



## Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2013/2014)

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## Executive Summary

This report is a summary of a survey of the Canadian solar thermal industry covering the 2013 and 2014 calendar years, conducted between January and March 2015.

The Canadian solar thermal industry did not change considerably between 2013 and 2014 after significant declines for multiple years prior to 2014. Total industry revenue in 2014 was \$17.5 million, a slight increase from the \$16.9 million reported in 2013, with collector sales also increasing from 84,070 m<sup>2</sup> in 2013 to 99,666 m<sup>2</sup> in 2014. The increase in revenue and collector area was largely driven by a growing export market, which was slightly offset by a shrinking domestic market.

The domestic market for each collector type experienced unique dynamics in 2013 and 2014 that warrant individual analysis. With the exception of unglazed liquid collectors, all collector types faced declines domestically. The air unglazed market segment decreased by 2% (revenue) and 9% (collector area) between 2013 and 2014. The liquid evacuated market segment also experienced declines in revenue (-8%) and collector area sold (-4%). The liquid glazed market segment shrunk by 1% in revenue, but grew by 14% in collector area. The liquid unglazed market segment experienced 9% growth in both revenue and collector area, bucking the general market trend.

On a national basis, Quebec maintained its position as the domestic market leader, but decreased slightly from 43% of the market to 42%. Ontario's market share increased from 28% to 31% between 2013 and 2014. British Columbia continued to experience declines in market share shrinking to 6% from 25% in 2011.

Industry optimism remained low in 2014 with 32% of respondents expecting little to no growth over the next two years. Thirty-three percent of respondents expected positive sales growth while 34% predicted a decrease in sales of the same time period.

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## 1. Introduction

This report provides the results of a survey of the solar thermal industry in Canada covering the calendar years of 2013 and 2014. The survey was commissioned by Natural Resources Canada (NRCan), and was undertaken by ClearSky Advisors. This survey is a continuation of a series of annual 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. The ecoENERGY for Renewable Heat program replaced the REDI program in 2006, and ended on March 31, 2011. Active solar thermal systems, including air and water heating, represent two of the types of renewable energy technologies previously supported by the ecoENERGY program.

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).

The purpose of this study was to survey the Canadian active solar thermal collector industry to obtain data for the 2013 and 2014 calendar years. 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.

Survey respondents were asked a series of questions about employment, revenue, sales by collector area, and detailed breakdowns of sales by five collector types: unglazed air, glazed air, evacuated tube (liquid), unglazed liquid, and glazed liquid. For consistency with previous studies, no data was included for concentrating solar thermal collectors – although there was some concentrating solar thermal collector activity in 2013 and 2014. Future surveys may include this category if applicable.

### 1.1. Comparison to Earlier Surveys

Comparisons to data from previous surveys are made throughout this report. Note that the identity of companies responding to the survey varies from year to year, and therefore may introduce some uncertainty in the comparisons. All attempts were made to ensure that the underlying methodology for analysis of the 2013 and 2014 survey data remained consistent with past surveys.

The reader should also be aware that the authors of this report are not aware of which companies responded to the survey in any particular year. To protect commercially sensitive information, access to individual responses was limited to only select members of the survey team. Outside staff members of ClearSky Advisors and all staff members of NRCan 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 January 2015, a bilingual survey was sent by email to over one hundred Canadian companies believed to be active in the solar thermal industry. The survey could be completed online, or returned by email, fax, or regular mail. The majority of the companies were then contacted by phone to confirm receipt of the survey, and to encourage them to respond. Most respondents completed the survey online.

A copy of the survey may be found in Appendix A.

### 2.2. Estimated Data Capture Rates and Comparison to 2011 Survey

This study involved three phases:

- 1) Data collection
- 2) Analysis
- 3) Verification and Validation

During data collection the goal was to capture as much of each market segment as possible. A comparison of revenue and sales data reported in the latest survey to the 2012 survey indicates the capture of data from 18 of the top 20 contributors by revenue. The 2012 survey covered 47 respondents of which 46 provided both 2011 and 2012 revenues. The latest survey covered 47 respondents of which 38 provided both 2013 and 2014 revenues.

### 3. Survey Results

#### 3.1. Industry Characterization

The following three figures categorize the business characteristics of the companies responding to the survey. Figures 1 and 2 provide a breakdown by industry role and collector type for the 47 respondents participating in the 2013/2014 survey. The vast majority of participants, 83%, reported involvement in the “Other” (e.g., design or consulting services, repairs), up from 40% in the 2012 survey. The increase indicates a general shift away from core solar thermal industry activities. 70% (33 out of 47) of respondents were involved in direct retail sales and installations, down from 75% in 2012. With a collapse of the distribution business, wholesalers saw a dramatic reduction between 2012 and 2014, dropping from 44% to 26% of respondents.<sup>1</sup> Of the surveyed respondents, 36% were active in the liquid glazed sectors.

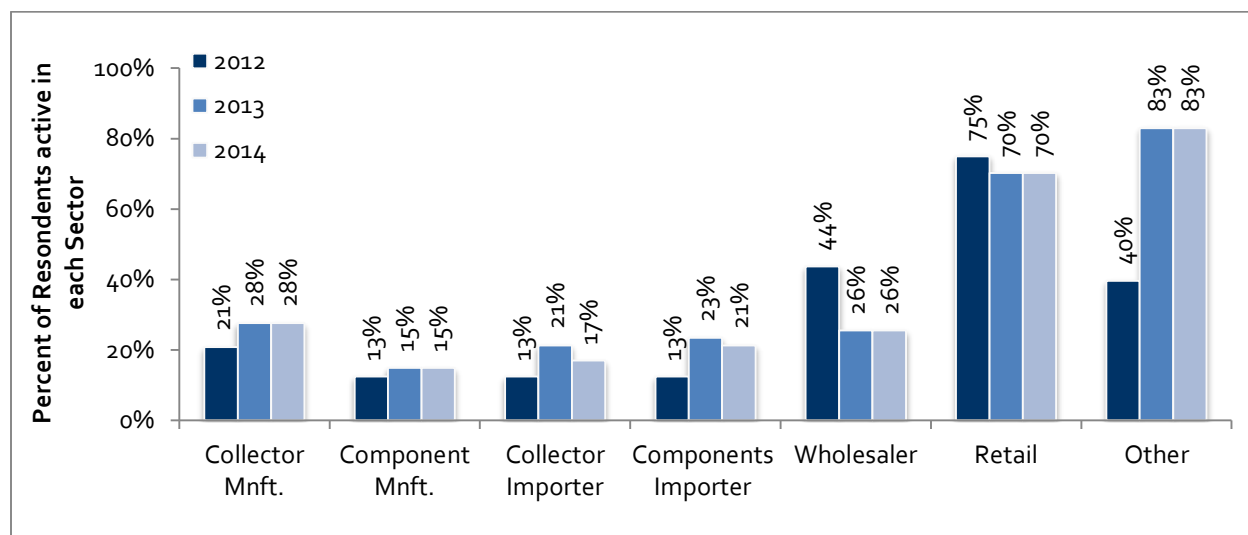
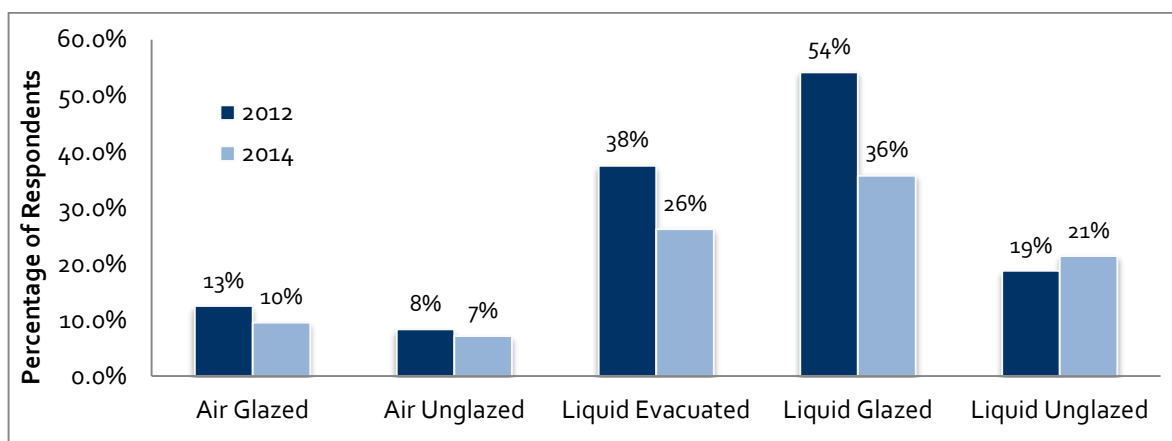


Figure 1: Sector involvement within the solar thermal industry.



<sup>1</sup> Note: respondents were able to select multiple categories



Figure 2: Respondent activity by collector type.

Twenty-eight percent of 2013/2014 survey participants indicated that over 80% of their corporate revenue is derived from solar thermal activities (Figure 3). Overall, 37% of respondents generated at least half of their revenue from solar thermal activities in 2014, down from 46% in 2012.

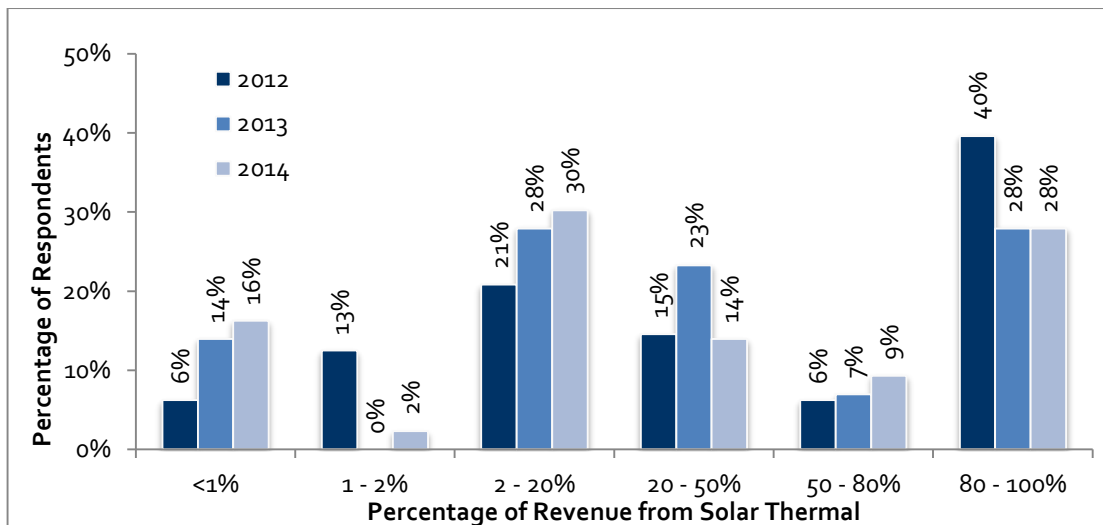


Figure 3: Solar thermal revenue as a percentage of total corporate revenue (2012, 2013 and 2014).

Fifty-six percent of respondents had between one to four full-time employees in 2014, a significant decrease when compared to the 73% reported in 2012. Peak employment was reported to be 20 employees. Total employment among respondents was reported to be 110 employees in 2014, down from 153 employees in 2012. Note that this survey was not designed to capture all employment at the manufacturing, distribution, retail and installer levels, and therefore total employment in the Canadian solar thermal industry is likely to be much higher than is presented in this report.

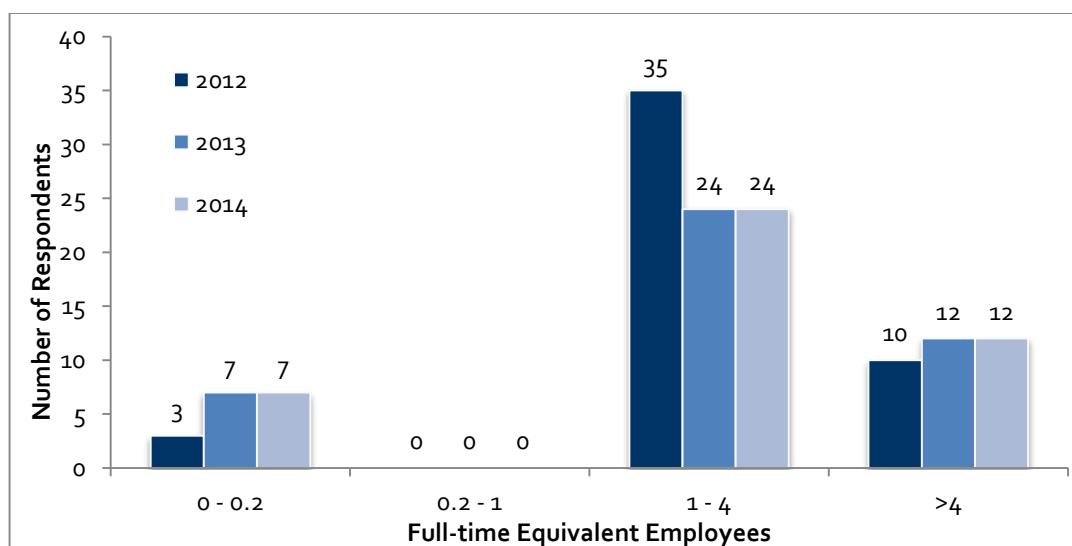


Figure 4: Number of employees per company engaged in solar thermal activities (2012, 2013, and 2014).

### 3.2. Industry Size and Growth

Overall, the Canadian solar thermal industry in 2014 experienced steady declines when compared to 2012. A comparison of key metrics for 2012 and 2014 is provided below. Refer to Table 1 for detailed 2013 and 2014 industry sales segmented by collector type.

- Total industry revenue decreased from \$26.0 million to \$17.6 million.
- Total area of collectors sold decreased from 186,043 m<sup>2</sup> to 99,666 m<sup>2</sup>
- Revenue from domestic sales decreased from \$20.1 million to \$13.5 million.
- Collector area from domestic sales decreased from 114,018 m<sup>2</sup> to 57,688 m<sup>2</sup>
- Revenue from export sales decreased from \$5.9 million to \$4.0 million.
- Collector area from export sales decreased from 72,025 m<sup>2</sup> to 41,599 m<sup>2</sup>.

**Table 1: Solar collector sales by type (2013 and 2014).**

Collector Type	Domestic Sales Revenue (\$ thousands)		Collector Area (m <sup>2</sup> )		Thermal Capacity (MW)	
	2013	2014	2013	2014	2013	2014
Air - Glazed	1,955	1,912	5,584	5,223	4.0	3.7
Air - Unglazed	4,443	4,360	23,904	21,753	16.8	15.3
Liquid - Evacuated	2,534	2,331	3,650	3,498	2.6	2.5
Liquid - Glazed	2,179	2,160	3,125	3,553	2.2	2.5
Liquid - Unglazed	2,526	2,754	21,804	23,661	15.3	16.6
<b>Total</b>	<b>13,636</b>	<b>13,516</b>	<b>58,067</b>	<b>57,688</b>	<b>40.8</b>	<b>40.5</b>

Collector Type	Export Sales Revenue (\$ thousands)		Collector Area (m <sup>2</sup> )		Thermal Capacity (MW)	
	2013	2014	2013	2014	2013	2014
Air - Glazed	1,005	1,890	6,907	16,740	4.7	11.3
Air - Unglazed	1,115	1,300	7,625	14,625	5.3	10.1
Liquid - Evacuated	214	256	434	539	0.3	0.4
Liquid - Glazed	466	142	1,072	384	0.7	0.3
Liquid - Unglazed	441	449	9,965	9,310	7.0	6.5
<b>Total</b>	<b>3,241</b>	<b>4,037</b>	<b>26,003</b>	<b>41,599</b>	<b>18.0</b>	<b>28.6</b>

Collector Type	Total Sales Revenue (\$ thousands)		Collector Area (m <sup>2</sup> )		Thermal Capacity (MW)	
	2013	2014	2013	2014	2013	2014
Air - Glazed	2,960	3,802	12,491	22,324	8.7	15.5
Air - Unglazed	5,558	5,660	31,529	38,529	22.0	26.9
Liquid - Evacuated	2,748	2,587	4,085	4,190	2.9	2.9
Liquid - Glazed	2,645	2,302	4,196	3,508	2.9	2.4
Liquid - Unglazed	2,967	3,202	31,769	31,115	22.3	21.8
<b>Total</b>	<b>16,878</b>	<b>17,553</b>	<b>84,070</b>	<b>99,666</b>	<b>58.8</b>	<b>69.6</b>

The cost per m<sup>2</sup> for both liquid evacuated and liquid glazed collectors varied considerably from respondent to respondent, but did not deviate significantly from data collected in 2012. This range was due to variability in reported costs, some respondents reported fully installed costs, while others reported only manufacturing prices. The tables below provide a breakdown for manufacturing, manufacturing and distribution as well as fully installed cost for two collector types (liquid glazed and liquid evacuated). The wide range in costs is likely a result of technology differences between companies, varying cost pressures, and economies of scale, with per unit costs generally decreasing as system sizes become larger.

Due to the application of various weightings, average \$/m<sup>2</sup> costs calculated from Table 1 will not equal those reported in Table 2. In fact, figures provided in Table 2 represent individual prices for various steps of the solar thermal value chain, whereas the figures provided in Table 1 represent a weighted average of the numbers according to the proportion that each activity represents within each segment.

While there has not been much movement in costs between 2012 and 2014 on a numbers basis, there are several complex factors counteracting each other to maintain the overall status quo. Imports from China have forced prices lower, but increased material costs due to reduced economies of scale and the weakened Canadian dollar have had the opposite effect. These impacts have not been felt equally by all respondents, with larger participants better able to mitigate the factors at play.

**Table 2: Cost breakdown for select technologies (\$/m<sup>2</sup>)**

**Liquid Glazed Cost Breakdown (\$/m<sup>2</sup>)**

	Manufacturing		Manufacturing and Distribution		Total Installed System	
	2012	2014	2012	2014	2012	2014
High end of range	964	1,053	1,300	1,420	3,052	3,333
Low end of range	330	310	444	413	1,043	1,012
Average	495	470	667	620	1,567	1,520

**Liquid Evacuated Cost Breakdown (\$/m<sup>2</sup>)**

	Manufacturing		Manufacturing and Distribution		Total Installed System	
	2012	2014	2012	2014	2012	2014
High end of range	1,158	901	1,566	1,218	3,000	2,333
Low end of range	141	134	190	177	365	347
Average	378	390	483	493	925	1,010

Figure 5 presents the rate of growth in the domestic market by collector type, for the five types of solar thermal collectors. With the exception of unglazed air collectors (51% growth in 2013), all other collector types experienced a decline between 2012 and 2014. The year-over-year growth rates are derived from a limited sample of the solar thermal market, and may not be indicative of the entire domestic market as a whole.

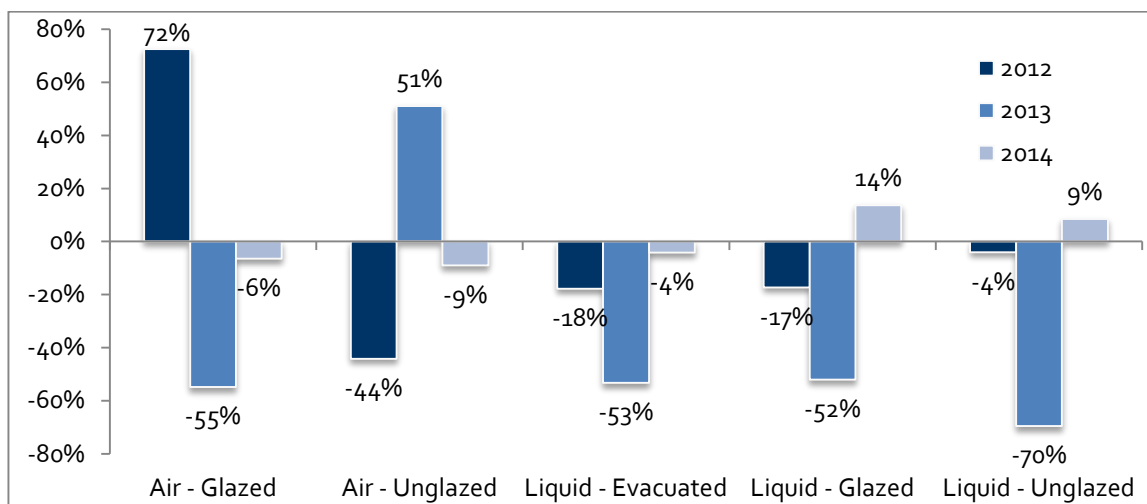


Figure 5: Collector area growth rates by collector type (2012, 2013, and 2014).

Figure 6 provides a historical overview of annual domestic collector sales from 2001 to 2014 for glazed liquid, air (glazed and unglazed), and unglazed liquid collector types. Figure 7 provides annual revenue data for domestic and total collector sales from 2003 to 2014. Export revenues maintained 23% of total sales between 2012 and 2014, overcoming a slight dip to 19% in 2013.

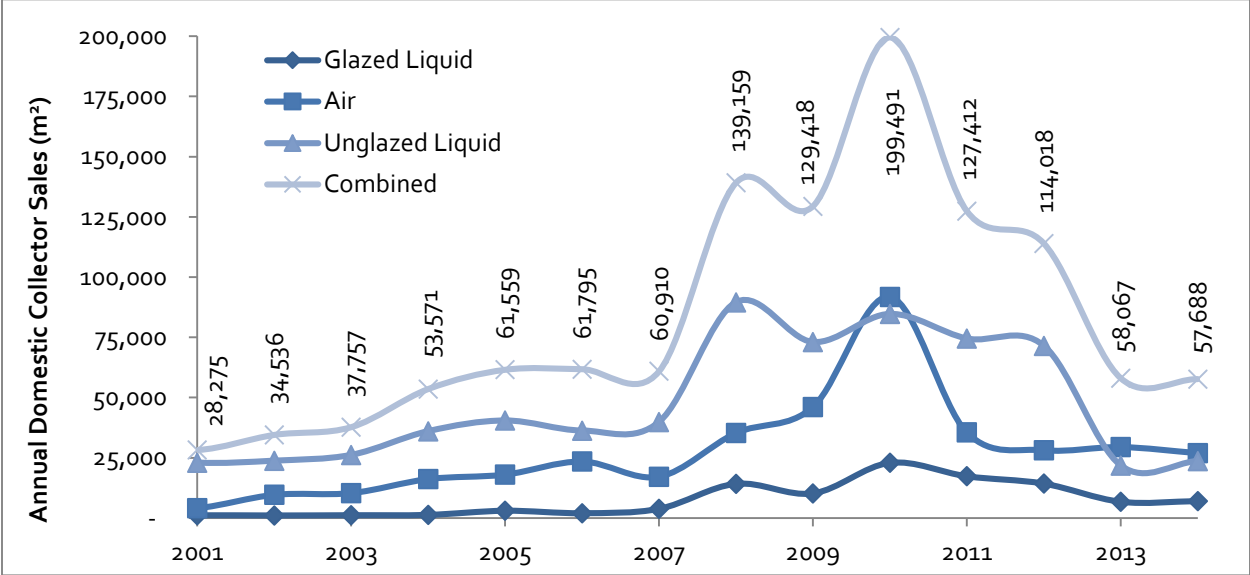


Figure 6: Historical annual domestic collector sales (m²).

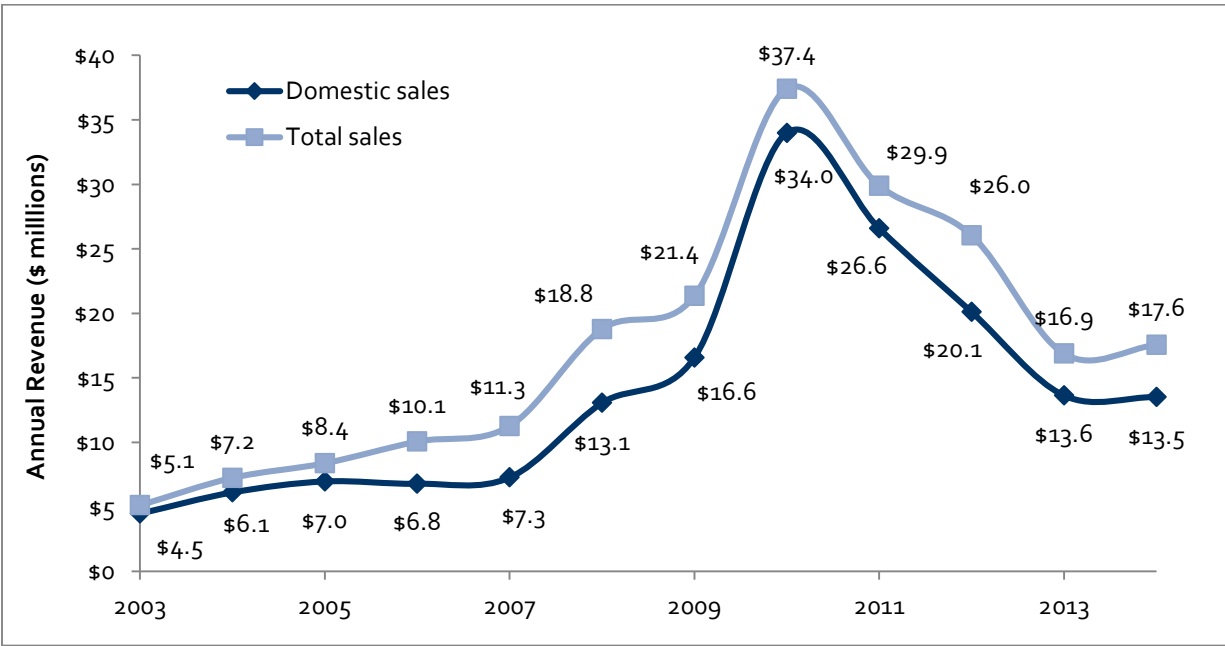


Figure 7: Canadian solar thermal industry revenue growth.

### 3.3. Applications of Solar Thermal Technology

Tables 3 and 4 provide a breakdown of revenue by collector type and end-use application. There are some changes when compared to the distribution found in 2012 but overall trends remain similar. The one exception to the general trend is the liquid glazed collector type, which has seen much more activity in residential than in 2012. Other variations may be attributed to having a slightly different respondent pool than previous years. Unglazed liquid collectors are used primarily for residential pool heating (95%). Conversely, liquid evacuated collectors have a more even distribution across both residential and industrial/commercial/institutional (ICI) sectors. 2012 and 2014 distributions for liquid evacuated collectors are comparable, with 2013 seeing much more ICI activity.

Glazed air collectors are used in both the residential and ICI sectors, but that market segment has significantly shifted more towards ICI sectors (97% compared to 73% in 2011). Unglazed air collectors continue to be used predominantly for ICI space heating.

**Table 3: Solar heating collector type by sector (2013 and 2014).**

Revenue by Sector	Air - Glazed		Air - Unglazed		Liquid - Evacuated		Liquid - Glazed		Liquid - Unglazed	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Residential	3%	3%	0%	0%	23%	42%	77%	82%	95%	95%
ICI <sup>2</sup>	97%	97%	100%	100%	77%	58%	23%	18%	5%	5%
Unknown	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

**Table 4: Solar heating collector type by application (2013 and 2014).**

Revenue by Sector	Air - Glazed		Air - Unglazed		Liquid - Evacuated		Liquid - Glazed		Liquid - Unglazed	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Residential – Pool	0%	0%	0%	0%	7%	8%	0%	0%	90%	93%
Residential – DHW	0%	0%	0%	0%	11%	12%	39%	52%	4%	1%
Residential – Space	3%	3%	0%	0%	0%	0%	10%	3%	0%	0%
Residential–Combined/Other	0%	0%	0%	0%	4%	22%	28%	27%	0%	0%
ICI – Pool	0%	0%	0%	0%	0%	0%	12%	5%	5%	5%
ICI – DHW	1%	1%	0%	0%	51%	45%	10%	12%	0%	0%
ICI – Process Heat	15%	10%	4%	1%	12%	12%	1%	1%	0%	0%
ICI – Space Heat	81%	86%	96%	99%	0%	0%	0%	0%	0%	0%
ICI – Combined/Other	0%	0%	0%	0%	14%	1%	0%	0%	0%	0%
Unknown/Wholesale	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

<sup>2</sup> Industrial, Commercial, Institutional

### 3.4. Geographical Distribution

#### 3.4.1. Domestic Sales

Solar thermal collectors were sold throughout Canada in 2013 and 2014, including in the Canadian Territories. Quebec was the largest market by revenue accounting for 42% of domestic sales, followed by Ontario, which accounted for 31% of domestic sales. Quebec also had the highest revenue per capita (\$0.56 per capita), much higher than the national average of \$0.31 per capita in 2014.

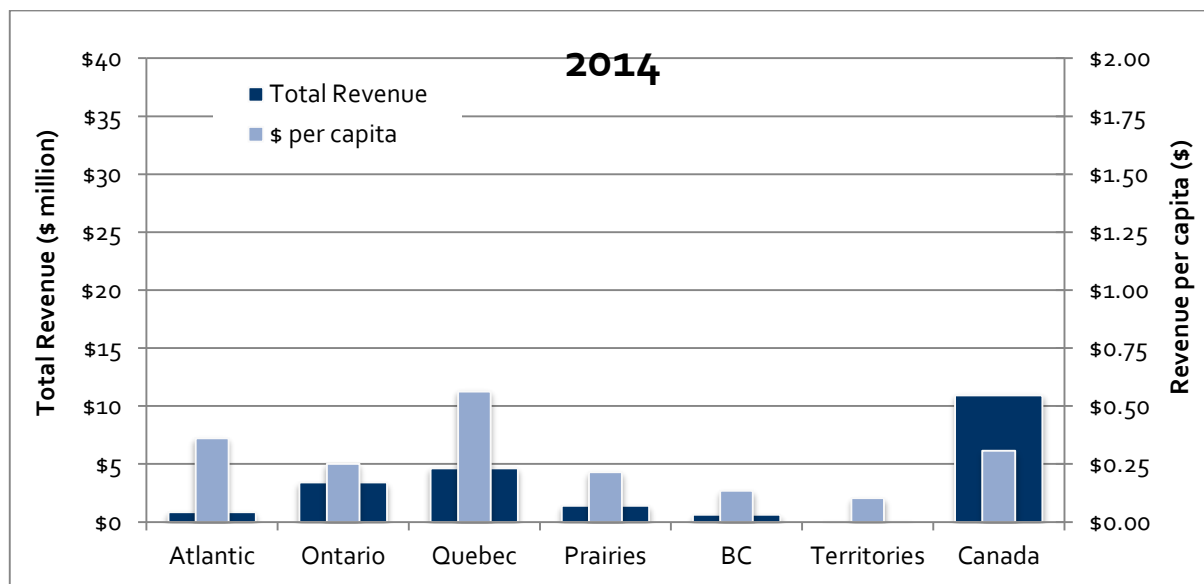


Figure 8: Regional solar collector sales (2014).

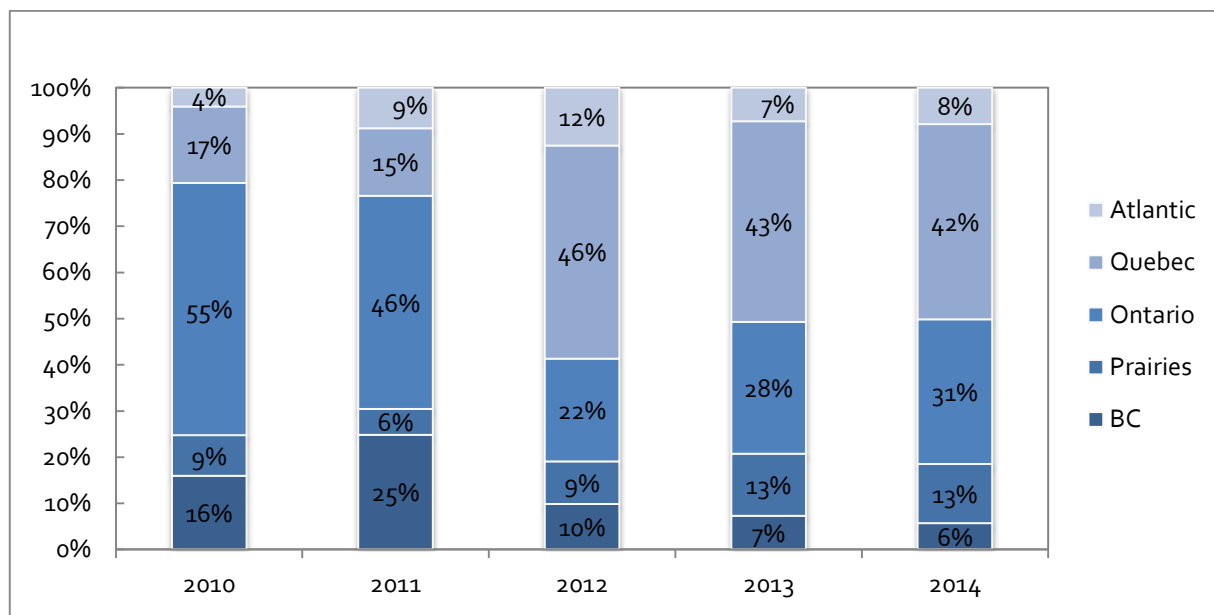


Figure 9: Regional distribution of domestic revenue.

### 3.4.2. Exports

In 2014, Canada exported \$4.0 million of solar thermal collectors, up from \$3.2 million in 2013 but down from \$5.9 million in 2012. This increase in exports in 2014 may be due in part to the significant decrease in domestic demand (resulting from a loss of incentives), which has driven the industry to look to other markets for sales. Exports to Europe have increased from 2% in 2012 to 21% of exports in 2014 while exports to the United States have dropped from 86% to 65%. Little to no exports to Africa, or Oceania were reported whereas exports to Asia and the Middle East increased from 1% to 8%. By collector type, glazed air collectors were the single largest category of exports followed by unglazed air and unglazed liquid collectors.

**Table 5: Regional distribution of solar thermal exports, by revenue (2013 and 2014).**

Distribution of Solar Thermal Exports	2013	2014
United States	63%	65%
Latin America	8%	6%
Europe	25%	21%
Asia and Middle East	2%	8%
Africa	2%	0%
Oceania	0%	0%
Total	100%	100%

**Table 6: Solar thermal collector exports, by revenue (2013 and 2014).**

Distribution of Solar Thermal Exports	2013	2014
Air - Glazed	31%	47%
Air - Unglazed	34%	32%
Liquid - Evacuated	7%	6%
Liquid - Glazed	14%	4%
Liquid - Unglazed	14%	11%
Total	100%	100%



### 3.5. Anticipated Sales Growth

Figure 10 provides a compilation of participant's outlook for future sales growth, relating to their 2014 solar thermal revenue. Respondents in the 2013/2014 surveys were mixed in their views of future growth when compared to the evident pessimism in previous surveys. Thirty-three percent of respondents expected positive sales growth (30% in 2012) while thirty-four percent of respondents predicted a decrease in sales over the same time period (22% in 2012). Comments provided by respondents suggest that the reason there is a split between those feeling buoyant and those having a negative growth outlook is that some larger firms have been able to find success in export markets while smaller firms have struggled to survive. 32% of respondents expect no further growth due to a lack of provincial and federal incentives for the industry.

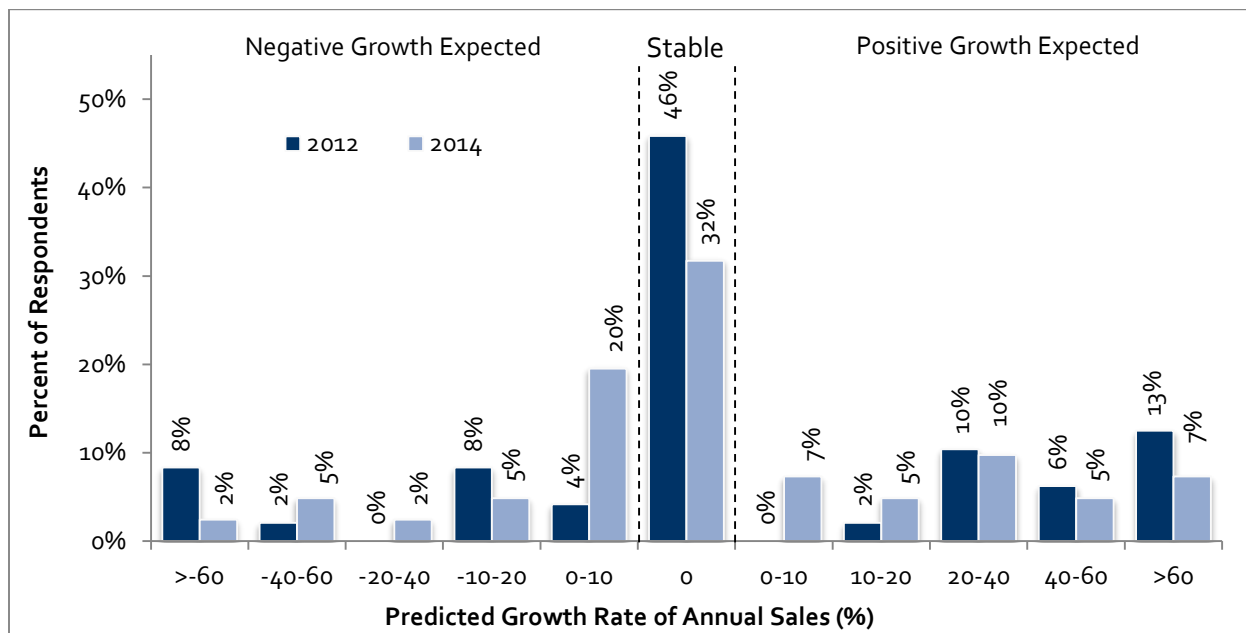


Figure 10: Estimate of future sales growth.

### 3.6. Sales of Packaged Systems

Respondents were asked if they sold packaged residential systems, either for domestic hot water or pool heating. Based on our results, approximately 31% of all liquid evacuated and glazed collectors (by collector area) were sold as packaged residential DHW systems in 2014. An expanded definition of a packaged system in the 2012 survey was carried through in the 2013/2014 survey, but the dramatic increase in revenue, collector area, and systems sold in 2012 as a result of the revised definition was absent in the 2013/2014 survey. There was a slight increase in the total collector area, up from 1,744 m<sup>2</sup> in 2012, but this can likely be attributed to variations in the respondents.

Due to low response in our sample from the pool heating sector, data for packaged pool heating systems were not reported. It is probable that many more such systems were sold, just not reported in our survey. Note that the pricing below does not reflect the fully installed price, but rather the packaged system equipment price.

Table 7: Domestic sales of packaged residential systems (2013 and 2014).

	Packaged Residential DHW Systems	
	2013	2014
<b>Systems Sold</b>	247	310
<b>Average Collector Area per System</b>	6	6
<b>Total Collector Area (m<sup>2</sup>)</b>	1,499	1,901
<b>Total Revenue from Packaged Systems</b>	\$ 1,463,141	\$ 1,541,501
<b>Average Revenue per System</b>	247	310

## 4. Estimate of Avoided Greenhouse Gas Emissions

### 4.1. Background

The estimation of avoided GHG emissions from solar thermal installations in Canada involves numerous variables such as displaced fuel mix, system sizes, system efficiency, and operating conditions, many of which are difficult to accurately estimate. The methodology for estimating GHG emission avoidance in a current year involved the following major steps:

- Researching historical sales data, and interpolating as necessary to provide estimates for missing data.
- Estimating the useful operational life of various solar thermal collectors or systems, to estimate the total solar collector area operational in a specific year.
- Developing typical or reference systems and applications, from which to estimate annual energy production per square meter of collector surface.
- Analyzing the fuel being displaced by solar, for each of the reference systems.
- Calculating the quantity of displaced fuel, and thus the GHG emissions avoided.

To maintain consistency in reporting, this document continues to use the method that was used for previous reports for estimating avoided GHG emissions, developed by Weiss et al with the support of the International Energy Agency (IEA). Section 4.2 provides a summary of the reference systems used.

Figure 11 shows historical solar thermal collector area that is installed and operating in Canada. By the end of 2014, 1,333,008 m<sup>2</sup> of solar thermal collectors were operating in Canada.

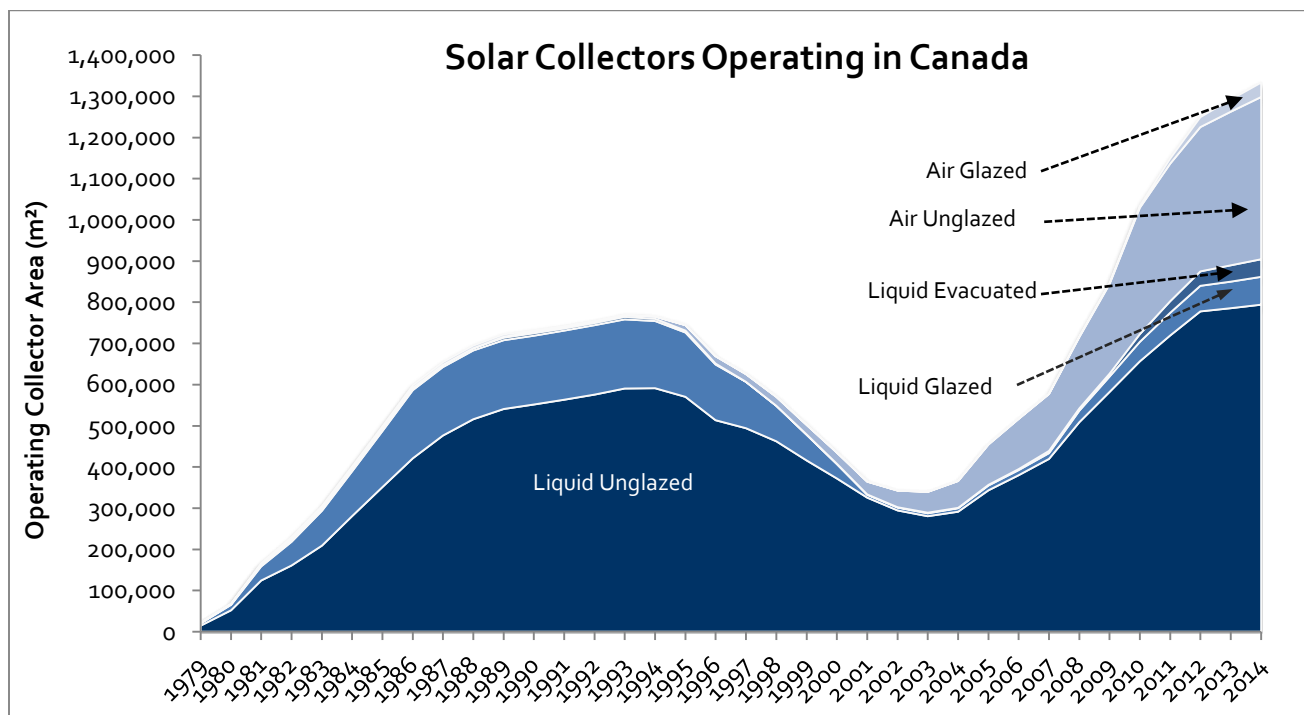


Figure 11: History of operating solar thermal collectors in Canada.

## 4.2. Reference System Definitions

Three of the four reference systems developed by Weiss et al are applicable for solar thermal systems in Canada, which were selected for estimating GHG savings. Adjustments were made to reflect the Canadian market, and a commercial air category was added to capture a segment of the market not present in Weiss' methodology.

**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, with a 300 L hot water storage tank.<sup>3</sup> 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>. 200 m<sup>2</sup> was selected as the reference system size, 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.

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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 DHW heating systems are a small segment of the Canadian market, the overall effect would be negligible. Moreover, because the relevant assumptions made for annual and specific yields per system were not far from those of a 225 L system, the actual effect of using Weiss' figures are reduced even further.

### 4.3. GHG Emissions Avoidance Calculations

Table 8 details the calculations used to estimate avoided GHG emissions in 2014 based on the total operating solar thermal collectors in Canada. The avoidance is equivalent to 104,595 tonnes of CO<sub>2</sub>, an increase of 10% when compared to the 2012 calculated value.

Table 8: Analysis of avoided GHG emissions, 2012.

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> )	1.6	1.64	0.78	2.11
<u>Displaced fuel mix (%)</u>				
· 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)	97.6	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> )	55,046	55,046	794,063	428,854
Calculated number of systems	9,174	1,101	31,763	2,144
Total annual CO <sub>2</sub> avoided (t/a)	8,807	5,328	36,209	54,250
Total annual CO <sub>2</sub> avoided, all types (t/a)	<b>104,595</b>			

The 104,595 tonnes of avoided GHG emissions from solar thermal installations in Canada is equivalent to removing more than 20,900 mid-sized cars from Canadian roads, or the total GHG emissions of over 4,500 Canadians.<sup>4</sup>

<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.

#### 4.4. Forecast GHG Emission Avoidance from Collectors sold in 2012

A similar calculation to that above was performed to estimate the total avoided GHG emissions over the lifetime of solar thermal collectors installed in Canada in 2014. Based on the 57,688 m<sup>2</sup> that was installed, the equivalent of 141,877 tonnes of CO<sub>2</sub> will be avoided over the lifetime of these systems (assuming a 20 year expected life for all water systems and a 30 year life for commercial air systems).

The Canadian solar industry earned \$13.5 million in revenue from domestic sales in 2014, this amounts to a displacement of one tonne of CO<sub>2</sub> for every \$95 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 2014 will be responsible for avoiding approximately 42,100 tonnes of CO<sub>2</sub> equivalent, during their operating life.

## 5. Conclusions

The Canadian solar thermal industry experienced a substantial decrease in revenue (32.6%) and collector area (46%) compared to 2012.

Figure 12 summarizes the 2014 solar thermal industry domestic market share by collector type. Glazed and unglazed air collectors accounted for the largest market share by collector area (47%), and also accounted for 47% of market share by revenue. Conversely, glazed liquid collectors only made up 12% of market share by collector area but 33% of market share by revenue. The GHG savings reflect projected savings over total lifetime for collectors installed in 2014.

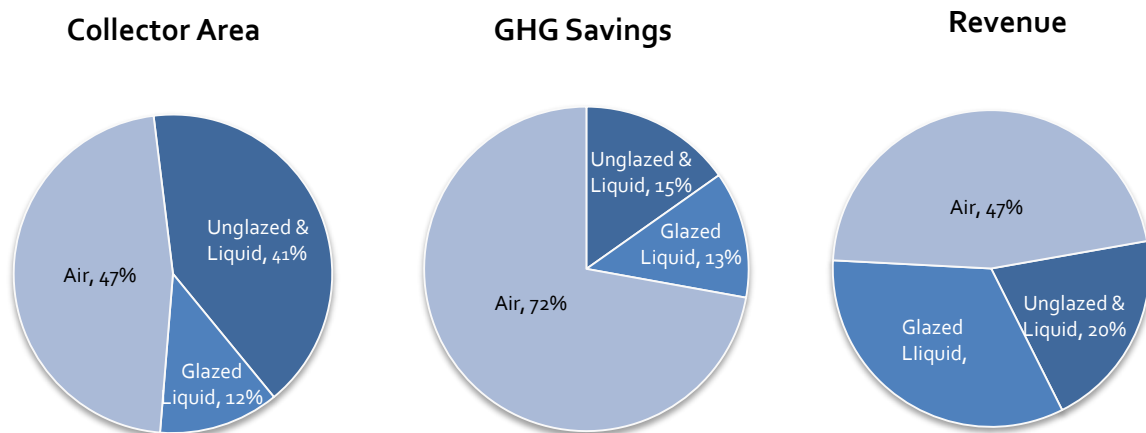


Figure 12: 2014 market share by collector area, revenue, and projected GHG savings.

Table 9 below, provides a breakdown of domestic end-use for glazed liquid and evacuated tube collectors based on collector area. Glazed liquid and evacuated tube collectors installed in Canada were predominantly used for swimming pool heating and domestic hot water (DHW) supply (65% in 2013 and 68% in 2014). Fifty-four percent of total installed collectors (1,967 m<sup>2</sup>) were for DHW systems in single family houses in 2014, up from 47% in 2013. (Note: DHW systems for single family houses include packaged and non-packaged system sales).

Table 9: Domestic sales of evacuated and glazed liquid collectors, by application (2013 and 2014)

Application	2013 Gross Collector Area (m <sup>2</sup> )	2014 Gross Collector Area (m <sup>2</sup> )
Swimming pool heating	57	10
DHW system for single family houses	1,610	1,967
DHW system for multiple family houses	215	192
DHW system for the tourism sector	-	-
DHW system for the public sector	340	305
Solar combi systems for single family houses	265	282
Solar combi systems for multiple family houses	364	300
Solar district heating systems	-	-
Solar process heat applications	582	582
Solar air conditioning and cooling	-	-

Figure 13 summarizes market share of each of the five collector types by total revenue in 2014. Liquid glazed collectors experienced the greatest decrease, dropping from 16% of the market in 2013 to 13% of the market in 2014. Air glazed experienced the largest increase in market share, moving from 18% in 2013 to 22% in 2014.

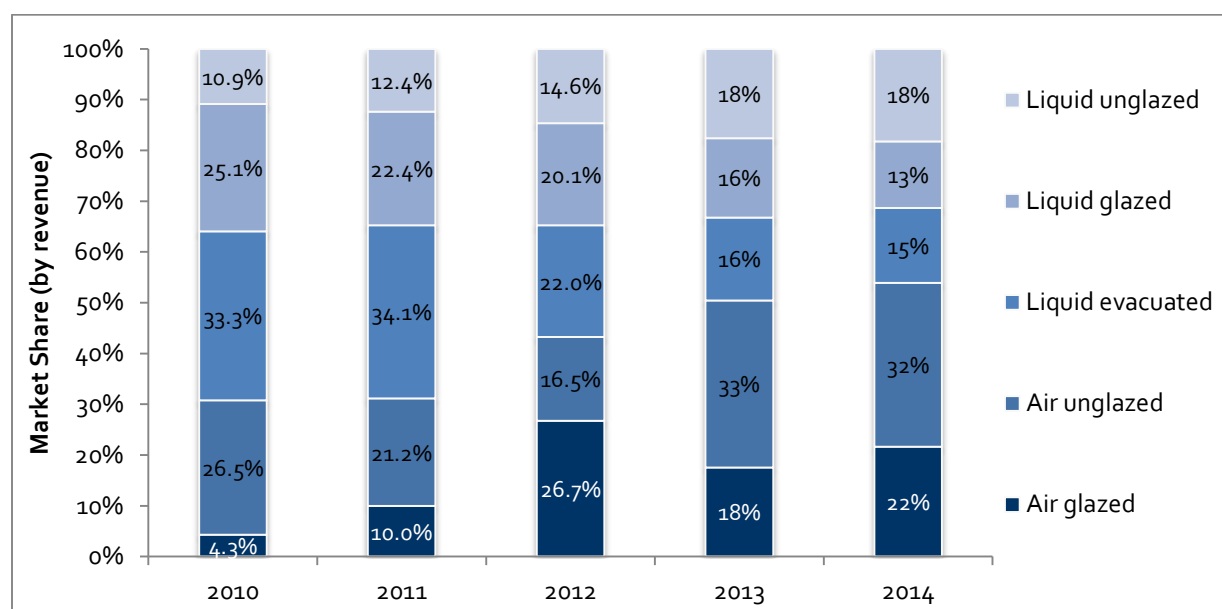


Figure 13: Market share of five collector types by total revenue in 2014.

## 6. References

1. **Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2012)**, July 2013, ClearSky Advisors.
2. **Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2011)**, August 2012, ClearSky Advisors.
3. **Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2002 – 2004)**, August 2005, SAIC Canada report no. CM001743.
4. **Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2005)**, October 2006, SAIC Canada report no. CM002056.
5. **Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2006 & 2007)**, March 2008, SAIC Canada report no. CM002208.
6. **Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2008)**, September 2009, SAIC Canada report no. CM002285
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8. Omboli, Eugène and McClenahan, Doug, 2002, **NRCan In-house Survey of Solar Collectors for 1995 – 2001**, Natural Resources Canada.
9. 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.



## Appendix A - Survey Questionnaire (English)

### Introduction

You have been invited to participate in a study of the Canadian Solar Thermal industry, commissioned by Natural Resources Canada (NRCan) and undertaken by ClearSky Advisors. The study results will help to provide comprehensive and reliable information on market size and industry trends, including sales and revenue, import and export, as well as employment figures. This pdf file can either be scanned and emailed or faxed to ClearSky Advisors.

Before you begin this questionnaire, it would be helpful for you to have the following information for your company on hand: 1) employment figures for 2013 and 2014; 2) 2013 and 2014 sales and revenue (\$ and gross collector area) by region, collector type, and end use; and 3) information on your equipment supplier and sources.

**Please note that your responses will be kept anonymous and your privacy protected. Collected data will only be presented in aggregate.** You may choose not to answer any of the descriptive questions by writing "N/A" in the comment text. A copy of the 2012 Solar Thermal industry survey report may be found at the following CanSIA's web site: [www.cansia.ca/market-intelligence/solar-thermal](http://www.cansia.ca/market-intelligence/solar-thermal)

ClearSky Advisors ([www.clearskyadvisors.com](http://www.clearskyadvisors.com)) is an independent research and advisory firm focused on renewable energy offering fact-based advice to the industry. We offer our clients the value of up-to-date research and thought leadership from a fast changing industry. ClearSky Advisors serves a range of different stakeholders in the solar industry and regularly publishes reports on timely issues.

### [Start Questionnaire]

Please enter company contact information:

1. Company Name: \_\_\_\_\_
2. Company Address: \_\_\_\_\_
3. Contact Name: \_\_\_\_\_
4. Title: \_\_\_\_\_
5. Phone: \_\_\_\_\_
6. Email: \_\_\_\_\_
7. If necessary, may ClearSky Advisors contact you to supplement the information gathered through the survey process? (Y/N)
8. Please select the primary business that your company carried out in 2013 and 2014 (select only one).
  - Solar Thermal
  - Other Renewable Energy (e.g. solar PV, wind, etc.)
  - Swimming Pool Sales and Installation
  - Plumbing Contractor
  - HVAC Contractor
  - HVAC Equipment Manufacturer or Distributor
  - Building Contractor
  - Other Building Trades
  - Other (please specify): \_\_\_\_\_

9. In addition to your primary business as indicated in Q7, please indicate if your business was involved in any of the following business segments in 2013 and 2014. Check all that apply.

**2013**

- Solar Thermal
- Other Renewable Energy (e.g. solar PV, wind, etc.)
- Swimming Pool Sales and Installation
- Plumbing Contractor
- HVAC Contractor
- HVAC Equipment Manufacturer or Distributor
- Building Contractor
- Other Building Trades
- Other (please specify): \_\_\_\_\_

**2014**

- Solar Thermal
- Other Renewable Energy (e.g. solar PV, wind, etc.)
- Swimming Pool Sales and Installation
- Plumbing Contractor
- HVAC Contractor
- HVAC Equipment Manufacturer or Distributor
- Building Contractor
- Other Building Trades
- Other (please specify): \_\_\_\_\_

10. 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 2013 and 2014? Check all that apply.

	2013	2014
Solar Thermal Collector Manufacturer	<input type="checkbox"/>	<input type="checkbox"/>
Solar Thermal System Component Manufacturer	<input type="checkbox"/>	<input type="checkbox"/>
Solar Thermal Collector Importer	<input type="checkbox"/>	<input type="checkbox"/>
Solar Thermal System Components Importer	<input type="checkbox"/>	<input type="checkbox"/>
Wholesale Distributor	<input type="checkbox"/>	<input type="checkbox"/>
Retailer/Installer	<input type="checkbox"/>	<input type="checkbox"/>
Design/Consulting Services	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify): _____	<input type="checkbox"/>	<input type="checkbox"/>

11. Please estimate the time spent on Solar Thermal activities by all employees (full and part-time), and contractors, to provide the number of full-time employee equivalents. A full-time employee is defined as an employee who works 40 hours a week, 52 weeks a year (e.g., If two employees each spend approximately 20 hours per week over the course of a year on your Solar Thermal business, this would be counted as one full-time Solar Thermal employee).

2013: \_\_\_\_\_  
2014: \_\_\_\_\_

12. Including full-time, part-time and seasonal staff, but excluding contractors, what was the peak number of persons employed at any single time?

2013: \_\_\_\_\_

2014: \_\_\_\_\_

13. What percentage of your organization's total revenue was from active Solar Thermal business?

2013: \_\_\_\_\_

2014: \_\_\_\_\_

14. Please report your total revenue earned from solar thermal activities in 2013 and 2014, and provide the percentage of this revenue that was earned from various types of sales. Please include all types of revenue related to Solar Thermal activities (e.g., product sales, service contracts, installation fees, consulting revenues). The percentages provided should sum to 100%. (Please note that two years of revenue information is being requested to ensure accuracy and continuity of data.)

	2013	2014
<b>Total Sales Revenue from Solar Thermal Activities</b>	\$	\$
<b>Revenue of All Export Sales</b>	%	%
<b>Revenue from Sales to Canadian Resellers</b>	%	%
<b>Revenue from Sales Direct to Canadian End Users</b>	%	%
<b>Revenue from Other Canadian Sales</b>	%	%

15. Please provide total Solar Thermal collector sales in 2013 and 2014, by collector gross area, and provide the percentage of Solar Thermal collector sales, export and Canadian, by gross collector area. The percentages provided should sum to 100%.

**2013**

Total Solar Thermal Collector Sales (square meters) \_\_\_\_\_ m<sup>2</sup>  
 Percent of Collectors Exported \_\_\_\_\_ %  
 Percent of Collectors Sold Within Canada \_\_\_\_\_ %

**2014**

Total Solar Thermal Collector Sales (square meters) \_\_\_\_\_ m<sup>2</sup>  
 Percent of Collectors Exported \_\_\_\_\_ %  
 Percent of Collectors Sold Within Canada \_\_\_\_\_ %

16. Compared to 2014, does your organization expect more, less or about the same revenues in the Solar Thermal collector and components sales and services area over the next 2 years?

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

17. Please report collector sales in 2013 and 2014 by collector type in both collector gross area (m<sup>2</sup>) and revenue (\$). 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.

	Air - Glazed <sup>5</sup>		Air - Unglazed		Liquid - Evacuated		Liquid - Glazed <sup>6</sup>		Liquid - Unglazed	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Revenue from manufacturing <sup>7</sup>	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
Revenue from distribution	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
Revenue from installations	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
Revenue from other sources	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
Total Solar Thermal Revenue	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
# of projects										
Average project size										

If **Other Sources** selected, please specify the nature of the revenue: \_\_\_\_\_

<sup>5</sup> Includes transpired glazed

<sup>6</sup> Includes thermosiphon, integral collector storage, and non-pumped storage types of liquid glazed systems

<sup>7</sup> Includes sales of all associated equipment (e.g., thermal fluid) and shipping costs

18. Please provide a percentage distribution, by collector type for dollar sales by application in 2013 and 2014. The total for each column should sum up to 100%. If a collector type is not applicable, please leave the column blank. If you were wholesaling the product to re-sellers, and are unaware of the final application, please report these shipments in the "unknown" category. (ICI: Industrial/Commercial/Institutional)

	Air - Glazed <sup>8</sup>		Air - Unglazed		Liquid - Evacuated		Liquid - Glazed		Liquid - Unglazed	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
<b>Residential – Pool</b>	%	%	%	%	%	%	%	%	%	%
<b>Residential – DHW</b>	%	%	%	%	%	%	%	%	%	%
<b>Residential – Space</b>	%	%	%	%	%	%	%	%	%	%
<b>Residential – Combined/Other (includes hot tubs)</b>	%	%	%	%	%	%	%	%	%	%
<b>ICI – Pool</b>	%	%	%	%	%	%	%	%	%	%
<b>ICI – DHW</b>	%	%	%	%	%	%	%	%	%	%
<b>ICI – Process Heat</b>	%	%	%	%	%	%	%	%	%	%
<b>ICI – Space Heat</b>	%	%	%	%	%	%	%	%	%	%
<b>ICI – Combined/Other</b>	%	%	%	%	%	%	%	%	%	%
<b>Unknown/Wholesale</b>	%	%	%	%	%	%	%	%	%	%

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<sup>8</sup> Includes transpired glazed

19. Within each region, please report the 2013 and 2014 sales by revenue and collector gross area for each collector type. If your business did not conduct sales in a particular region, please leave the applicable section blank.

<b>2013</b>		<b>Air - Glazed<sup>9</sup></b>	<b>Air - Unglazed</b>	<b>Liquid - Evacuated</b>	<b>Liquid - Glazed</b>	<b>Liquid - Unglazed</b>
<b>Atlantic Provinces</b>	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
<b>Ontario</b>	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
<b>Quebec</b>	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
<b>Prairie Provinces</b>	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
<b>British Columbia</b>	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
<b>Canadian Territories</b>	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
<b>United States</b>	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
<b>Latin America</b>	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
<b>Europe</b>	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
<b>Asia, Middle East</b>	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
<b>Africa</b>	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
<b>Australia, New Zealand, Oceania</b>	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>

<sup>9</sup> Includes transpired glazed

2014		Air - Glazed <sup>10</sup>	Air - Unglazed	Liquid - Evacuated	Liquid - Glazed	Liquid - Unglazed
Atlantic Provinces	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
Ontario	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
Quebec	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
Prairie Provinces	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
British Columbia	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
Canadian Territories	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
United States	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
Latin America	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
Europe	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
Asia, Middle East	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
Africa	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>
Australia, New Zealand, Oceania	Revenue	\$	\$	\$	\$	\$
	Collector Gross Area	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>

<sup>10</sup> Includes transpired glazed



20. a) Do you manufacture any Solar Thermal collectors in house?

- Yes  
 No

b) If yes, please select the collector types that you manufacture and indicate the cumulative dollar value of all Solar Thermal collectors manufactured in the year 2013 and 2014.

2013

- Air - Glazed  
 Air - Unglazed  
 Liquid - Evacuated  
 Liquid - Glazed  
 Liquid - Unglazed

Revenue Earned from of Solar Thermal Collector Sales (\$): \_\_\_\_\_

2014

- Air - Glazed  
 Air - Unglazed  
 Liquid - Evacuated  
 Liquid - Glazed  
 Liquid - Unglazed

Revenue Earned from of Solar Thermal Collector Sales (\$): \_\_\_\_\_

21. Please list your sources of Solar Thermal collectors, including: the collector type, the name of the supplier, the location of the supplier (using the regions listed in Q18), and the total dollar value (Revenue Earned) for each collector source for the year 2013 and 2014.

2013	Collector Type	Supplier Name	Supplier Location	Dollar Value (Revenue) of Supply
<b>Purchased Within Canada</b>				\$
				\$
				\$
				\$
				\$
<b>Purchased Outside of Canada</b>				\$
				\$
				\$
				\$
				\$

2014	Collector Type	Supplier Name	Supplier Location	Dollar Value (Revenue) of Supply
Purchased Within Canada				\$
				\$
				\$
				\$
				\$
Purchased Outside of Canada				\$
				\$
				\$
				\$
				\$

22. Please briefly describe any changes to your business during 2013 and 2014 (e.g., merger, acquisitions, etc.) that have had a significant impact on solar thermal sales from previous years. If none, please enter "N/A".

--

23. Does your business sell packaged residential solar hot water systems in Canada?

- Yes  
 No

If yes, please provide information on the number and type of systems sold in 2013 and 2014. Please provide data only on Canadian sales, excluding exported systems.

	Solar DHW Systems		Solar Pool Heating Systems	
	2013	2014	2013	2014
Total Revenue from Packaged Residential Sales (including all packaged equipment revenue but excluding any related labour and/or services revenue)	\$	\$	\$	\$
Number of Packaged Systems Sold				
Total Solar Thermal Collector Area in Packaged Residential Sales (gross)	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>	m <sup>2</sup>

24. This question is relevant to sales in Canada (not exports) of liquid glazed flat plate and evacuated tube collectors only. Please estimate in collector gross area and number of projects, the breakdown by end user for total sales of these two types of collectors in 2013 and 2014.

Application	2013		2014	
	m <sup>2</sup>	# of projects	m <sup>2</sup>	# of projects
Swimming pool heating				
DHW System for single family houses				
DHW System for multiple family houses				
DHW System for the tourism sector				
DHW System for the public sector				
Solar combi systems for single family houses				
Solar combi systems for multiple family houses				
Solar district heating systems				
Solar process heat applications				
Solar air conditioning and cooling				
Total (m <sup>2</sup> of all 2013/2014 sales of liquid flat plate and evacuated tube collectors )				

25. For any 2013 and 2014 Solar Thermal business conducted in Canada, did you or the system end user take advantage of any federal, provincial, or municipal initiatives? If applicable, indicate the initiative and approximate collector gross area per initiative (if known). e.g., PEI Sales Tax Exemption or Efficiency Nova Scotia Corporation

Name of Incentive, Program or Procurement Initiative	Gross Collector Area (m <sup>2</sup> )
	m <sup>2</sup>
	m <sup>2</sup>
	m <sup>2</sup>
	m <sup>2</sup>
	m <sup>2</sup>
	m <sup>2</sup>
	m <sup>2</sup>
	m <sup>2</sup>