

Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2011)

Prepared by ClearSky Advisors Inc.

Report presented to:
Dr. Reda Djebbar
Natural Resources Canada

August 2012



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 (CanSIA).

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.

For more information on this survey report and related inquiries, please contact:

Dr. Reda Djebbar
CanmetENERGY
Natural Resources Canada
580 Booth Street
Ottawa, Ontario
K1A 0E4
Email: rdjebbar@nrcan.gc.ca

Executive Summary

This report is a summary of a survey of the Canadian solar thermal industry covering the 2011 calendar year, conducted between February to March 2012.

The survey shows a significant decline in the solar thermal market in 2011, with total revenue of \$29.9 million, a decrease of 20% from the \$37.4 million reported in 2010. Total collectors sales decreased by 29%, dropping from 252,146 m² in 2010 to 179,971 m² in 2011. Revenue derived from all collector types decreased in 2011, with the exception of glazed air collectors, which grew 86%.

Ontario continued as the domestic market leader, although the reported 46% of sales by revenue in 2011 represents a decline from the 55% reported in 2010. British Columbia experienced significant growth in market share for the second consecutive year, increasing from 16% in 2010 to 25% in 2011.

Industry optimism continued its sharp decline in 2011. Only 37% of respondents expect positive sales growth over the next two years, while 40% of respondents predict sales to decrease. When the predicted future sales is weighted by each respondents' 2011 reported revenue, total sales are expected to decrease by an annual average of 18% over the next two years.

Table of Contents

ACKNOWLEDGEMENTS	2
Executive Summary	3
List of Tables	5
List of Figures	5
1 Introduction	1
1.1 Comparison to Earlier Surveys	1
2 Survey Process	1
2.1 Survey Development and Distribution.....	1
2.2 External Data Sources	2
2.3 Estimated Data Capture Rates and Comparison to 2010 Survey	2
3 Survey Results	3
3.1 Industry Characterization.....	3
3.2 Industry Size and Growth	5
3.3 Applications of Solar Thermal Technology.....	7
3.4 Geographical Distribution	8
3.5 Anticipated Sales Growth.....	10
3.6 Sales of Packaged Systems	11
4 Estimate of Avoided Greenhouse Gas Emissions	12
4.1 Background	12
4.2 Reference System Definitions.....	13
4.3 GHG Emissions Avoidance Calculations	13
4.4 Forecast GHG Emission Avoidance from Collectors sold in 2011.....	14
5 Conclusions	15
6 References	16
Appendix A – Survey Questionnaire (English)	17

List of Tables

Table 1: Solar collector sales by type, 2011. 5

Table 2 Cost breakdown for select technologies (in \$/m2)..... 6

Table 3: Solar heating applications (by revenue), by sector and collector type..... 8

Table 4: Regional distribution of solar thermal exports, by revenue. 10

Table 5: Solar thermal exports by collector type, by revenue. 10

Table 6: Domestic sales of packaged residential systems..... 11

Table 7: Analysis of avoided GHG emissions, 2011..... 14

List of Figures

Figure 1: Sector involvement within the solar thermal industry..... 3

Figure 2: Solar thermal revenue as a percentage of total corporate revenue..... 4

Figure 3: Number of employees per company engaged in solar thermal activities..... 4

Figure 4: Annual domestic sales by collector type (m²). 6

Figure 5: Ten-year history of domestic collector sales (m²). 7

Figure 6: Canadian solar thermal industry revenue growth. 7

Figure 7: 2011 regional solar collector sales. 9

Figure 8: Regional distribution of domestic revenue 9

Figure 9: Estimate of future sales growth. 11

Figure 10: History of operating solar thermal collectors in Canada..... 12

Figure 11: 2011 market share by collector area, revenue, and projected GHG savings..... 15

Figure 12: Market share of five collector types by total revenue in 2011. 15

1 Introduction

This report provides results of a survey of the solar thermal industry in Canada covering the calendar year of 2011. 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 2011 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 CO₂ 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.

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. In order to ensure continuity, current respondents were asked to report both 2010 and 2011 revenue. This enabled a cross-check with the responses from previous years. Where appropriate, such responses were utilized to account for variance in the survey sample from year to year. All attempts were made to ensure that the underlying methodology for analysis of the 2011 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 February 2012, 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 External Data Sources

2.2.1 Natural Resources Canada ecoENERGY

Natural Resources Canada operated two ecoENERGY programs that provide grants and rebates for the installation of solar thermal systems. The ecoENERGY for Renewable Heat program expired on March 31, 2011, however, eligible installations were required to be installed by December 31, 2010, and therefore are not applicable for informing the 2011 survey data. The ecoENERGY Retrofit – Homes program was available through 2011, and this data was compared to the survey data directly.

Under the ecoENERGY Retrofit – Homes program, ecoENERGY reported that approximately 466 packaged residential solar domestic hot water systems were installed in 2011. The survey respondents reported 438 of these systems. The greater number was used in this report.

2.3 Estimated Data Capture Rates and Comparison to 2010 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. By comparing the reported revenue and sales data in the 2011 survey to the 2010 survey, it was clear that while the response rates and coverage were impressive, this survey did not capture the entire Canadian solar thermal industry. Out of the 42 respondents that took part in the survey, 31 provided both 2010 and 2011 revenue.

In the analysis phase, the survey data was adjusted according to the data capture rates for the various industry segments in order to produce a comprehensive estimate of the industry in 2011. Assuming that the 2010 reported results captured 100% of the Canadian market, the data capture rate for each collector type was determined by comparing the reported 2010 revenue from the 2010 survey and the 2011 survey. The following capture rates were determined: 100% for glazed air; 92% for glazed liquid; 91% for unglazed air; 67% for unglazed liquid; and 8% for evacuated tube liquid. Such adjustments, although reasonable given the data available, do have shortcomings. For example, if market share of the respondents shifted drastically from one year to the next, it would reduce the accuracy of the adjustments. The adjustment was particularly large for the evacuated tube liquid segment, similar to the adjustment used in the 2010 survey.

To ensure that the adjustments made were reasonable, ClearSky Advisors undertook an extensive data verification and validation process. This involved speaking at length with industry representatives through both one-on-one conversations to cross-check results and a focus group with stakeholders from throughout the industry.

It is likely that this survey did not capture the entire market, and actual sales differed somewhat from those provided in this report. However, given the data provided in the surveys, publically available data available to cross-check our results, and the results of our validation exercise, it appears that the adjustments made produce the most reasonable and likely estimates of the solar thermal market activity in 2011.

3 Survey Results

3.1 Industry Characterization

The following three figures categorize the business characteristics of the companies responding to the survey.

Figure 1 shows that, out of the 42 respondents in 2011, 36% (15 out of 42) of them manufactured solar collectors in 2011. Close to two-thirds of respondents (64%) are involved in direct retail sales, indicating that solar thermal collectors and systems are often sold through direct channels rather than longer wholesale and distribution supply chains.

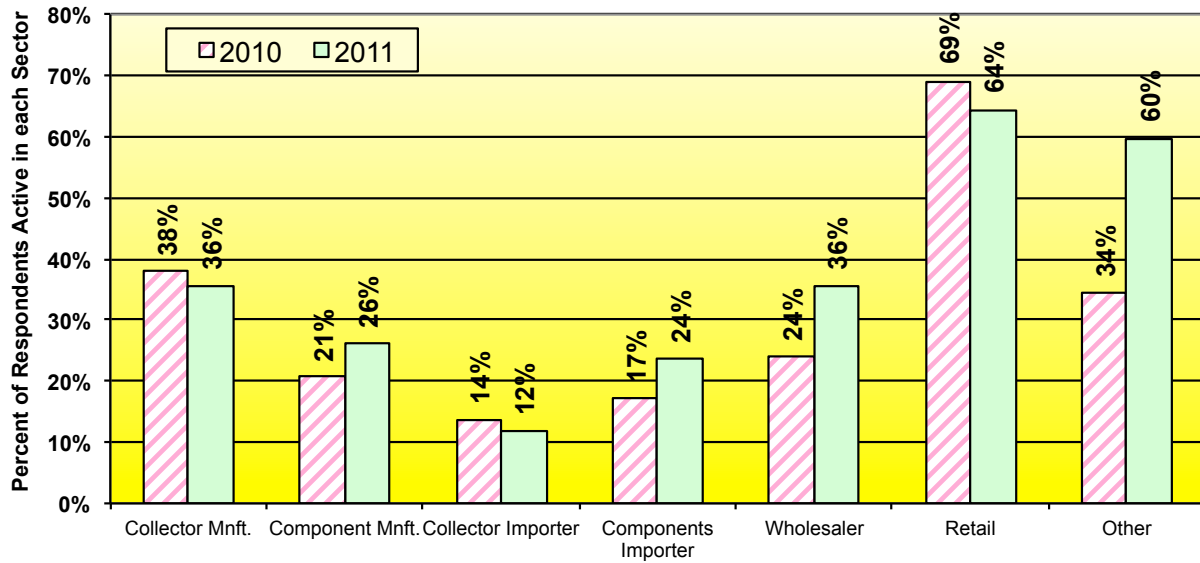


Figure 1: Sector involvement within the solar thermal industry.

Figure 2 shows that over one-third (40%) of respondents derived over 80% of their corporate revenue from solar thermal in 2011. Overall, 47% of respondents generated at least half of their revenue from solar thermal activities in 2011, down from 59% in 2010.

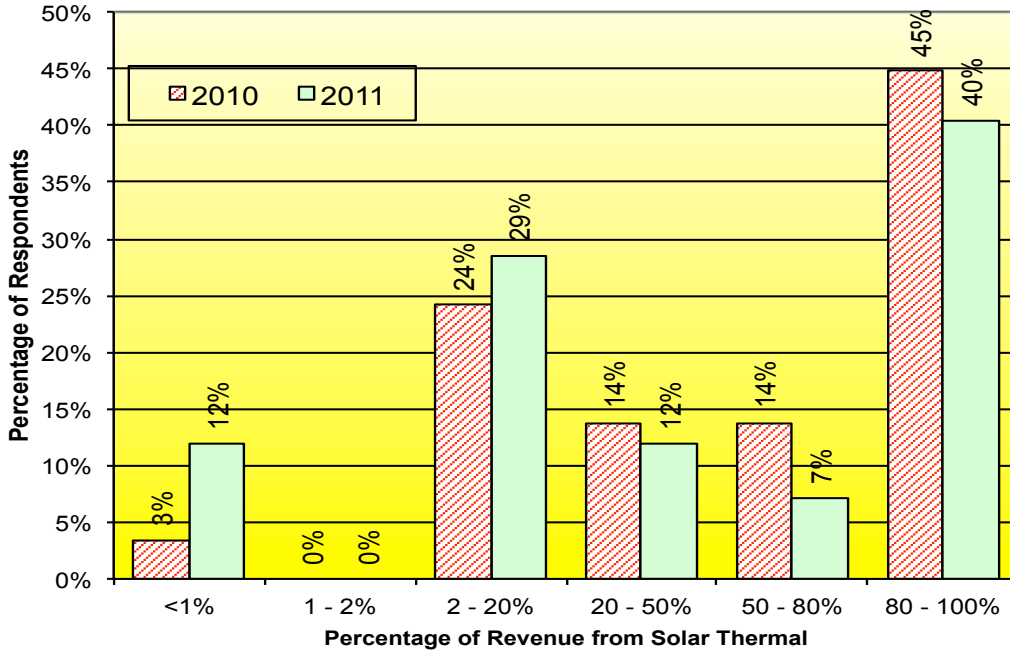


Figure 2: Solar thermal revenue as a percentage of total corporate revenue

Figure 3 demonstrates that 45% of all respondents had between one to four full-time employees in 2011, compared to 31% in 2010. Peak employment was reported as 21 employees. Total employment in the industry was reported to be 218 employees in 2010, and was likely a similar amount in 2011, albeit reduced somewhat due to the decline of industry revenues. Note that this survey was not designed to capture all employment at the retail and installer level, and therefore total employment in the Canadian solar thermal industry is likely to be much higher than is presented in this report.

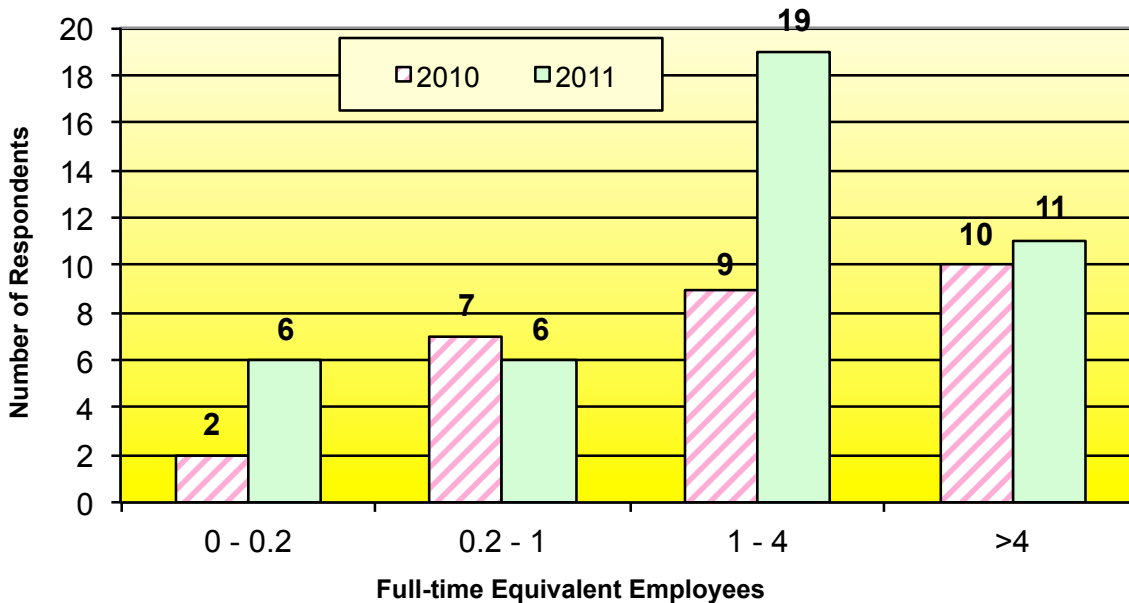


Figure 3: Number of employees per company engaged in solar thermal activities.

3.2 Industry Size and Growth

The Canadian solar thermal industry in 2011 suffered a significant decline when compared to 2010. According to respondents, the decrease in domestic sales is primarily likely attributed to the expiry of the ecoENERGY for Renewable Heat program in March 2011.

- Total industry revenue decreased from \$37.4 million to \$29.9 million (-20.1%).
- Total area of collectors sold decreased from 252,146 m² to 179,971 m² (-28.6%).
- Revenue from domestic sales decreased from \$34.0 million to \$26.6 million (-21.8%).
- Revenue from export sales continued to decrease from \$3.4 million to \$3.3 million (-3%).

Table 1 below details industry sales figures for 2011. For the respondents that provided both 2010 and 2011 revenue data (31 out of 42 respondents), their total revenue decreased 25% in 2011. The results for individual companies however, varied substantially, with 10 out of 31 earning greater solar-thermal related revenue in 2011, and 21 out of 31 earning less in 2011 than 2010.

The thermal capacity is estimated using an IEA equation 0.7 kWth/m² of collector area.

Table 1: Solar collector sales by type, 2011.

Domestic Sales

Collector Type	Thermal Capacity (MW)	Collector Area (m ²)	Revenue (\$1,000's)
Air - Glazed	5.1	7,165	2,073
Air - Unglazed	19.9	28,377	5,527
Liquid - Evacuated	6.7	9,500	10,195
Liquid - Glazed	5.5	7,880	6,286
Liquid - Unglazed	52.2	74,490	2,500
	89.3	127,412	26,581

Export Sales

Collector Type	Thermal Capacity (MW)	Collector Area (m ²)	Revenue (\$1,000's)
Air - Glazed	2.2	3,246	902
Air - Unglazed	7.1	10,248	806
Liquid - Evacuated	0.0	0	0
Liquid - Glazed	0.5	715	404
Liquid - Unglazed	26.9	38,350	1,205
	36.7	52,559	3,317

Total Sales

Collector Type	(MW)	Collector Area (m ²)	Revenue (\$1,000's)
Air - Glazed	7.3	10,411	2,975
Air - Unglazed	27.0	38,625	6,333
Liquid - Evacuated	6.7	9,500	10,195
Liquid - Glazed	6.0	8,595	6,690
Liquid - Unglazed	79.0	112,840	3,704
	126.0	179,971	29,898

The cost per m² for both liquid evacuated and liquid glazed collectors varied considerably from respondent to respondent. This is because some respondents reported fully installed costs, while others reported only manufacturing prices, depending on their position in the marketplace. The tables below show the breakdown for solely manufacturing costs, plus distribution costs, and fully installed cost for two of the technologies (liquid glazed and liquid evacuated). The wide range in cost is likely a factor of technology differences between companies and economies of scale, with costs decreasing as system sizes become larger.

Table 2 Cost breakdown for select technologies (in \$/m²)

Liquid Glazed Cost Breakdown (in \$/m²)

	Manufacturing	Manufacturing and Distribution	Total Installed System
High end of range:	679	915	2,149
Low end of range:	211	400	667
Average:	488	658	1,544

Liquid Evacuated Cost Breakdown (in \$/m²)

	Manufacturing	Manufacturing and Distribution	Total Installed System
High end of range:	1,397	1,889	3,619
Low end of range:	290	392	750
Average:	455	692	1,178

Figure 4 depicts the rate of growth in the domestic market by collector type, for the five types of solar thermal collectors. 2011 saw a decline in growth for all collector types except air glazed, which experienced a growth rate of 216% from 2010 to 2011. 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.

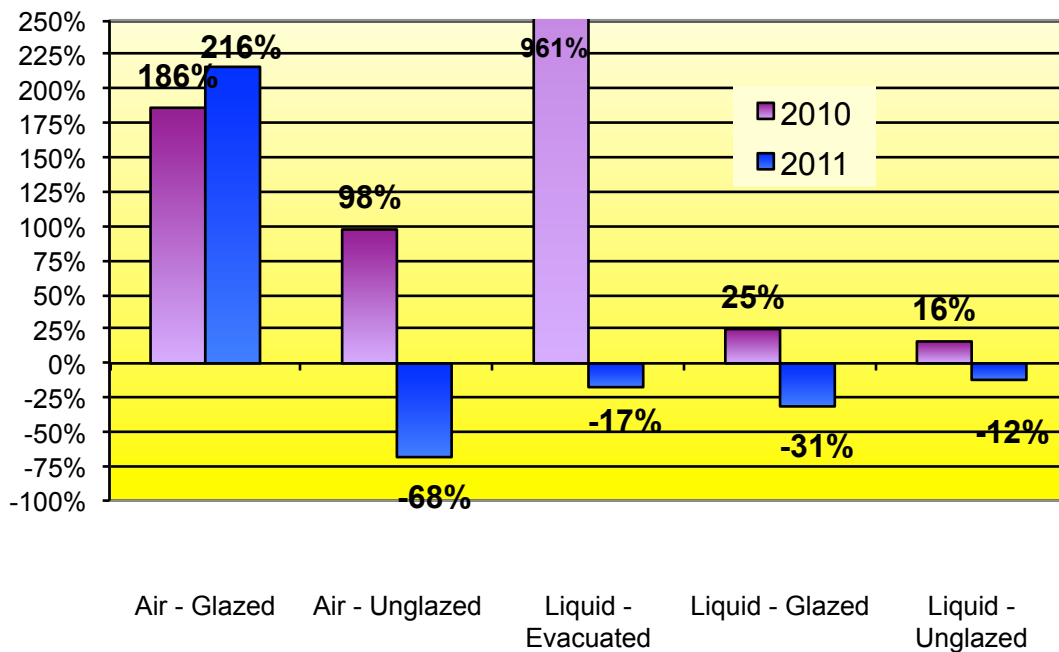


Figure 4: Annual domestic sales by collector type (m²).

Figure 5 and Figure 6 depict the history of domestic solar collector sales over the past ten years, and the history of solar thermal-related revenue over the past eight years. As previously noted, air glazed liquid collectors was the only category that did not experience a decline in sales in 2011. Export revenue continues to decline and accounts for 11% of total industry revenue in 2011.

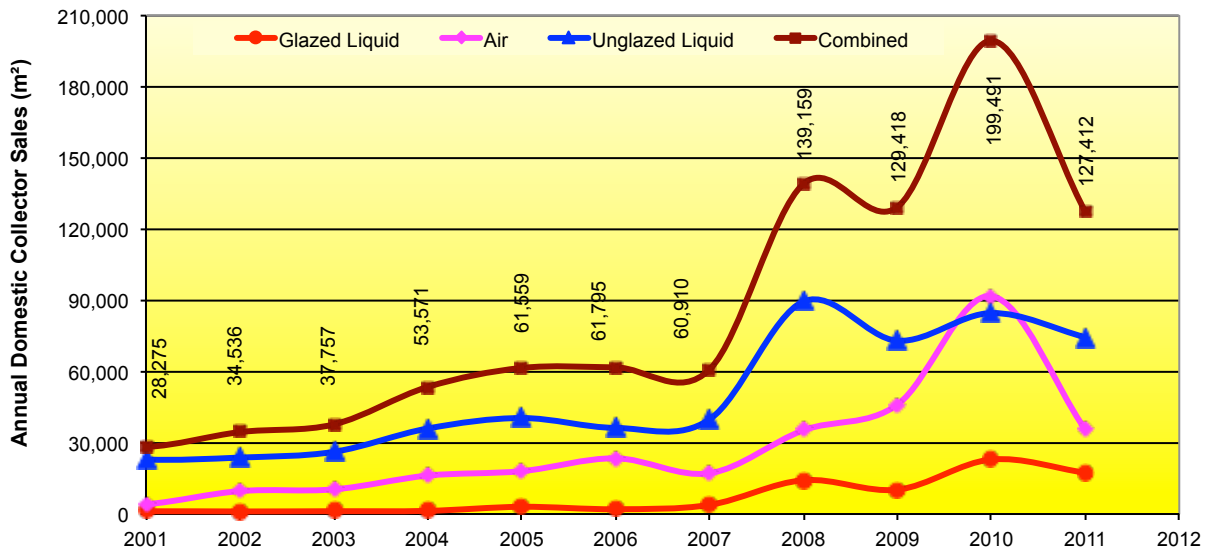


Figure 5 Ten-year history of domestic collector sales (m²).



Figure 6: Canadian solar thermal industry revenue growth.

3.3 Applications of Solar Thermal Technology

Table 3 displays the breakdown of revenue by collector type and end-use application. There are some changes when compared to the distribution found in 2010, though this may be attributed to having a slightly different respondent pool than in previous years. Unglazed liquid collectors are used primarily for residential pool heating. Conversely, the other two types of liquid collectors (evacuated and glazed) have much broader applications across both the residential and Industrial/Commercial/Institutional (ICI) sectors, though domestic hot water remains the primary end-use.

Glazed air collectors are used in both the residential and ICI sectors, predominately for ICI (27% residential space heating and 73% ICI). Unglazed air collectors are almost used exclusively for ICI space heating.

Table 3: Solar heating applications (by revenue), by sector and collector type.

Revenue by Sector	Liquid			Air	
	Evacuated	Glazed	Unglazed	Glazed	Unglazed
Residential	72%	30%	87%	27%	--
Industrial/Commercial/Institutional (ICI)	28%	70%	13%	73%	97%
Unknown	--	--	--	--	3%

Revenue by Sector	Liquid			Air	
	Evacuated	Glazed	Unglazed	Glazed	Unglazed
Residential – Pool	--	--	87%	--	--
Residential – Domestic Hot Water	50%	26%	--	--	--
Residential – Space	16%	--	--	24%	--
Residential – Combined/Other	5%	4%	--	2%	--
ICI – Pool	--	4%	11%	--	--
ICI – Domestic Hot Water	15%	62%	2%	--	--
ICI – Process Heat	--	--	--	--	2%
ICI – Space Heat	10%	--	--	73%	95%
ICI – Combined/Other	4%	4%	--	--	--
Unknown/Wholesale	--	--	--	--	3%

3.4 Geographical Distribution

3.4.1 Domestic Sales

Solar thermal collectors were sold throughout Canada in 2011, including in the Canadian Territories. Although 46% of domestic revenue was generated from sales in Ontario, the revenue per capita was highest in British Columbia (\$1.44 per capita), which is almost double that of the industry Canada-wide (\$0.77 per capita).

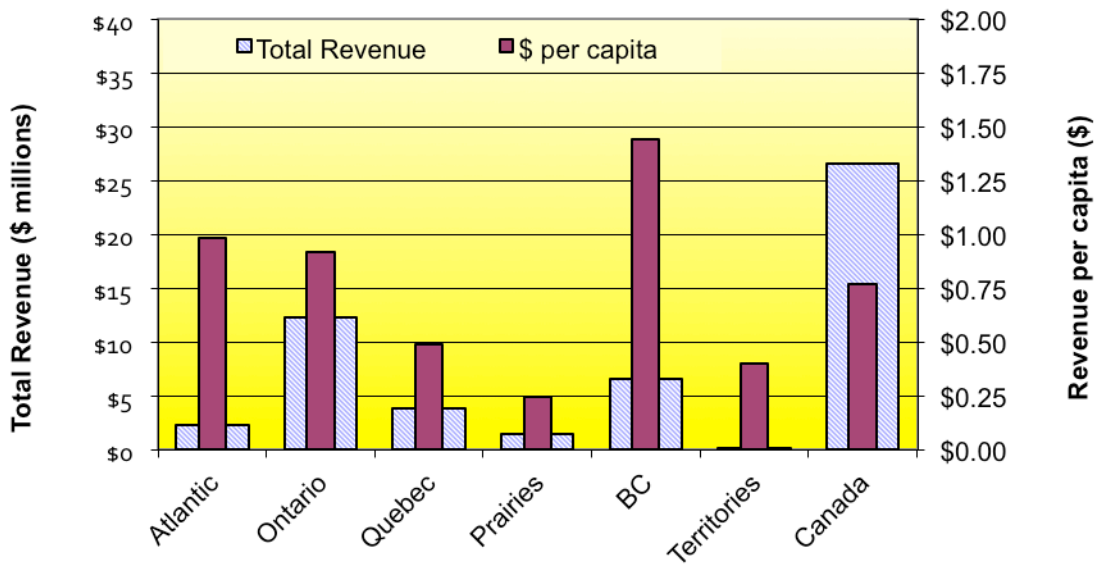


Figure 7: 2011 regional solar collector sales.

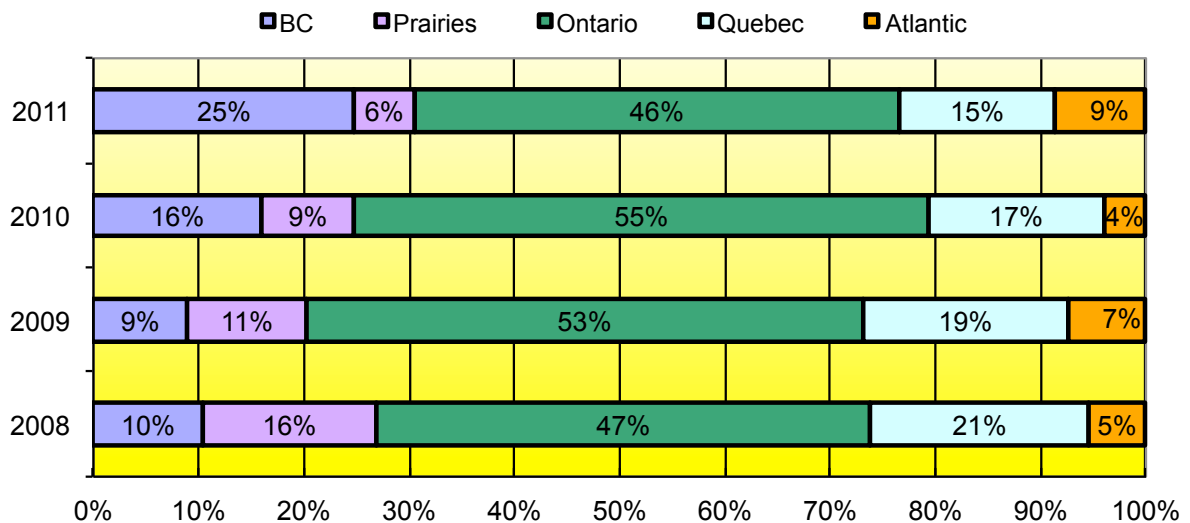


Figure 8: Regional distribution of domestic revenue

In Ontario, the expiry of several programs (both Federal and Provincial) hurt the market. However, several larger projects were supported by the Ministry of Municipal Affairs and Housing and the Ministry of Education. A total of 111 projects were built in 2010 and 2011 through the Renewable Energy Initiative- Social Housing Renovation and Retrofit Program (SHRRP). Growth in the BC market can be attributed to a number of provincial programs that also made funding available for solar thermal projects.

3.4.2 Exports

In 2011, Canada exported just over 52,000 m² of solar thermal collectors (almost equal to 2010), with a value of \$3.3 million (down 3% from 2010). The majority of exports, similar to 2010, were to the United States, though Europe was also a major market. No exports to Asia, Africa, or Oceania were reported. By collector type, glazed

air collectors was the single largest category of exports, followed closely by unglazed air collectors. No exports of evacuated liquid collectors were reported.

Table 4: Regional distribution of solar thermal exports, by revenue.

Distribution of Solar Thermal Exports	2010	2011
United States	91%	70%
Latin America	3%	7%
Europe	3%	23%
Asia and Middle East	1%	0%
Africa	2%	0%
Oceania	0%	0%
Total	100%	100%

Table 5: Solar thermal exports by collector type, by revenue.

Exports by Collector Type	2010	2011
Air - Glazed	14%	29%
Air - Unglazed	20%	26%
Liquid - Evacuated	18%	0%
Liquid - Glazed	12%	13%
Liquid - Unglazed	36%	33%
Total	100%	100%

3.5 Anticipated Sales Growth

Figure 9 shows the responses for the respondents' estimates of future sales growth, relating to their 2010 and 2011 solar thermal revenue. Respondents in the 2011 survey were markedly more pessimistic than in the previous survey. Only 37% of respondents expect positive sales growth over the next two years (63% in 2010), with 40% expecting sales to decrease over the next two years. When estimates were weighed by solar thermal revenue, an average sales decrease of 18% is expected. This is a continuation of a trend since 2008, with higher and higher percentages of respondents expecting no growth or negative growth in sales. Comments provided by respondents suggest that this ongoing pessimism in the Canadian solar thermal industry may largely be attributed to the expiration of the ecoENERGY for Renewable Heat program in March 2011.

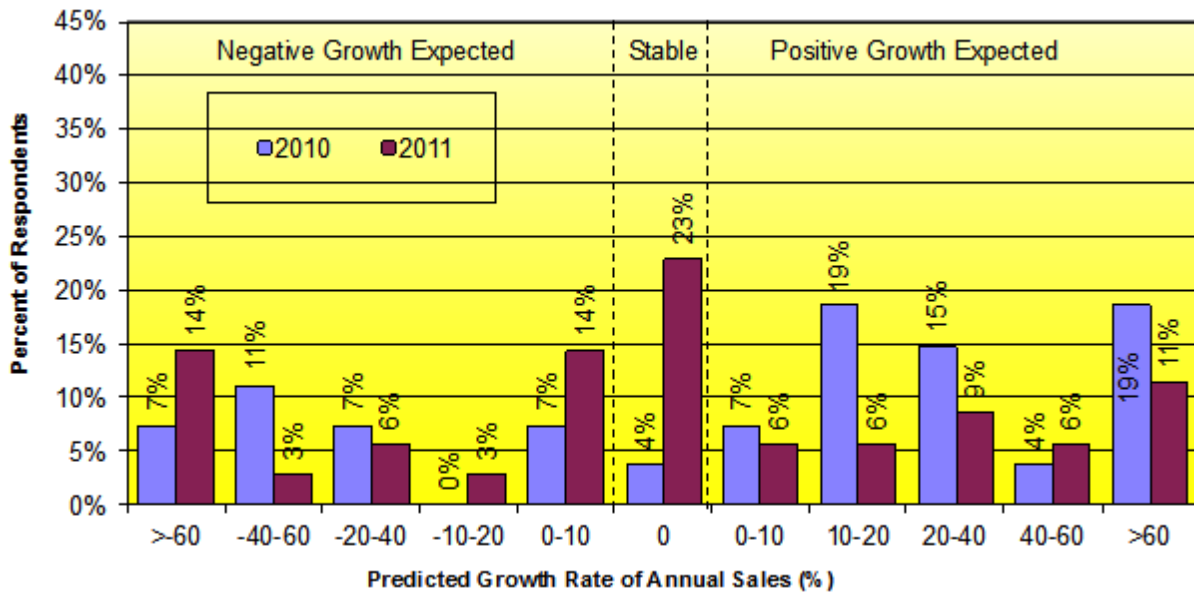


Figure 9: Estimate of future sales growth.

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 combined with small adjustments made due to data from other sources, approximately 13% of all liquid evacuated and glazed collectors (by collector area) were sold as packaged residential DHW systems. No sales of packaged pool heating systems were reported. However, due to low response in our sample from pool heating sector, it is probable that such systems were sold, just not reported in our survey. Note that prices below do not reflect the fully installed price, but rather the packaged system equipment price.

Table 6: Domestic sales of packaged residential systems.

Packaged Residential DHW Systems	
Systems Sold	466
Average Collector Area per System (m ²)	5.2
Total Collector Area (m ²)	2,404
Total Revenue from Packaged Systems	\$1,793,357
Average Revenue per System	\$3,848

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 10 shows historical solar thermal collector area that is installed and operating in Canada. By the end of 2011, 1,148,808 m² of solar thermal collectors were operating in Canada.

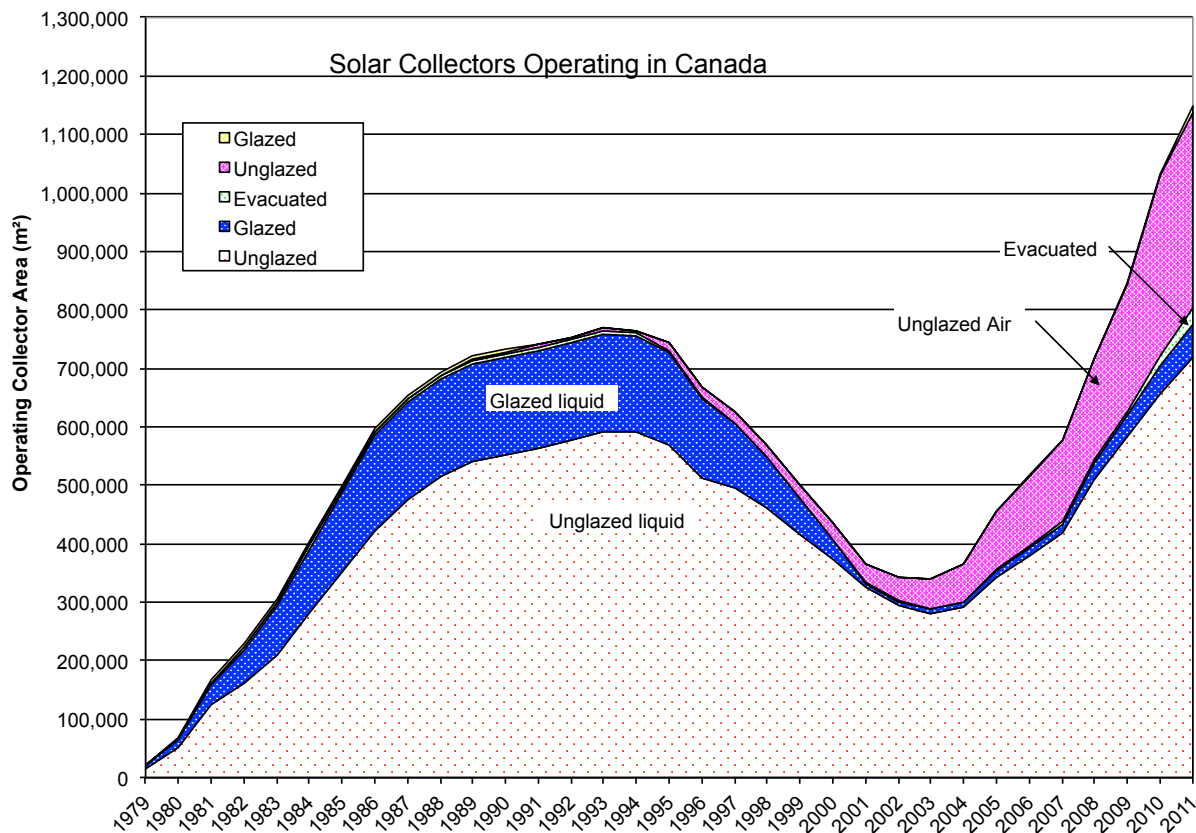


Figure 10: History of operating solar thermal collectors in Canada.

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 m²) glazed solar collectors, 150 L/d hot water usage¹, 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 m² 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 m² to 25 m², 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 m². 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 m² to 10,000 m². 200 m² 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.

4.3 GHG Emissions Avoidance Calculations

Table 7 details the calculations used to estimate avoided GHG emissions in 2011 based on the total operating solar thermal collectors in Canada. The avoidance is equivalent to 87,286 tonnes of CO₂, an increase of 16% when compared to the calculated value in 2010.

¹ 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.

Table 7: Analysis of avoided GHG emissions, 2011.

Parameter	Residential DHW	Commercial Water	Residential Pool	Commercial Air
Collector type	glazed	glazed	unglazed	unglazed air
Collector area (m ²)	6	50	25	200
Annual yield per system (GJ/a)	9.9	82.1	19.4	422
Specific annual yield (GJ/a-m ²)	1.64	1.64	0.78	2.11
<u>Displaced fuel mix (%)</u>				
· Oil (73 kg of CO ₂ /GJ)	4%	15%	1%	5%
· Natural gas (50 kg of CO ₂ /GJ)	50%	75%	63%	50%
· Propane (60 kg of CO ₂ /GJ)	--	5%	--	40%
· Electricity (151 kg of CO ₂ /GJ)	46%	5%	12%	5%
· Heat pump (38 kg of CO ₂ /GJ)	--	--	24%	--
· No fuel	--	--	--	--
Blended CO ₂ avoided (kg of CO ₂ /GJ)	97	59	59	60
Annual CO ₂ avoided (t/a-system)	0.96	4.84	1.14	25.3
Annual specific CO ₂ avoided (kg/a-m ²)	160	97	46	127
Estimated system life (years)	15/20	15/20	15/20	30
Total operating collector area (m ²)	41,619	41,619	719,364	346,207
Calculated number of systems	6,936	832	28,775	1,731
Total annual CO ₂ avoided (t/a)	6,659	4,029	32,803	43,795
Total annual CO ₂ avoided, all types (t/a)	87,286			

The 87,286 tonnes of avoided GHG emissions from solar thermal installations in Canada is equivalent to removing more than 17,000 mid-sized cars from Canadian roads, or the total GHG emissions of close to ,3,800 Canadians.²

4.4 Forecast GHG Emission Avoidance from Collectors sold in 2011

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 2011. Based on the 127,412 m² that was installed, the equivalent of 247,736 tonnes of CO₂ 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). This is a decrease of 49% compared to the 481,814 tonnes of CO₂ that will be avoided due to systems installed in 2010.

Since the solar industry earned \$26.6 million in revenue from domestic sales in 2011, this means that one tonne of CO₂ is saved for every \$107 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 2011 will be responsible for avoiding approximately 88,000 tonnes of CO₂ equivalent, during their operating life.

² "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.

5 Conclusions

The Canadian solar thermal industry underwent a decline in 2011 in both revenue (-20.1%) and collector area (-28.6%).

Figure 11 summarizes the 2011 solar thermal industry domestic market share by collector type. Unglazed liquid collectors, which accounted for the largest market share by collector area (58%), accounted for the smallest market share by revenue (9%). Conversely, glazed liquid collectors made up the lowest market share by collector area (14%) but highest by revenue (62%). The GHG Savings reflect projected savings over total lifetime.

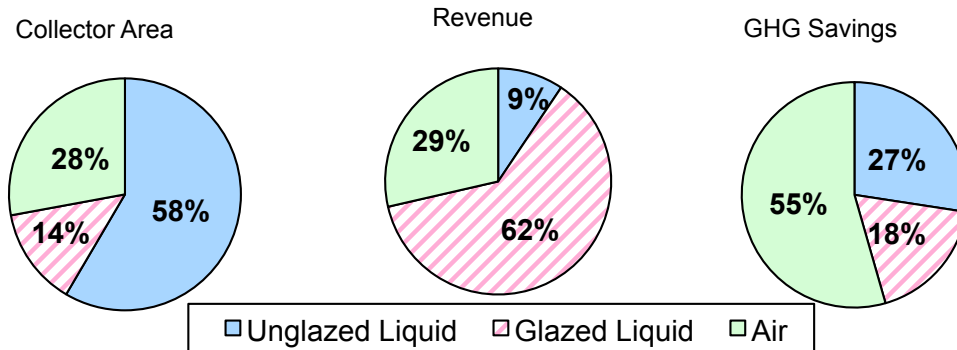


Figure 11: 2011 market share by collector area, revenue, and projected GHG savings.

Figure 12 summarizes market share of each of the five collector types by total revenue in 2011. The market shares are similar to those reported in 2010. Glazed air collectors experienced the largest increase (4.3% in 2010 to 10.2% in 2011), while the market share of air unglazed experienced the largest decrease (26.5% in 2010 to 21.7% in 2011).

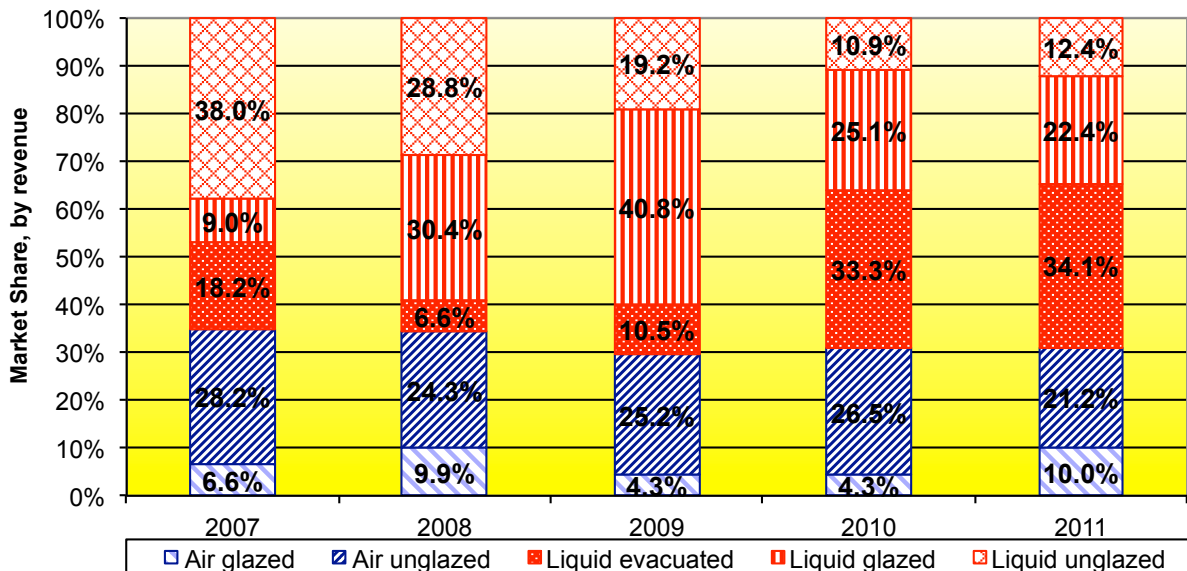


Figure 12: Market share of five collector types by total revenue in 2011.

6 References

Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2002 – 2004), August 2005, SAIC Canada report no. CM001743.

Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2005), October 2006, SAIC Canada report no. CM002056.

Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2006 & 2007), March 2008, SAIC Canada report no. CM002208.

Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2008), September 2009, SAIC Canada report no. CM002285

Final Report Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2009), August 2010, SAIC Canada report no. CM002285

Omboli, Eugène and McClenahan, Doug, 2002, **NRCan In-house Survey of Solar Collectors for 1995 – 2001**, Natural Resources Canada.

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)

The following pages contain a copy of the questions asked of survey recipients. The appendix contains the questions in English, although the questionnaire was distributed in both French and 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, and employment figures. You may complete the questionnaire through a telephone interview, online through the following link: <http://www.surveymonkey.com/s/3ZJSXXH>, or through this pdf version.

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 2010 and 2011; 2) 2011 sales and revenue (\$ and 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 2010 Solar Thermal industry survey report may be found at the following CanSIA's web site:
http://www.cansia.ca/sites/default/files/2010_nrcan_canadian_st_market.pdf

ClearSky Advisors (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 2011 (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 2011. Check all that apply.

- 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 2010 and 2011? Check all that apply.

	2010	2011
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 of 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.)

2010: _____
2011: _____

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

2010: _____
2011: _____

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

2010: _____
2011: _____

14. Please report your total revenue earned from solar thermal activities in 2010 and 2011, 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.)

	2010	2011
Total Sales Revenue from Solar Thermal Activities	\$	\$
Revenue of All Export Sales	%	%
Revenue from Sales to Canadian Resellers	%	%
Revenue from Sales Direct to Canadian End Users	%	%
Revenue from Other Canadian Sales	%	%

15. Please provide total Solar Thermal collector sales in 2011, by collector area, and provide the percentage of Solar Thermal collector sales, export and Canadian, by collector area. The percentages provided should sum to 100%.

Total Solar Thermal Collector Sales (square meters) _____ m²
 Percent of Collectors Exported _____ %
 Percent of Collectors Sold Within Canada _____ %

16. Compared to 2011, 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 2011 by collector type 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.

	Air - Glazed	Air - Unglazed	Liquid - Evacuated	Liquid - Glazed	Liquid - Unglazed
Revenue (\$)					
Collector Area (m²)					

18. Please provide a percentage distribution, by collector type, of dollar sales by application for 2011. 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	Air - Unglazed	Liquid - Evacuated	Liquid - Glazed	Liquid - Unglazed
Residential – Pool					
Residential – DHW					
Residential – Space					
Residential – Combined/Other (includes hot tubs)					
ICI – Pool					
ICI – DHW					
ICI – Process Heat					
ICI – Space Heat					
ICI – Combined/Other					
Unknown/Wholesale					

19. Within each region, please report the 2011 sales by revenue and collector area for each collector type. If your business did not conduct sales in a particular region in 2011, please leave the applicable section blank.

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

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 2011.

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

Dollar Value of Solar Thermal Collectors (\$): _____

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 for each collector source for the year 2011.

	Collector Type	Supplier Name	Supplier Location	Dollar Value of Supply
Purchased Within Canada				
Purchased Outside of Canada				

22. Please briefly describe any changes to your business during 2011 (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. a) Does your business sell packaged residential solar systems in Canada?

Yes

No

b) If yes, please provide information on the number and type of systems sold in 2011. Please provide data only on Canadian sales, excluding exported systems.

	Solar DHW Systems	Solar Pool Heating Systems
Total Revenue from Packaged Residential Sales (\$)		
Number of Systems Sold		
Total Solar Thermal Collector Area in Packaged Residential Sales	m ²	m ²