature requirements and climate conditions of each use.

The purpose of this study was to survey the Canadian active solar thermal collector industry to obtain data for the 2010 calendar year. The main objectives of the study were:

- To capture comprehensive and reliable information on market size and industry trends, including Canadian sales and revenues, import and export, and employment figures.
- To estimate delivered thermal energy and displaced CO<sub>2</sub> emissions of all active solar thermal systems operating in Canada.
- To analyze and report obtained data for publication and wider dissemination.

The Canadian solar thermal industry is a diverse, growing industry active across Canada, with roots going back to the mid-1970's. Five distinct types of solar collectors were sold in Canada during the surveyed period:

1. Unglazed, liquid collectors;
2. Unglazed, air collectors;
3. Glazed, liquid collectors;

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<sup>1</sup> For more information, visit the ecoENERGY for Renewable Heat website, <http://www.ecoaction.gc.ca/ECOENERGY-ECOENERGIE/heat-chauffage/index-eng.cfm>

4. Evacuated tube liquid collectors, and;
5. Glazed, air collectors.

Survey respondents were asked a series of questions, some about total sales of any type of solar thermal collector, and some questions seeking more detailed information on the breakdown of sales by these five types of collectors.

The survey results show exceptionally strong growth in the Canadian solar thermal industry, with 2010 revenue of \$29.2 million, an increase of 37% over the \$21.3 million reported in 2009.

### **1.1 Comparisons to 2009 and earlier surveys**

Throughout this report, comparisons are made to data from the 2009 and earlier surveys. While these comparisons accurately compare the survey results between this and other years, the reader should be cautioned that the identity of companies responding to the survey has varied over the years. In 2009 and 2010, 29 companies responded to the survey. However, only 21 companies responded in both years, with eight companies dropping out, and eight new ones added. While the report authors have attempted to compensate for changes in the makeup of responding companies, the changes in the identity of those who respond does introduce some uncertainty in comparisons between years.

The reader should also be aware that the authors of this report are not aware of which companies have responded to the survey in any particular year. To protect commercially sensitive information, the report authors are presented with aggregated data only, prepared by the survey team staff. Staff members of the Renewable Energy and Climate Change Program within SAIC Canada have no access to either the individual survey responses or the identity of companies who submit responses.

## **2 SURVEY PROCESS**

### **2.1 Survey Development and Distribution**

In December 2010, a bilingual survey questionnaire was sent to over one hundred companies in Canada thought to be active in the solar thermal industry. The questionnaire was distributed at the 2010 CanSIA conference in Toronto (“Solar Canada 2010”), as well as by e-mail. Completed copies could be returned by e-mail, fax or regular mail. The majority of the companies were then contacted by phone (at least twice; many times in a few cases), to ensure they had received the questionnaire, and to encourage them to respond.

A copy of the questionnaire can be found in Appendix A.

### **2.2 External Data Sources**

#### *2.2.1 United States Energy Information Agency*

One of the more reliable sources of related data is the U.S. Energy Information Agency, which conducts an annual, mandatory survey of solar thermal collector manufacturers in the United States, including imports from and exports to other countries. They have not yet published data for 2010. Their 2009 data reveals that the U.S. manufacturers shipped 46,384 m<sup>2</sup> to Canada, while importing 1,493 m<sup>2</sup> from Canada (with both of these figures down sharply from the EIA 2008 survey). Unfortunately, the EIA does not provide a breakdown by collector type. The most that can be said about this data is that it does not contradict any data revealed by this survey of the Canadian industry.

#### *2.2.2 Natural Resources Canada ecoENERGY*

During the period covered by this survey, Natural Resources Canada (NRCan) operated two programs under the ecoENERGY umbrella that provided financial incentives to install solar heating systems, and they were kind enough to share aggregate data from these programs. Data from both ecoENERGY programs covers the one-year period from April 1, 2010 through March 31, 2011 (unlike the survey, which covers the full calendar year of 2010). Also, the reporting date for the survey and ecoENERGY periods were defined differently, with the survey asking for the date of shipping of product, and the ecoENERGY programs reporting on the system commissioning date. This difference in reporting date definitions should have served to lessen the three-month shift in the period covered. Thus it was decided to compare the data from ecoENERGY and the survey response directly, without trying to account for the three-month shift in the dates covered by the data.

Under the ecoENERGY Retrofit – Homes program, ecoENERGY reported that approximately 1,000 packaged small residential systems were installed. The survey responders reported 945 of these systems. Because these two numbers were in close agreement, the survey data was used, without adjustment.

Under the ecoENERGY for Renewable Heat program, ecoENERGY reported installation of commercial solar thermal systems containing approximately 7,777 m<sup>2</sup> of liquid glazed collectors and approximately 11,493 m<sup>2</sup> of liquid evacuated tube collectors. The corresponding values from the survey responses were 11,481 m<sup>2</sup> and 3,238 m<sup>2</sup>. The value for the liquid glazed was left unchanged, since the survey data has the greater value. (As is reasonable, since industry participants reported that not all installations received the



ecoENERGY incentive). For the evacuated tube collectors, the ecoENERGY value was used, as it was greater<sup>2</sup>. Revenue values were also adjusted accordingly.

### **2.3 Estimated Data Capture Rate**

When this survey series began, it was clear when comparing survey responses to other public data – and when factoring in the number of recipients of the survey questionnaire who did not complete the questionnaire – that the survey did not capture all of the Canadian solar thermal industry. To compensate for this incomplete data set, the report authors estimated data capture rates for the various industry segments, and then modified some of the survey data accordingly. The estimated data capture rates were included in each report.

For more recent reports, including this report covering 2010, a high number of recipients have responded, and no public data could be found that would indicate that the responses to the survey missed any substantial part of the solar thermal industry. Thus in this report the data capture rate is assumed to be 100% across all sectors, except the evacuated tube liquid collectors (as noted in section 2.2). Thus the values reported herein are directly from the survey responses, except those for evacuated tube collectors, where the survey responses have been modified based on the data from the ecoENERGY program. .

Even given the above conclusion, it is likely that this survey did not capture the entire market, and that actual sales were somewhat higher than reported herein.

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<sup>2</sup> In addition to the firm ecoENERGY data, there is some anecdotal evidence that the survey responses did not capture all of the shipments of evacuated tube collectors, all of which are manufactured outside of Canada and imported through various channels.

### 3 SURVEY RESULTS

#### 3.1 Industry Characterization

The following three figures provide an idea of the type of companies responding to the survey. Figure 1 shows that this year 38% (11 of 29) of respondents manufacture solar collectors; this is one fewer manufacturer than responded to the 2009 survey, but higher than all previous years. The fact that the number of manufacturers has increased over the years appears to be an indication that the steady growth of the Canadian market, at least partially spurred by stable government incentives, has been successful in encouraging the industry to invest in Canada. In general, the makeup of survey respondents in 2010 is very similar to 2009.

Figure 1 does show that the majority of survey respondents (69%) maintain at least some involvement in direct retail sales. This high level of participation in retail sales likely indicates that solar thermal collectors and systems are considered “specialty” items, best sold through a short, independent supply chain, rather than through conventional wholesale and retailer supply networks.

**Figure 1: Sector involvement within the solar thermal industry**

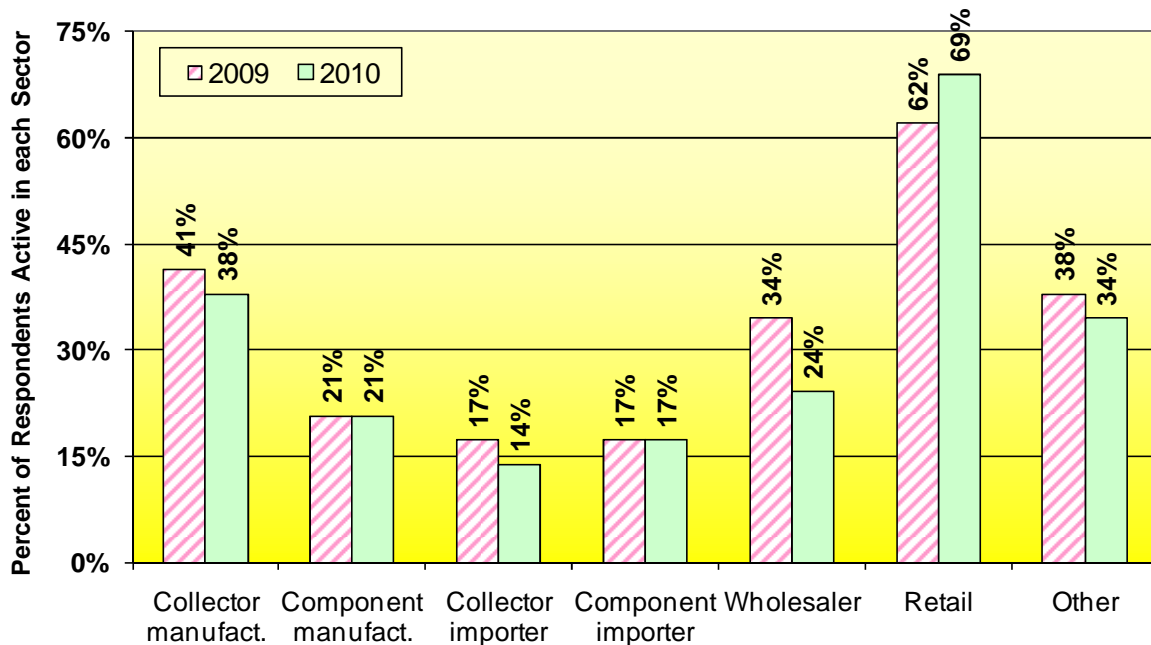
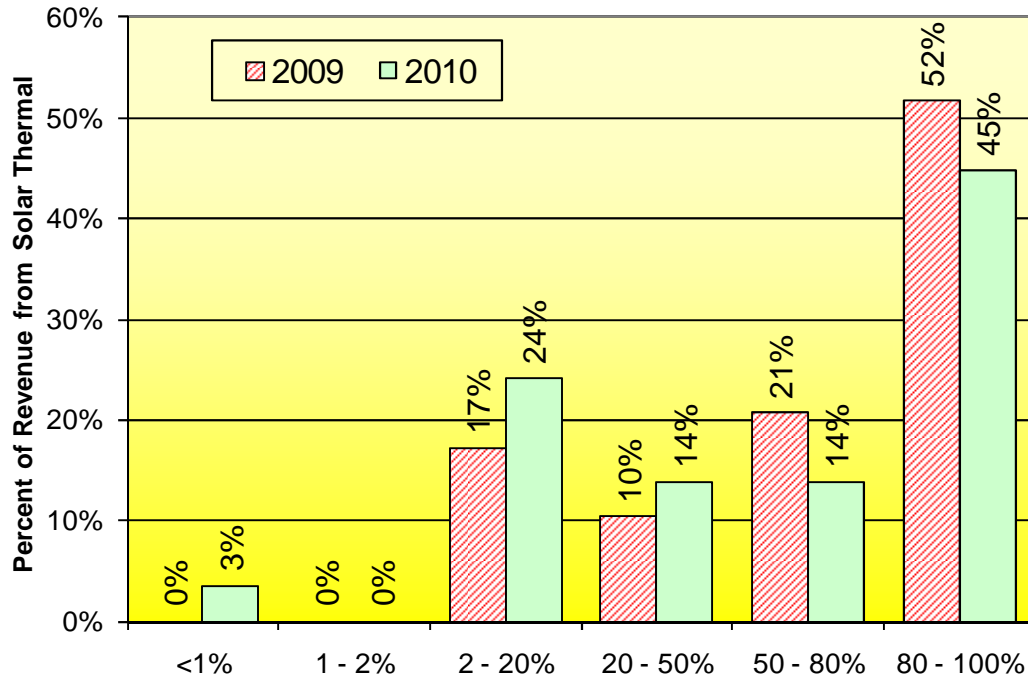


Figure 2 reveals that almost half (45%) of the survey respondents are specialized companies operating almost wholly within the solar thermal sector, deriving over 80% of their corporate revenue from solar. Fully 59% of respondents derived at least half of their total corporate revenue from solar thermal activities, down from 73% last year.

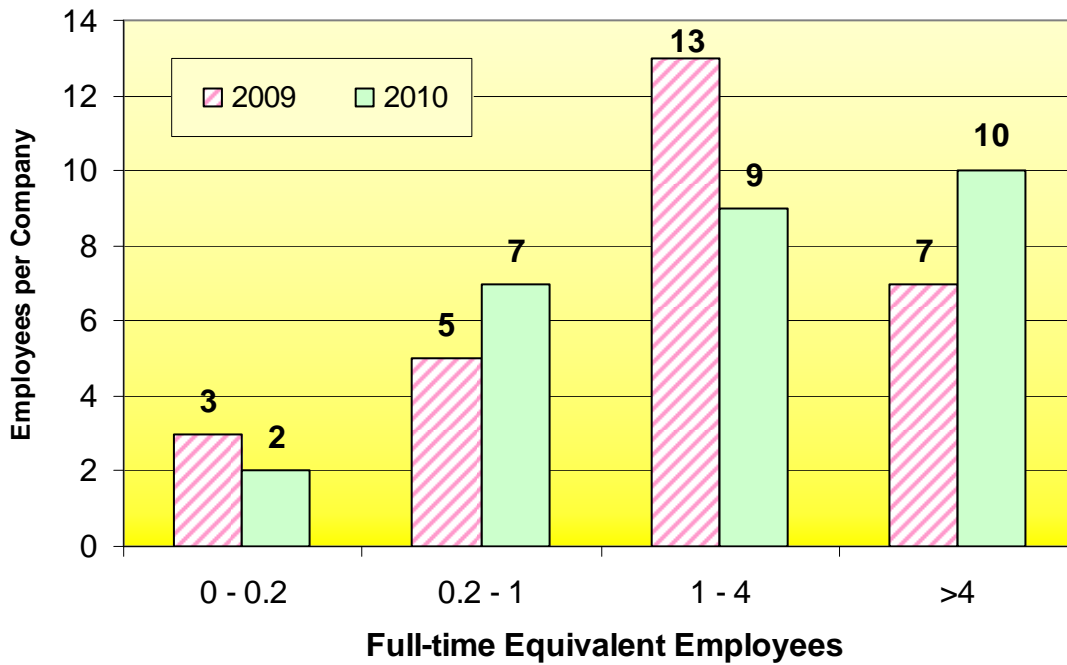
Similarly, Figure 3 reveals that 36% of all respondents have more than four full-time employees, up from 25% in 2009. The total number of person-years of employment in the

solar thermal industry, as reported by respondents was 164, or an average of more than 5.6 employees per respondent, up marginally from 2009. Peak employment was reported as 218 employees. Both values are the highest yet observed in this series of surveys. Note that total employment in the Canadian solar thermal industry is likely much higher than these values, because this survey was not designed to capture all those working at the retail sales and installer level.

**Figure 2: Solar thermal revenue as a percent of total corporate revenue**



**Figure 3: Number of employees per company engaged in solar thermal activities**



### 3.2 Industry Size and Growth

Table 1 contains industry sales figures for 2010. This table reveals healthy growth over 2009 in both revenue (76%) and collector area sold (47%).

- Total industry revenue has increased from \$21.3 to 37.4 million (76%).
- Total area of collectors sold increased from 171,279 to 252,146 m<sup>2</sup> (47%).
- Revenue from domestic sales more than doubling from \$16.6 to 34.0 million (105%).
- Revenue from export sales continues to decrease from \$4.8 to 3.4 million (-29%)

A more detailed review of the data reveals that for respondents that completed the survey in both 2009 and 2010 (21 common respondents); the revenue growth rate in 2010 was 43%. This clearly indicates that the industry experienced healthy growth in 2010, although the results were somewhat mixed for individual companies, with 13 of 21 earning greater revenue in 2010, while 8 earned less in 2010 than in 2009.

**Table 1: Solar collector sales by type, 2010**

<b>Domestic Sales</b>			
Collector Type	Thermal Capacity (MW)	Collector Area (m2)	Revenue (\$1,000's)
Air glazed	1.6	2,267	1,117
Air unglazed	62.7	89,560	9,233
Liquid evacuated	8.2	11,493	11,855
Liquid glazed	8.0	11,481	8,979
Liquid unglazed	59.3	84,690	2,807
<b>Total</b>	<b>139.8</b>	<b>199,491</b>	<b>33,991</b>
<b>Export Sales</b>			
Collector Type	Thermal Capacity (MW)	Collector Area (m2)	Revenue (\$1,000's)
Air glazed	2.1	3,051	491
Air unglazed	7.1	10,209	672
Liquid evacuated	0.3	450	600
Liquid glazed	0.7	1,000	400
Liquid unglazed	26.6	37,945	1,262
<b>Total</b>	<b>36.8</b>	<b>52,655</b>	<b>3,425</b>
<b>Total Sales</b>			
Collector Type	Thermal Capacity (MW)	Collector Area (m2)	Revenue (\$1,000's)
Air glazed	3.7	5,318	1,608
Air unglazed	69.8	99,769	9,905
Liquid evacuated	8.5	11,943	12,455
Liquid glazed	8.7	12,481	9,379
Liquid unglazed	85.9	122,635	4,069
<b>Total</b>	<b>176.6</b>	<b>252,146</b>	<b>37,416</b>

Figure 4 shows the rate of growth of the domestic market, by collector area, for each of the five types of solar thermal collectors. Because of the relatively small sample size, the precise year-over-year growth rates should be taken with caution. This graph shows that sales of all five collector types were higher in 2010, with both air glazed and liquid evacuated collectors – the two types with fewest total sales – experiencing the highest growth rates in 2010. It should be pointed out that there is evidence that the almost ten-fold increase in liquid evacuated collector sales is partly due to an under-representation of this sector in previous surveys.

**Figure 4: Annual domestic sales growth by collector type (m<sup>2</sup>)**

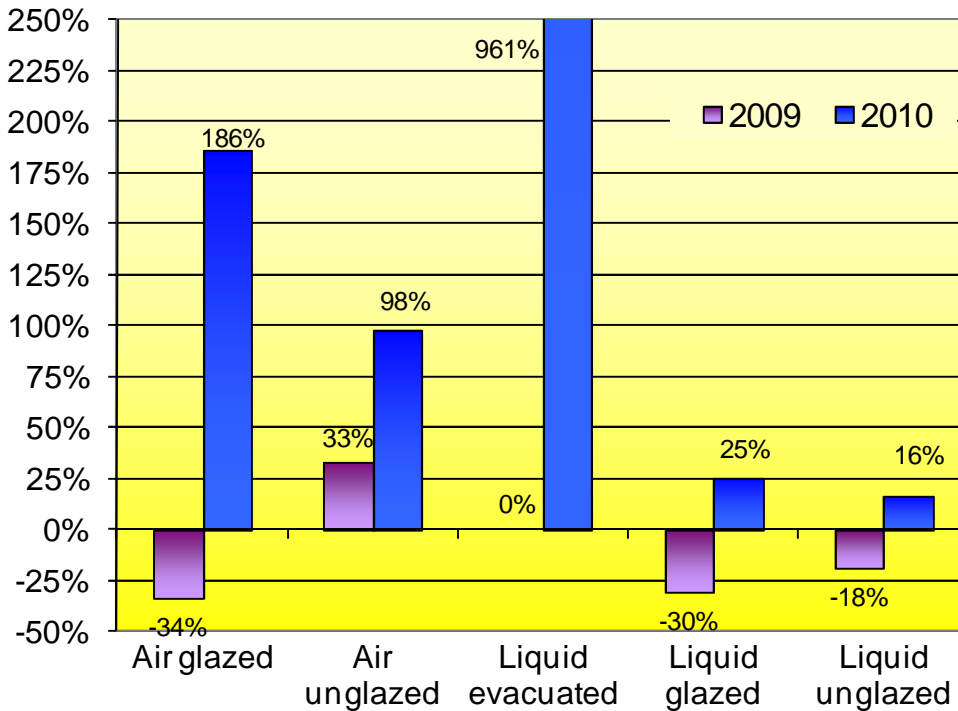
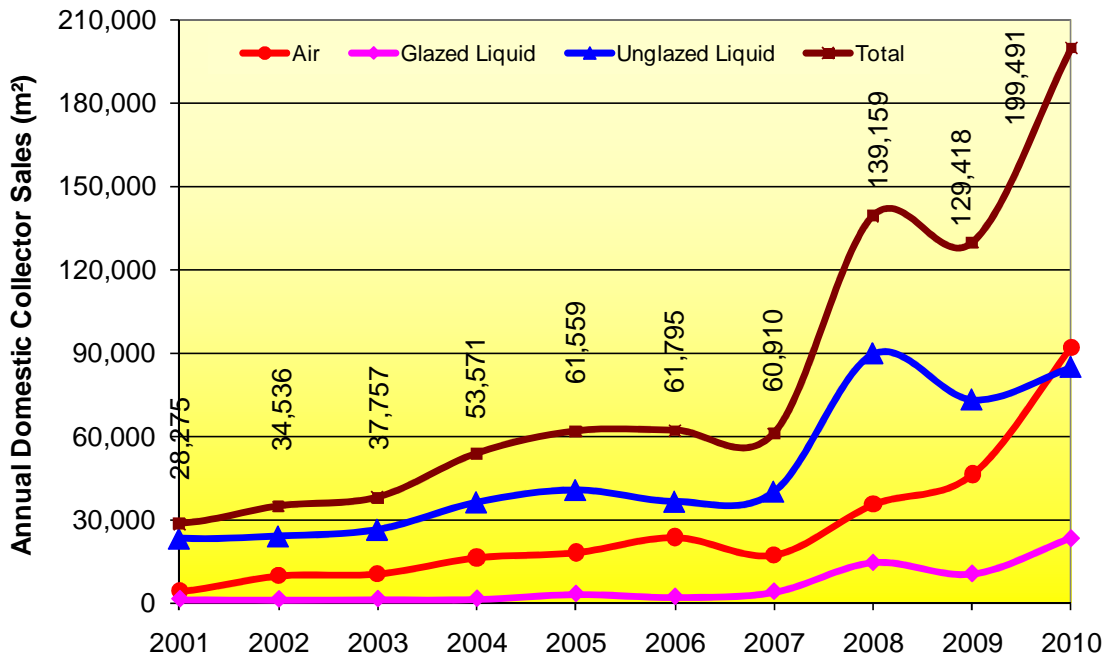
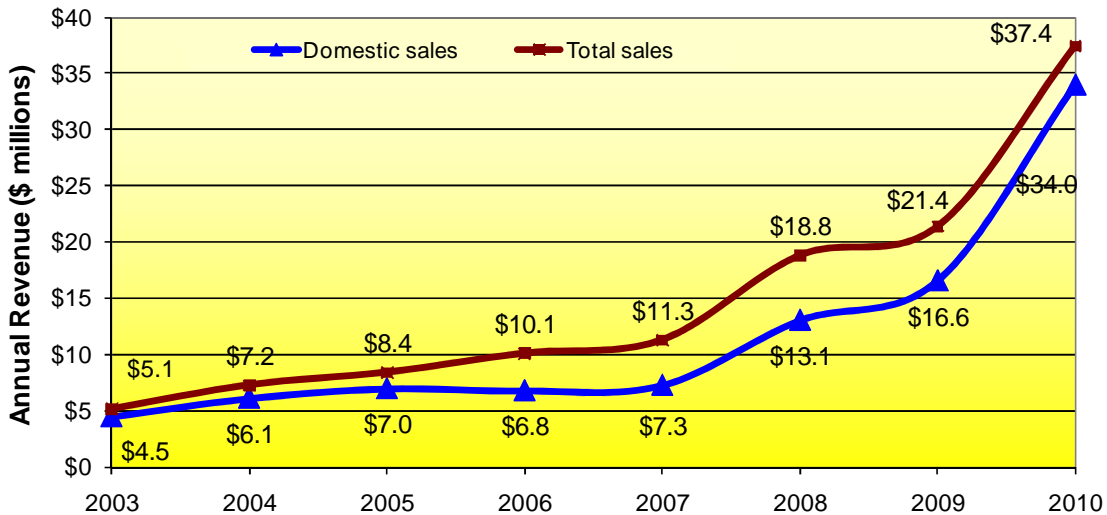


Figure 5 and Figure 6 provide a history of domestic solar collector sales in Canada over the past 10 years, and a history of revenue growth for the past eight years of this survey series. Both show consistent, strong growth over the years. Note that in 2010 the combined sales, by collector area, of air collectors (unglazed and glazed) exceeded sales of liquid unglazed collectors for the first time in this period. This is a result of the strong growth in these products over the past three years. Note also that the total area of solar thermal collectors sold in Canada in 2010 is more than three times the sales in the 2005 – 2007 period, a period during which total sales were fairly stable. Also of note, from Figure 6, is that the export revenue has declined in relative importance to the Canadian industry, especially in 2010, providing a smaller fraction of total industry revenue than in preceding years.

**Figure 5: Ten-year history of domestic collector sales (m<sup>2</sup>)**



**Figure 6: Canadian solar thermal industry revenue growth**



### 3.3 Applications of Solar Thermal Technology

Table 2 provides a summary of end-use application by collector type. There are only moderate changes in these applications from 2009. Unglazed liquid collectors are used almost exclusively for residential swimming pool heating, and air-based collectors are used

almost exclusively for space heating. There is a divergence between glazed and unglazed air collectors, where the unglazed are sold almost exclusively into the Industrial/Commercial/Institutional (ICI) sector, and the glazed air collectors are used approximately equally in both ICI and residential applications. The use of the glazed air collectors in the ICI sector is new in 2010, having not previously been detected by survey.

As in previous years, the glazed liquid and evacuated tube collectors have the broadest range of applications. In 2010 both of these were employed more extensively in the ICI sector than the residential sector, continuing a general trend that has been underway since at least 2006. Even though these two collector types show a diversity of application, the vast majority are employed for heating domestic hot water (87% and 85% for glazed and evacuated, respectively).

**Table 2: Solar heating applications (by revenue), by sector and collector type**

Revenue by Sector	Liquid			Air	
	Unglazed	Glazed	Evacuated	Unglazed	Glazed
Residential	100%	38%	27%	--	53%
Industrial/Commercial/Institutional (ICI)	--	62%	73%	97%	47%
Unknown	--	--	--	3%	--

Revenue by Solar Heating Application	Liquid			Air	
	Unglazed	Glazed	Evacuated	Unglazed	Glazed
Residential pool heating	100%				
Residential domestic water heating		34%	22%		
Residential space heating		1%	3%		53%
Residential combined space and water heating		3%	2%		
ICI pool heating		1%	1%		
ICI domestic water heating		53%	63%		
ICI process heat		3%		1%	
ICI space heating		1%		96%	47%
ICI combined/other		4%	9%		
Unknown	--	--	--	3%	--

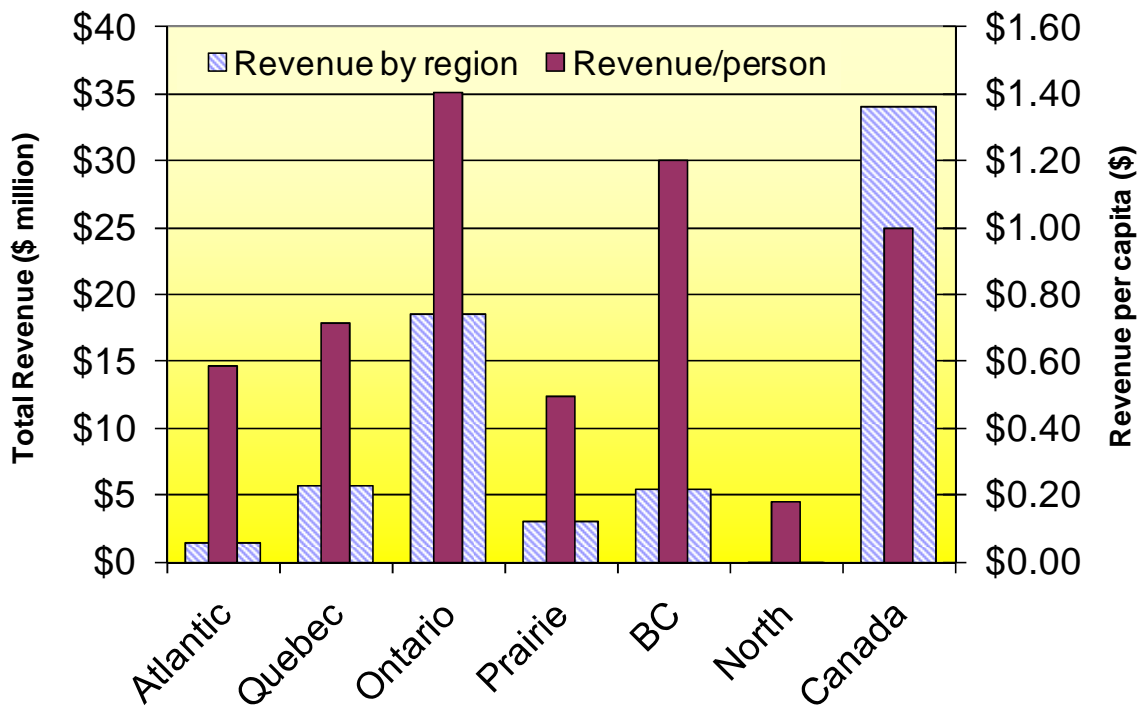


### 3.4 Geographic Distribution

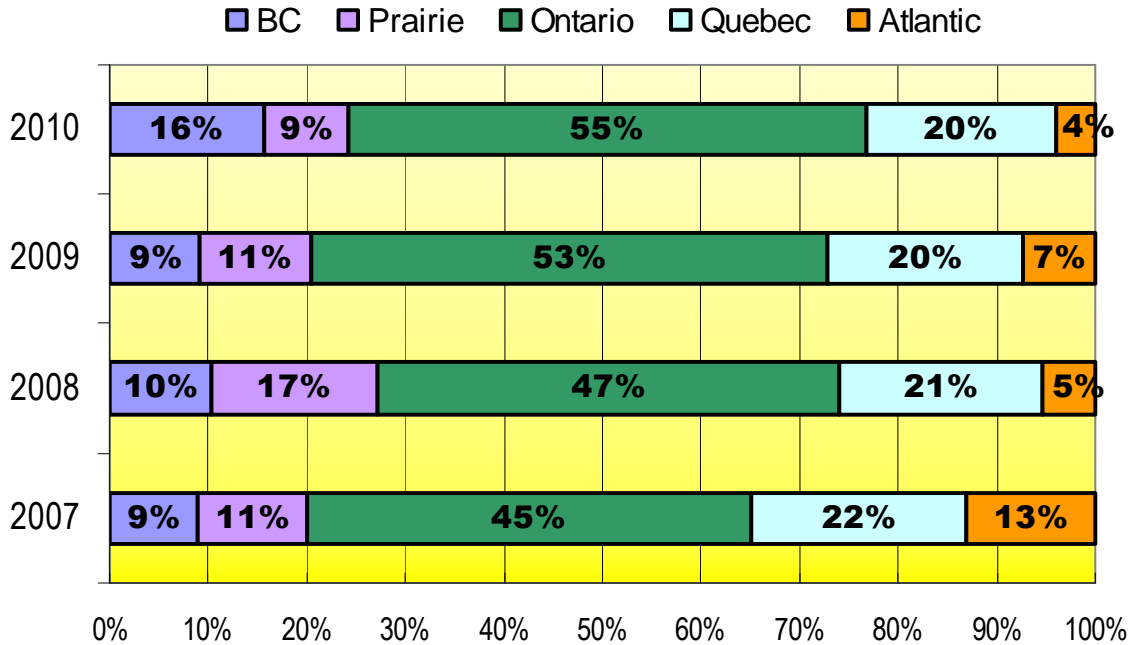
#### 3.4.1 Domestic Sales

In 2010, solar thermal collectors were installed in all areas of Canada, including the North. On a *per capita* basis, Canada-wide industry revenue has essentially doubled, from \$0.51 per person in 2009 to \$1.00 in 2010 (see Figure 7). All regions saw increased sales over 2009, except the North. Quebec, Ontario, the Prairies and British Columbia all experienced growth exceeding 50%, over 2009, with B.C. leading the way with a 250% annual growth rate.

**Figure 7: 2010 regional solar collector sales, by population**



**Figure 8: Regional distribution of domestic market (by revenue)**



### 3.4.2 Exports

Canada continues to export solar thermal collectors in considerable quantities, exporting approximately 53,000 m<sup>2</sup> (up 29% from 2009), valued at \$3.4 million (down 26% from \$4.6 million in 2009). As can be seen from Table 3, approximately 91% by revenue (95% by collector area) was exported to the United States, with minimal exports to Europe, Central and South America, Asia and Africa. As in recent years, all five major types of collectors were exported (Table 4). Liquid unglazed collectors accounting for the largest single segment of exported collectors (38%, by revenue), with the other four collector types all ranging between 10 and 20% of exports, by revenue. There was a steep decline in the export of liquid glazed collectors; they ranked first in 2008 and 2009, but accounted for the smallest export earnings in 2010.

**Table 3: Regional distribution of solar exports (by revenue)**

Distribution of Solar Exports	2009	2010
United States	94%	91%
Central and South America	2%	3%
Europe	4%	3%
Asia	--	1%
Africa	--	2%
Australia	--	--
<b>Total</b>	100%	100%

**Table 4: Exports by collector type (by revenue)**

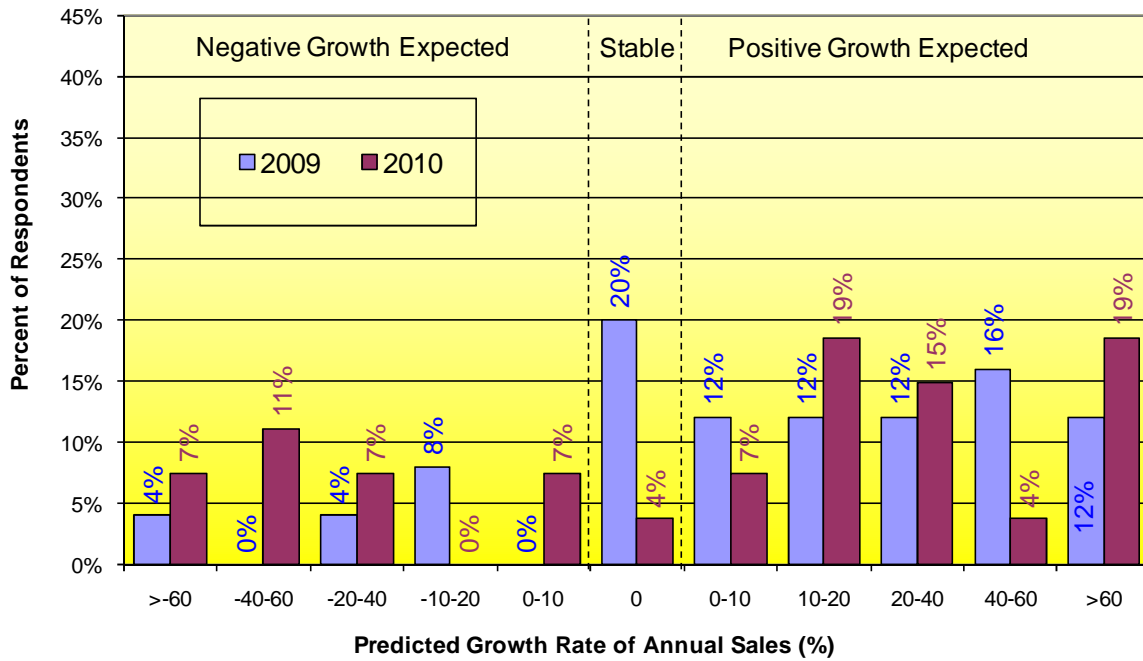
Exports by Collector Type	2009	2010
Air, glazed	12%	14%
Air, unglazed	5%	20%
Liquid, evacuated tube	20%	18%
Liquid, glazed	37%	12%
Liquid, unglazed	26%	36%
<b>Total</b>	100%	100%

### 3.5 Anticipated Sales Growth

The recipients were asked to estimate how future sales revenue would relate to their 2010 solar revenue. Figure 9 shows the range of responses, both from this survey and the previous survey (2009). This figure apparently shows optimism for future market growth, with two-thirds of the respondents anticipating increasing sales - including more than one-quarter predicting growth rates exceeding 40% - and only one-third predicting decreasing sales. However, there is strong polarization in the industry, with larger companies being pessimistic, and smaller companies showing optimism. When the respondents' replies were weighted by the amount of revenue derived from solar thermal activities, the respondents expect future sales to decrease by 5%. This contrasts strongly with the weighted average future growth rate of 31% reported in the 2009 survey, and is the first such decrease reported in the nine-year history of this survey.

Perhaps just as indicative of the growing pessimism in the Canadian solar thermal industry is that the number of companies that expect either no growth or a decline has increased from 0% in 2007, to 20% in 2008, 26% in 2009 and then to 36% for 2010. This steady decline in industry optimism is likely due to a variety of reasons, but the planned end of the ecoENERGY for renewable heat program in March 2011 is almost certainly a contributing factor.

**Figure 9: Estimate of future sales growth**



### 3.6 Sales of Packaged Systems

Question 12 asks if vendors sold packaged solar systems, either for domestic hot water (DHW) or swimming pool heating, within Canada. A total of thirteen respondents (up by one, from last year) indicated that they sold such packaged systems, with results shown in Table 5.

**Table 5: Domestic sales of packaged systems**

	Packaged DHW Systems	Packaged Pool Heating Systems
Number of systems sold	945	2,711
Average collector area per system (m <sup>2</sup> )	4.6	13.4
Total collector area (m <sup>2</sup> )	4,632	36,203
Total revenue from packaged systems	\$ 3,284,307	\$ 2,282,000
Average revenue per system	\$ 3,475	\$ 842

Based on these results, approximately 31% of all liquid glazed and evacuated collectors sold in Canada are sold in packaged DHW systems, that average about two collectors per system. Similarly, approximately 42% of all liquid unglazed collectors sold domestically are sold in packaged pool heating systems, with 3 or 4 collectors in the typical system.

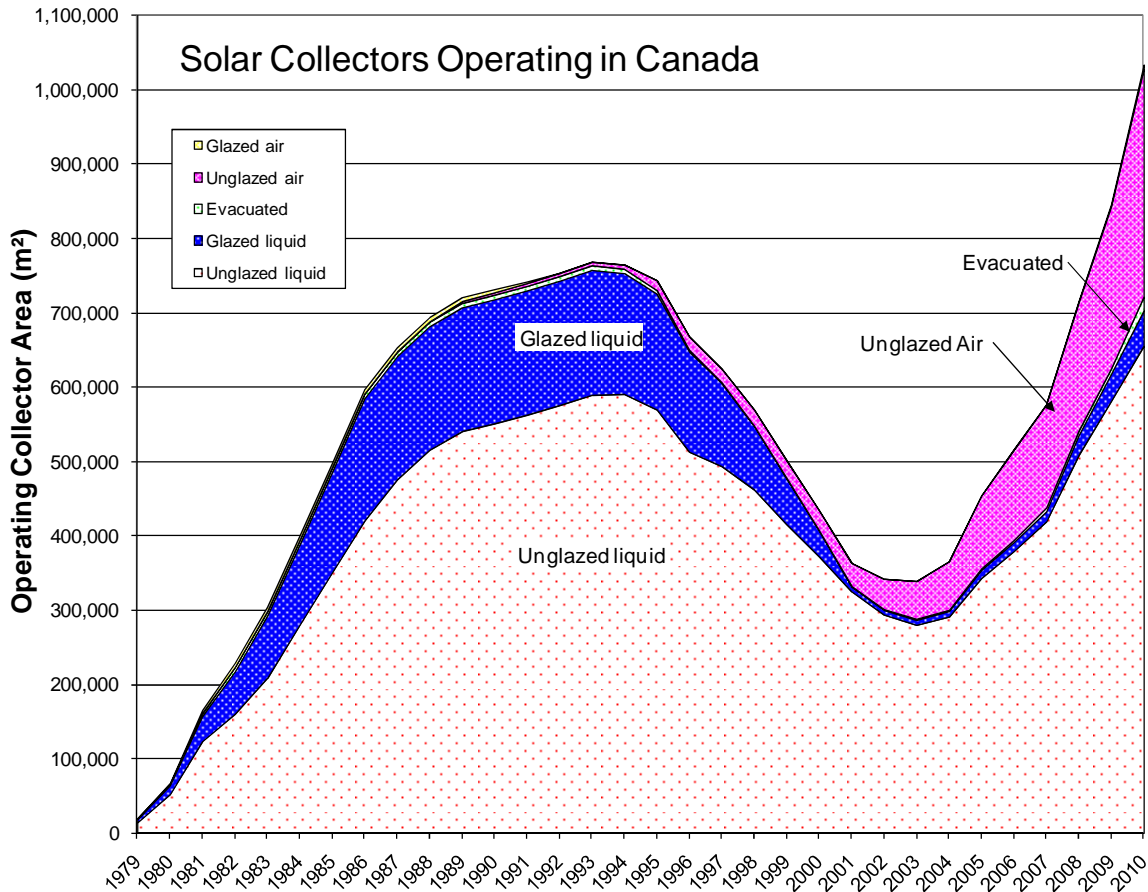
## 4 ESTIMATE OF AVOIDED GREENHOUSE GAS EMISSIONS

### 4.1 Background

Estimating GHG emissions avoided due to solar thermal installations in Canada is a complex issue that involves estimating the operational effectiveness of all solar heating systems in Canada, the fuel that they displace, and the location of the systems within Canada, among other variables. These variables cannot all be known with precision. With the support of the IEA, Weiss *et al* developed a methodology for estimated GHG avoidance, using a system of reference solar heating systems. This methodology was adopted, with some modifications, for use on earlier Canadian data, and is described in detail in a previous report (ref 1). A summary of the reference system definitions follows.

Figure 10 shows a historical record of installed, operational solar collectors. This data – showing 1,033,864 m<sup>2</sup> of solar collectors operating in Canada at the end of 2010 – was used in calculating the amount of GHG's avoided due to the use of active solar thermal energy in Canada.

**Figure 10: History of operating solar thermal systems in Canada**



## 4.2 Reference System Definitions

Weiss developed four reference systems in his work on estimating avoided GHG emissions, but only three of these four were applicable within Canada. We have chosen to use the same three systems, albeit with some adjustments to reflect the Canadian market, plus a fourth – commercial air.

Residential DHW – This system is identical to Weiss' solar domestic hot water systems for single family houses in Canada. It represents a typical solar DHW preheat system consisting of two 4' x 8' (6 m<sup>2</sup>) glazed solar collectors, 150 L/d hot water usage<sup>3</sup>, with a 300 L hot water storage tank. Commercial marketing material indicates that each system will produce about 50% of the energy required for hot water in a home, on an annual basis.

Commercial Water – This system is essentially a new name for Weiss' solar domestic hot water systems for multi-family houses and district heating, retaining many of its features. This incorporates all larger scale systems with glazed, liquid collectors, covering applications from institutional or multi-residential DHW, to municipal indoor pool heating, to process water at car washes, laundries or other facilities. As with Weiss, the reference system consists of 50 m<sup>2</sup> of collectors, 2,000 L/d hot water draw and a 2,500 L storage tank.

Residential Pool – This system is identical to Weiss, except that the collector area has been reduced from 200 m<sup>2</sup> to 25 m<sup>2</sup>, to more closely reflect the Canadian market (5-6 nominal 4' x 12' collectors per system). This reduction in size has little impact on the GHG analysis, but it does affect the calculation of the number of systems. Note that this reference system covers all unglazed, liquid-type collectors, and thus does include seasonal municipal or resort pools, which may have collector areas of 50 – 300 m<sup>2</sup>. However, these commercial pools constitute well below 5% of the Canadian market, and they do perform similarly to the more common residential pools.

Commercial Air – This is a new reference system, based on the successful use of unglazed air collectors for preheating ventilation and makeup air in industrial, commercial and agricultural (livestock barns) applications. Within Canada, this is a strong market sector, and cannot be ignored. System sizes vary widely from below 50 m<sup>2</sup> to 10,000 m<sup>2</sup>. For a reference system we have selected 200 m<sup>2</sup>, because it is within the size range for both agricultural and industrial/commercial/institutional sectors, and should provide a reasonable estimate of the mean size of all systems.

## 4.3 GHG Emission Avoidance Calculations

Table 6 shows the calculations used to estimate the GHG emissions avoided due to all solar thermal systems operating in Canada at the end of 2010. The value of 77,800 tonnes of CO<sub>2</sub>e avoided in 2010 is 29% higher than the value reported in 2009, indicating that the healthy growth in the solar thermal industry is significantly impacting GHG emissions in Canada.

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<sup>3</sup> The 150 L/d hot water usage used by Weiss is probably low for Canadian practice, but we chose to keep this value for consistency with international reports. Using a larger hot water draw (~225 L/d is more typical of actual hot water usage in Canada) would have increased the estimate of GHG avoided, but since residential DHW heating systems are a small segment of the Canadian market, the overall effect would be small.

**Table 6: Analysis of avoided GHG emissions, using four reference systems, 2010**

Parameter	Residential DHW	Commercial Water	Residential Pool	Commercial Air
Collector type	glazed	glazed	unglazed	unglazed air
Collector area (m <sup>2</sup> )	6	50	25	200
Annual yield per system (GJ/a)	9.9	82.1	19.4	422
Specific annual yield (GJ/a-m <sup>2</sup> )	1.64	1.64	0.78	2.11
Displaced fuel mix (%)				
• Oil (73 kg of CO <sub>2</sub> /GJ)	4%	15%	1%	5%
• Natural gas (50 kg of CO <sub>2</sub> /GJ)	50%	75%	63%	50%
• Propane (60 kg of CO <sub>2</sub> /GJ)	--	5%	--	40%
• Electricity (151 kg of CO <sub>2</sub> /GJ)	46%	5%	12%	5%
• Heat pump (38 kg of CO <sub>2</sub> /GJ)	--	--	24%	--
• No fuel	--	--	--	--
Blended CO <sub>2</sub> avoided (kg of CO <sub>2</sub> /GJ)	97	59	59	60
Annual CO <sub>2</sub> avoided (t/a-system)	0.96	4.84	1.14	25.3
Annual specific CO <sub>2</sub> avoided (kg/a-m <sup>2</sup> )	160	97	46	127
Estimated system life (years)	15/20	15/20	15/20	30
Total operating collector area (m <sup>2</sup> )	33,107	33,107	656,485	311,165
Calculated number of systems	5,518	662	26,259	1,556
Total annual CO <sub>2</sub> avoided (t/a)	5,297	3,205	29,936	39,362
Total annual CO <sub>2</sub> avoided, all types (t/a)	<b>77,800</b>			

The 77,800 tonnes of GHG emissions avoided due to solar thermal installations in Canada is equivalent to removing more than 15,000 mid-size cars from Canadian roads, or the total GHG emissions of more than 3,300 Canadians<sup>4</sup>.

#### 4.4 Forecast GHG Emission Avoidance from Collectors sold in 2010

An alternative view of GHG emission avoidance - and one that is more representative of the current sales rate of solar thermal systems, rather than past sales - is to estimate the total GHG's that will be avoided over the operating life of systems installed in the current year. Applying the same calculations in the previous section to the 199,491 m<sup>2</sup> of collectors installed in Canada during 2010, leads to the conclusion that 481,814 tonnes of CO<sub>2</sub> equivalent will be saved over the lifetime of these systems (using a 20 year expected life for all water systems and a 30 year life for commercial air systems).

<sup>4</sup> "Human Activity and the Environment: Annual Statistics – 2007 and 2008" Statistics Canada, March 2009. This report indicates that the per capita GHG emissions from a typical Canadian are 23 tonnes per annum, and that a typical mid-size car driven 25,000 km each year emits 5 tonnes of GHG's.

Since the solar industry earned 34.0 million dollars in revenue from domestic sales in 2010, this means that one tonne of CO<sub>2</sub> is saved for every \$71 of revenue (neglecting any service and repair revenue that may be earned over the life of the systems).

Depending upon climatic conditions and displaced fuel data in the country of use, it is likely that the solar collectors exported from Canada during 2010 will be responsible for avoiding approximately 107,000 tonnes of CO<sub>2</sub> equivalent, during their operating life.



## 5 CONCLUSIONS

The Canadian solar thermal industry has shown sustained growth through the early years of the twenty-first century, with very strong growth in 2010 in both revenue (76%) and collector area (47%).

Figure 11 shows the 2010 domestic market share, by collector type, against three different metrics. Note that air collectors dominate the projected GHG savings (partly due to their longer projected average life: 30 vs. 20 years), and are indeed the most effective at avoiding GHG emissions, when measured on a cost per tonne basis. Glazed liquid collectors, used primarily for heating domestic hot water, accounted for 61% of industry revenue in 2010, yet constitute only 12% of sales by area, and are projected to account for only 12% of the avoided GHG emissions from the solar thermal industry.

**Figure 11: 2010 market share by Area, Revenue and Projected GHG Savings**

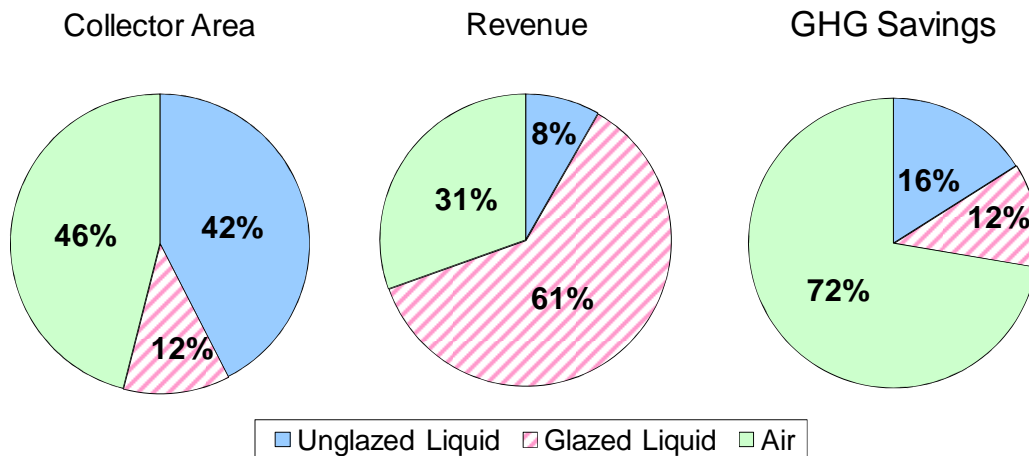
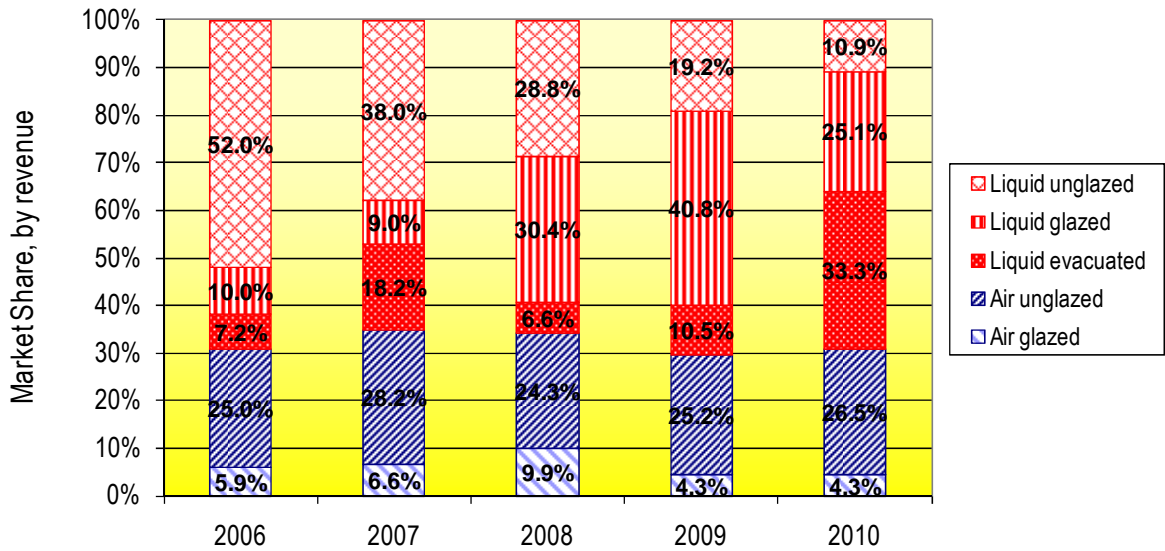


Figure 12 summarizes recent changes in the market of the five collector types, by revenue (domestic plus export). The overall ratio between liquid and air collectors has remained roughly stable at 2:1. A significant trend revealed by this data is the gradual decline in importance of the liquid unglazed market, from 52% in 2006 to 11% in 2010 – even though sales of this collector type increased during this same period. Also of interest is the very large increase in liquid evacuated collector sales in 2010, from 10.5% to 33.3% of the market. At least part of this increase is likely due to under-reporting of these sales in previous years, but the extent of this cannot be determined.

**Figure 12: Recent changes in market share of five collector types (domestic plus export sales, by revenue)**



## 6 REFERENCES

- 1) ***Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2002 – 2004)***, August 2005, SAIC Canada report no. CM001743.
- 2) ***Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2005)***, October 2006, SAIC Canada report no. CM002056.
- 3) ***Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2006 & 2007)***, March 2008, SAIC Canada report no. CM002208.
- 4) ***Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2008)***, September 2009, SAIC Canada report no. CM002285
- 5) ***Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2009)***, August 2010, SAIC Canada report no. CM002285
- 6) Mayes, Fred *et al*, July 2006. ***Renewable Energy Trends 2005: With Preliminary Data for 2005***. Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels, U.S. Department of Energy.
- 7) Mayes, Fred *et al*, July 2007. ***Renewable Energy Trends 2006: With Preliminary Data for 2006***. Energy Information Administration, Office of Coal, Nuclear, Electric and Alternate Fuels, U.S. Department of Energy.
- 8) U.S. Energy Information Agency, ***Renewable Energy Trends in Consumption and Electricity 2008***, August 2010
- 9) Omboli, Eugène and McClenahan, Doug, 2002, ***NRCan In-house Survey of Solar Collectors for 1995 – 2001***, Natural Resources Canada.
- 10) Weiss, Werner; Bergmann, Irene and Faninger, Gerhard, February 2004. ***Solar Heating Worldwide: Markets and Contribution to the Energy Supply 2001***. IEA Solar Heating & Cooling Program.
- 11) Hubbard, Richard, 2005, ***Canadian Swimming Pool Industry: 2005 Market Report***, Pool & Spa Marketing, spring 2006.
- 12) Hubbard, Richard, 2006, ***Canadian Swimming Pool Industry: 2006 Market Report***, Pool & Spa Marketing, spring 2007.
- 13) Energy, Mines and Resources Canada, ***Energy in Canada 1986 Handbook***
- 14) Watson, Heather Louise, 2009, a summary of recent ecoENERGY-supported solar thermal installations in Canada, private communication

## **APPENDIX A – Survey Questionnaire**

The following pages contain a copy of the 12 questions asked of survey recipients. The appendix contains the questions in English, although the questionnaire was distributed in both French and English.

ID No.

To be assigned during processing

## Questionnaire

### Solar Thermal Collector Survey

#### Calendar Year 2010

*Please note that, for the purpose of this survey, active Solar Thermal (ST) includes activity pertaining to solar collector-based systems only. Any solar technology that does not incorporate manufactured solar collectors – such as most passive solar applications – is beyond the scope of this survey.*

**Please enter company contact information:**

COMPANY \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
NAME \_\_\_\_\_  
TITLE \_\_\_\_\_  
TELEPHONE \_\_\_\_\_  
FAX \_\_\_\_\_  
E-MAIL \_\_\_\_\_

**DEADLINE FOR COMPLETION IS FRIDAY, FEBRUARY 14, 2010**

**Completed surveys should be returned to:**

Sandi Mish  
SAIC Canada  
Suite 1516, 60 Queen Street  
Ottawa, Ontario  
K1P 5Y7

Tel: (613) 563-7242  
Fax: (613) 563-3399  
Toll-free number: 1-888-SAIC-CAN

E-mail: [mishs@saiccanada.com](mailto:mishs@saiccanada.com)

1. Please provide some profile information pertaining to your Solar Thermal business. Which of the following business segments were/are applicable to your organization for the calendar years 2009 and 2010?

<b>Business Segments</b>	<b>2009</b>	<b>2010</b>
a. ST Collector Manufacturer	<input type="checkbox"/>	<input type="checkbox"/>
b. ST System Component Manufacturer	<input type="checkbox"/>	<input type="checkbox"/>
c. ST Collector Importer	<input type="checkbox"/>	<input type="checkbox"/>
d. ST System Components Importer	<input type="checkbox"/>	<input type="checkbox"/>
e. Wholesale Distributor	<input type="checkbox"/>	<input type="checkbox"/>
f. Retailer/installer	<input type="checkbox"/>	<input type="checkbox"/>
g. Other: Design/consulting services: Please describe:	<input type="checkbox"/>	<input type="checkbox"/>

2. a) Please estimate the time spent on ST activities of all employees (full and part-time), and contractors, to provide the number of full-time employee equivalents.

\_\_\_\_\_ person-years in 2010

- b) Including full-time, part-time and seasonal staff, but excluding contractors, what was the peak number of persons employed at any single time during 2010? \_\_\_\_\_

3. In 2010, what proportion of your organization's total revenue was from active solar thermal business?  
\_\_\_\_\_%

4. In addition to solar thermal, please indicate if your business was involved in any of the following business segments in 2010. Check all that apply in the left column; in the right column, check only one, as your primary area of business. If your PRIMARY Business Segment is "Other", please specify it by name in the space provided.

<b>Business Segments</b>	<b>Some Involvement (check all that apply)</b>	<b>Primary Business (check only one)</b>
Other renewable energy (e.g. PV, wind, wood stoves, etc.)	<input type="checkbox"/>	<input type="checkbox"/>
Swimming pool sales and installation	<input type="checkbox"/>	<input type="checkbox"/>
Plumbing contractor	<input type="checkbox"/>	<input type="checkbox"/>
HVAC contractor	<input type="checkbox"/>	<input type="checkbox"/>
HVAC equipment manufacturer or distributor	<input type="checkbox"/>	<input type="checkbox"/>
Building contractor	<input type="checkbox"/>	<input type="checkbox"/>
Other building trades	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify):	<input type="checkbox"/>	<input type="checkbox"/>

5. a. Please report your total revenue earned from solar thermal activities, and then provide the percentage of this revenue that was earned from various types of sales. For this table, please include all types of revenue related to ST activities (e.g. product sales, service contracts, installation fees, consulting revenues). In 5b, also provide total collector sales, export and Canadian, by collector area.

<b>Total Sales Revenue from Solar Thermal Activities</b>	\$
--	----

<b>Revenue from All Export Sales</b>	<b>Revenue from Sales to Canadian Re-sellers</b>	<b>Revenue from Sales Direct to Canadian End Users</b>	<b>Revenue from Other Canadian Sales</b>
%	%	%	%

(Should sum to 100%)

- b. Collector Area

<b>Total ST Collector Sales, by area</b>	m <sup>2</sup>
--	----------------

<b>Percent of collectors exported (by m<sup>2</sup>)</b>	<b>Percent of collectors sold within Canada (by m<sup>2</sup>)</b>
%	%

---

 (Should sum to 100%)

6. Compared to this year, does your organization expect more, less or about the same revenues in the ST collector and components sales and services area over the next 2 years?

- Remain the same
- Increase by \_\_\_\_\_% average per year
- Decrease by \_\_\_\_\_% average per year

7. Please report collector sales in both collector area (square meters) and revenue (dollars). If your business involved the sale of complete systems, and/or related services and components along with solar collectors, please report the total revenue earned for the sale, in the most appropriate column.

Sales	Collector Type				
	<i>Air</i>		<i>Liquid</i>		
	Glazed	Unglazed	Evacuated	Glazed	Unglazed
Collector area (m <sup>2</sup> )					
Revenue (\$)					



8. Please provide a percentage distribution, by collector type, of dollar sales by application. If you were wholesaling the product to re-sellers, and are unaware of the final application, please report these shipments in the “unknown” category.

Sector	Application	Collector Type				
		<i>Air</i>		<i>Liquid</i>		
		Glazed	Unglazed	Evacuated	Glazed	Unglazed
<b>Residential</b>	Pool	%	%	%	%	%
	DHW	%	%	%	%	%
	Space	%	%	%	%	%
	Combined/other (includes hot tubs)	%	%	%	%	%
<b>Industrial/ Commercial/ Institutional</b>	Pool	%	%	%	%	%
	DHW	%	%	%	%	%
	Process heat	%	%	%	%	%
	Space heat	%	%	%	%	%
	Combined/other	%	%	%	%	%
<b>Unknown/Wholesale</b>		%	%	%	%	%
<b>Total</b>		<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>

9. Please provide details on the geographic region to which the ST Collectors were shipped/sold. Question 9a deals with the regional distribution of **Collector Revenue**, while Question 9b deals with the regional sales distribution of **Collector Area**.
- a. **Collector Revenue:** Within each region, please report the distribution of collector types, by percentage. *Example: If you sold \$10,000 of liquid glazed collectors plus \$40,000 of liquid unglazed collectors into the Atlantic region, report regional sales as \$50,000, and then write 20% beside “liq-GLAZ” and 80% beside “liq-UNGL”. (Note: The % Types in each Region should sum to 100%).*

Canadian Sales			Export Sales		
Region	Revenue (\$)	Type (%)	Region	Revenue (\$)	Type (%)
Atlantic Provinces		air-GLAZ	United States		air-GLAZ
		air-UNGL			air-UNGL
		liq-EVAC			liq-EVAC
		liq-GLAZ			liq-GLAZ
		liq-UNGL			liq-UNGL
Ontario		air-GLAZ	Central & South America, Mexico, Caribbean		air-GLAZ
		air-UNGL			air-UNGL
		liq-EVAC			liq-EVAC
		liq-GLAZ			liq-GLAZ
		liq-UNGL			liq-UNGL
Quebec		air-GLAZ	Europe		air-GLAZ
		air-UNGL			air-UNGL
		liq-EVAC			liq-EVAC
		liq-GLAZ			liq-GLAZ
		liq-UNGL			liq-UNGL
Prairie Provinces		air-GLAZ	Asia, Middle East		air-GLAZ
		air-UNGL			air-UNGL
		liq-EVAC			liq-EVAC
		liq-GLAZ			liq-GLAZ
		liq-UNGL			liq-UNGL
British Columbia		air-GLAZ	Africa		air-GLAZ
		air-UNGL			air-UNGL
		liq-EVAC			liq-EVAC
		liq-GLAZ			liq-GLAZ
		liq-UNGL			liq-UNGL
Northern		air-GLAZ	Australia, New Zealand, Oceania		air-GLAZ
		air-UNGL			air-UNGL
		liq-EVAC			liq-EVAC
		liq-GLAZ			liq-GLAZ
		liq-UNGL			liq-UNGL

- b. **Collector Area:** Within each region, please report the distribution of total collector area sales by type percentage. *Example: If you sold 20 m<sup>2</sup> of liquid glazed collectors plus 980 m<sup>2</sup> of liquid unglazed collectors into the Atlantic region, report regional area sales as 1,000 m<sup>2</sup>, and then write 2% beside “liq-GLAZ” and 98% beside “liq-UNGL”. (Note: The % Types in each Region should sum to 100%).*

Canadian Sales			Export Sales		
Region	Area sold (m <sup>2</sup> )	Type (%)	Region	Area sold (m <sup>2</sup> )	Type (%)
Atlantic Provinces		air-GLAZ	United States		air-GLAZ
		air-UNGL			air-UNGL
		liq-EVAC			liq-EVAC
		liq-GLAZ			liq-GLAZ
		liq-UNGL			liq-UNGL
Ontario		air-GLAZ	Central & South America, Mexico, Caribbean		air-GLAZ
		air-UNGL			air-UNGL
		liq-EVAC			liq-EVAC
		liq-GLAZ			liq-GLAZ
		liq-UNGL			liq-UNGL
Quebec		air-GLAZ	Europe		air-GLAZ
		air-UNGL			air-UNGL
		liq-EVAC			liq-EVAC
		liq-GLAZ			liq-GLAZ
		liq-UNGL			liq-UNGL
Prairie Provinces		air-GLAZ	Asia, Middle East		air-GLAZ
		air-UNGL			air-UNGL
		liq-EVAC			liq-EVAC
		liq-GLAZ			liq-GLAZ
		liq-UNGL			liq-UNGL
British Columbia		air-GLAZ	Africa		air-GLAZ
		air-UNGL			air-UNGL
		liq-EVAC			liq-EVAC
		liq-GLAZ			liq-GLAZ
		liq-UNGL			liq-UNGL
Northern		air-GLAZ	Australia, New Zealand, Oceania		air-GLAZ
		air-UNGL			air-UNGL
		liq-EVAC			liq-EVAC
		liq-GLAZ			liq-GLAZ
		liq-UNGL			liq-UNGL

10. Please list your sources of ST collectors, including in-house manufacturing. For calculation purposes, use dollar value of ST collectors from all sources for the year 2010 as 100%. Use an additional sheet, if needed.

Collector Source	Collector Type(s) <sup>†</sup>	Supplier Name	Supplier Location*	% of total supply (by \$)
<b>Manufactured In-house</b>		n/a	n/a	
<b>Purchased Within Canada</b>				
<b>Purchased Outside Canada</b>				
<b>Total</b>				<b>100%</b>

<sup>†</sup> Please use the five collector types: air-GLAZ, air-UNGL, liq-EVAC, liq-GLAZ, liq-UNGL

\* Please use a Canadian or a global region defined in the table in question 9 to identify the Supplier Location (e.g. Atlantic provinces, Ontario, United States, Europe, etc.)

11. Have there been any changes in your business during 2010 (e.g. merger, acquisition, etc.) that have had a significant impact on solar thermal sales from previous years? If so, please describe the change briefly.

ID No.

To be assigned during processing

12. Does your business sell packaged solar systems in Canada? (check one)  Yes  No

If you answered "Yes", please provide information on the number and type of systems sold by completing the tables below. Please provide data only on Canadian sales, excluding exported systems.

<b>Solar DHW Systems</b>		
<b>Total revenue from packaged sales within Canada</b>	<b>Number of systems sold</b>	<b>Total ST collector area in packaged sales</b>
\$		m <sup>2</sup>

<b>Solar Pool Heating Systems</b>		
<b>Total revenue from packaged sales within Canada</b>	<b>Number of systems sold</b>	<b>Total ST collector area in packaged sales</b>
\$		m <sup>2</sup>