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2009 Labour Force Survey of the Canadian Solar Industry

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Executive Summary

Synopsis

- The purpose of this study was to identify the main labour force trends in the Canadian solar industry over the next three years. The study involved a web-based survey of 91 companies in the Canadian solar industry. The survey results will be used by the Canadian Solar Industries Association (CanSIA) and the Electricity Sector Council to work with stakeholders to develop appropriate policies and programs to ensure that Canada's solar industry will be equipped with adequately qualified and trained human resources to sustain its growth.

- Solar companies anticipate a significant growth of 101% in the number of full-time equivalents to be employed by the end of 2011, despite the economic uncertainties that were starting to be experienced when the survey was conducted (October-November 2008).

- Some 41% of companies were experiencing labour shortages at the time of the survey, specifically in installation (75% of those experiencing shortages).

- By the end of 2011, 51% of companies expect to face shortages, once again in the area of installation (78%) followed by systems design and integration (51%), project management (40%), and engineering (40%).

- In terms of programs and policies suggested to mitigate the labour shortage, the inclusion of solar studies in the engineering and technical curricula of universities and colleges was highly recommended, as was a nationwide Canadian certification program of high standards for both photovoltaic and solar thermal installers. The introduction of an apprenticeship program for project management was another frequently-mentioned suggestion.

Background

This report contains the results of a labour force survey of companies in Canada's solar industry carried out on behalf of the Canadian Solar Industries Association (CanSIA) and the Electricity Sector Council by Kelly Sears Consulting Group. The objectives of the study were to prepare a concise profile of the Canadian solar industry based on a review of secondary sources, and to identify labour force trends in the photovoltaic (PV) and solar thermal (ST) segments of the industry. This study represents the first step for CanSIA and the Electricity Sector Council to work with stakeholders to develop programs and policies to ensure that Canada's solar industry will be equipped with adequately qualified and trained human resources to sustain its growth.

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Survey Results

1. Profile of Responding Companies

A total of 287 companies were invited via e-mail to participate in the online survey. The sampling frame included more than 90% of the universe as verified by CanSIA's membership database and popular trade directories.[1] Of these, 91 firms responded, for a response rate of 32%, which is above the 10%-20% average for this type of survey. The responding companies were equally balanced between the PV and ST segments (27.5% each), while 42% operated in both segments, and 3% operated in the other renewable energy segment.[2] Based on available industry statistics, the survey responses appear to be representative of the industry.

The companies operate in multiple business categories. The categories mentioned more frequently by the PV segment were: systems integrator (48%), installer (46%), and dealer/retailer (43%). The business categories mentioned more frequently by the ST segment were installer (62%) and retailer (46%).

2. The Labour Force in 2008 and 2011

The 88 respondents belonging to the PV or ST segments reported a total of 1,524 full-time equivalents (FTEs) in 2008. This labour force is expected to grow to 3,069 FTEs by 2011 – a dramatic growth rate of 101% in FTEs over the next 3 years. This bullish prediction is significant in view of the fact that the survey was administered at a time when a severe global economic downturn was commencing. The positive outlook of solar companies may be due to the growing belief that green technologies will be central to future economic growth.

Companies were asked to allocate their FTES to specific business functions in 2008. Manufacturing operations, sales, research, quality control, project management, installation, and engineering functions account for 65% of all FTEs.

Companies were asked to project the growth in each function over the next 3 years. The function forecast to experience the most growth is project management (178%: from 122 FTEs in 2008 to 339 in 2011). The second-highest growth rate is expected for installation (146%, from 107 FTEs to 263 FTEs). Other functions anticipating strong growth include sales (120%) and manufacturing (107%).

[1] http://energy.sourceguides.com.

[2] The photovoltaic (PV) segment uses technology (solar cells) to convert sunlight directly into electricity. The solar thermal (ST) segment uses technology for harnessing solar energy for thermal energy (heat). Other renewable energies include green energy alternatives such as wind, hydro (water), and biomass.

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3. Labour Shortages

Currently, 41% of companies are experiencing labour shortages. The most frequently mentioned areas of skills shortages were installation (of those companies experiencing shortages, 75% had a shortage in this function); technical areas (39%); systems design and integration (39%); sales (39%); project management (25%); and, engineering (25%).

Looking ahead 3 years, skills shortages are expected to become increasingly widespread: 51% of companies expect to experience a shortage of qualified personnel by 2011 (compared to 41% in 2008). The main functions expected to experience shortages are: installation (of those companies expecting a shortage, 78% selected this function), followed by systems design and integration (51%), project management (40%), engineering (40%), sales (38%) and technical areas (36%).

Of those companies currently experiencing a labour shortage, 51% stated that the shortage is critical to the growth of their companies over the next 3 years.

4. Required Polices and Programs to Address Labour Market Issues

Companies were asked to submit suggestions for any policies or programs that could help meet the industry's needs for adequately qualified human resources. The most popular suggestions were to add solar studies to the technical and professional curricula at colleges and universities and to promote a high quality, standardized, nationwide certification program (each of these suggestions was mentioned by 24% of companies). About 19% of the respondents suggested that the government should have a consistent, long-term policy to promote the solar industry and should stimulate the market prior to considering the development of human resources policies and programs.

The survey also solicited feedback on a number of specific initiatives to address issues pertaining to the labour market situation facing the solar industry. The results were very similar to the unaided suggestions. The initiatives that received the most support were the following:

- Add solar energy technologies and research to the technical and engineering curricula of colleges and universities.
- Encourage apprenticeship programs for students in technical areas by working with solar firms.
- Provide a nationwide, highly recognized Canadian certification program for ST and PV installers.
- Introduce an apprenticeship program for project management students to work in solar firms.

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1 Introduction

The Canadian Solar Industries Association (CanSIA) and the Electricity Sector Council have launched an initiative to examine the labour market trends and issues facing the Canadian solar industry, and to work with stakeholders to develop appropriate policies and programs. The Electricity Sector Council is assessing available labour market information as part of a three-year project to build a comprehensive database of human resources figures, trends and influences. CanSIA wants to ensure that appropriate education and training programs will be in place to support the industry in the years to come.

The two major segments of the solar industry in Canada are photovoltaic (PV) and solar thermal (ST). The PV segment uses technology (usually a solar panel) to produce free electrons when exposed to light, resulting in the production of an electric current, while the ST segment uses technology (collectors) for harnessing solar energy for thermal energy, i.e., heat.

An online labour force survey of 287 solar companies during October/November 2008 was undertaken. CanSIA sent out an email invitation inviting companies to participate in the survey. The survey was in the field for about eight weeks. A total of 91 companies responded, yielding a response rate of 32%. This response rate is above average for this type of survey.

The survey asked for information pertaining to:

- Business segments: photovoltaic and/or solar thermal.
- Business categories in which the firms were active.
- Number of "full-time equivalents" (FTEs) in 2008, and forecast for 2011.
- Distribution of FTEs by business functions (management, warehousing, administration, engineering, installation, etc.).
- Forecast growth/decline in each function to 2011.
- Shortages in qualified personnel, by function, both today and in 2011.
- Views on possible initiatives to address labour force issues.

The survey questionnaire is included in Appendix A.

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2 Profile of the Canadian Solar Industry

This section presents an in-depth profile of the Canadian solar industry, based on a review of available literature.

A. Introduction

The Canadian solar industry has shown significant strength and growth in photovoltaic (PV) and solar thermal (ST) segments, which include solar hot water heating, solar air heating and cooling, and solar pool heating. Today, solar energy represents less than one percent of the Canadian energy mix. However, as a result of increasing awareness about this environmentally-friendly technology, ease of procurement and installation, and increasing costs of traditional energy sources, the acceptance of solar energy in Canada is on the rise. In addition, due to the strength of the industry, the export potential of Canada in the solar energy sector also indicates a bright future. With the right incentives and policy frameworks to support the industry, it is expected that by 2025, the PV segment alone could meet 10% of Canada's new electricity requirements. [3]

B. Photovoltaic Segment

1. Industry Growth

From 1998 to 2007, the photovoltaic segment experienced an average annual compounded growth rate of 19% in terms of installed PV power in MW, as shown in Exhibit 1. From 2006 to 2007, Canada demonstrated a growth of 26% in total PV power installed, reaching 25.8 MW at the end of 2007.

Exhibit 1
Cumulative Installed PV Power in MW in Canada, 1999 to 2007

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Installed PV power (MW)	4.5	5.8	7.2	8.8	10.0	11.8	13.9	16.7	20.5	25.8

Although the installed capacities (cumulative total PV power installed) in Germany, Japan, Spain and the USA are much higher, it is encouraging to note that Canada has joined the 13 countries that are experiencing annual domestic demand of over 5 MW.[4] As shown in Exhibit 2, Canada ranks 11th in the world in terms of annual demand. The domestic market sales volume in Canada in 2007 was 5.29 MW,

[3] "The Potential for Solar Power in Canada", Presentation by CANSIA at the CANSIA/NRCan PV Forum, 12 February 2008.
[4] IEA PVPS Trends tables 2008 final, Josef Ayoub, CANMET, NRCan.

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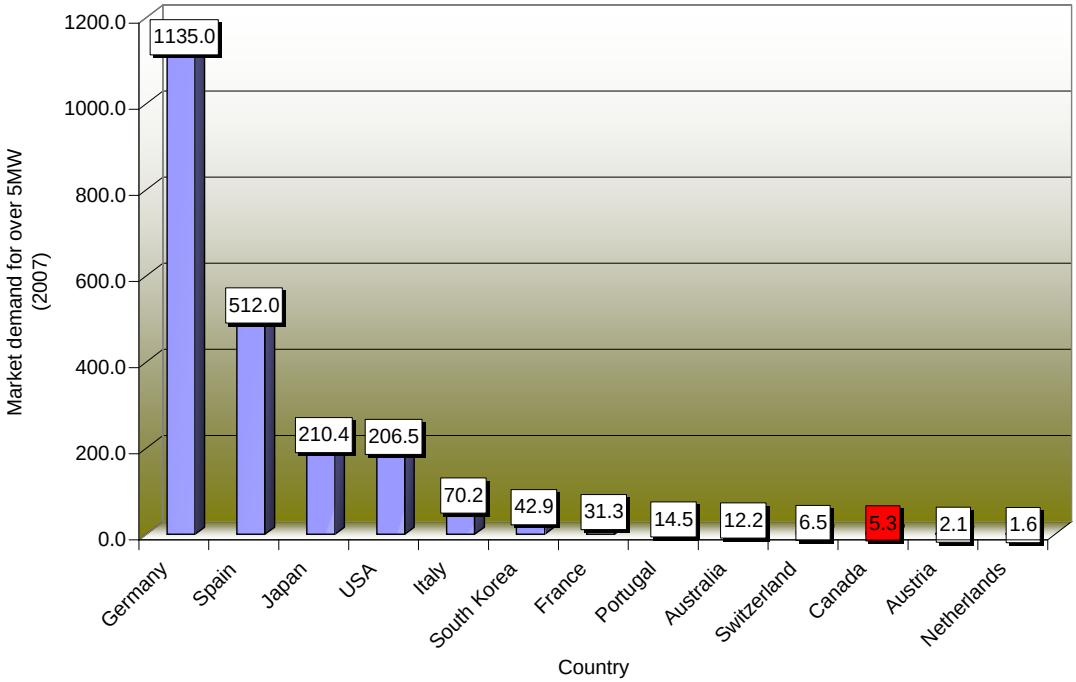
which was a 42% increase from 3.74 MW in 2006. The total sales including exports (12.62 MW) were significantly higher in 2007 compared to 2006, i.e., a growth of 167%.[5]

Exhibit 2
Annual Domestic Market (MW) in 2007 for 13 Countries



2. Applications

PV applications are generally classified under four categories:

- Off-grid residential PV systems installed in remote homes and cottages, recreational vehicles, residential communications (radios) and villages, which are not connected to the utility grid.

- Off-grid non-residential PV systems used for a variety of applications such as water pumping, transportation signalling, remote communications, road signals, telecommunication repeaters, safety and protection devices, industrial, sensing, monitoring and controlling devices, navigational aids, bus stop signalling, low illumination, etc., which are not connected to the utility grid.

- On-grid distributed PV systems installed on consumers' premises, usually on the demand side of the electricity metre. This includes grid-connected domestic PV systems and other grid-connected PV systems on commercial buildings and

[5] *2007 PV Systems and Modules Survey – Aggregate Survey Data Report*, Vasantha Narasimhan, 28 May 2007.

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motorway sound barriers, etc. A demonstration grid connected system was in operation in a federal government facility in Charlottetown.

- On-grid centralized PV systems used for support of the utility distribution grid, performing the function of a centralized power station.

The market for PV power in the four sub-markets in 2007 is shown in Exhibit 3.

Exhibit 3
PV power (kW) installed in Canada in 2007, by Sub-Market[6]

Sub-markets	Off-grid Residential	Off-grid Non-Residential	On-grid Distributed	On-grid Centralized
kW installed in Canada in 2007	1,408	2,480	1,403	0

3. Module Prices

In addition to growth, the health of an industry is measured in terms of its cost competitiveness. The PV industry in Canada has shown declines in the weighted average of module prices, for example, from $11.09 in 1999 to $4.47 in 2007. This represents an average annual price reduction of about 9.6% over the eight years (Exhibit 4). Module prices are expected to decline globally, which in turn will lead to lower turnkey prices/ watt of installed systems.

Exhibit 4
Module Prices $/WATT, 1999-2007

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Price	$11.09	$10.70	$9.41	$7.14	$6.18	$5.53	$4.31	$5.35	$4.47
Reduction	-	3%	12%	24%	13%	10%	22%	increase	17%

According to DENA, The German Energy Agency, commissioned by CanSIA to study the benefits and barriers to the development of solar power in Ontario, mass marketing, technological developments as well as overproduction will reduce PV system prices significantly within the next ten years. The price declines will be similar to the computer chip industry; however, the price reductions will be less drastic because the price of PV is not only determined by production costs for cells and modules but also by labour costs required for installation. The potential for

[6] *National Survey Report of PV Power Applications in Canada 2007, Task 1 – Exchange and dissemination of information on PV power system*, Cooperative Programme on Photovoltaic Power Systems, International Energy Agency, 06 June 2008.

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cost reduction in solar PV is very high and DENA states under a certain technological, marketing, and policy mix, the reductions will be in the magnitude of 50% leading to turnkey systems being priced around $3.88 (Canadian) by 2015.[7]

4. Full-Time Employee Equivalents[8]

Employees in the PV segment include those working in various parts of the supply chain, i.e., manufacturing, distribution, retail, sales, system integration, installation, consulting, research and development, engineering, management, and administration. The jobs are in both the private and public sectors, including PV-dedicated personnel in utilities. The full-time employee equivalents (FTEs) of 1,370 in 2007 showed a 27% increase over 2006 (Exhibit 5).

Exhibit 5
FTEs in PV, 1996 to 2007

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total labour	169	201	220	250	260	275	535	615	765	975	1,080	1,370
Annual growth	0	19%	10%	14%	4%	6%	94%	15%	24%	27%	11%	27%

5. Supply Chain and Types of Jobs

The results reported in the National Survey Report[9] matches with the supply chain provided by the Green Jobs Website (Exhibit 6). The supply chain consists of two types of manufacturers, namely, the cell and module manufacturers and the Balance of Systems Manufacturers (BOS). These manufacturers have suppliers of services as well as suppliers of materials and equipment. The next node in the supply chain includes distributors and integrators, importers and retailers who work either independently or in collaboration with a manufacturer to serve end users either directly or through contractors.

[7] *Preliminary Report on Ontario IPSP*, DENA, German Energy Agency, July 31, 2008.
[8] *National Survey Report of PV Power Applications in Canada 2007, Task 1*, International Energy Agency, 06 June 2008.
[9] Same as footnote 6.

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Exhibit 6
The PV Industry Supply Chain[10]

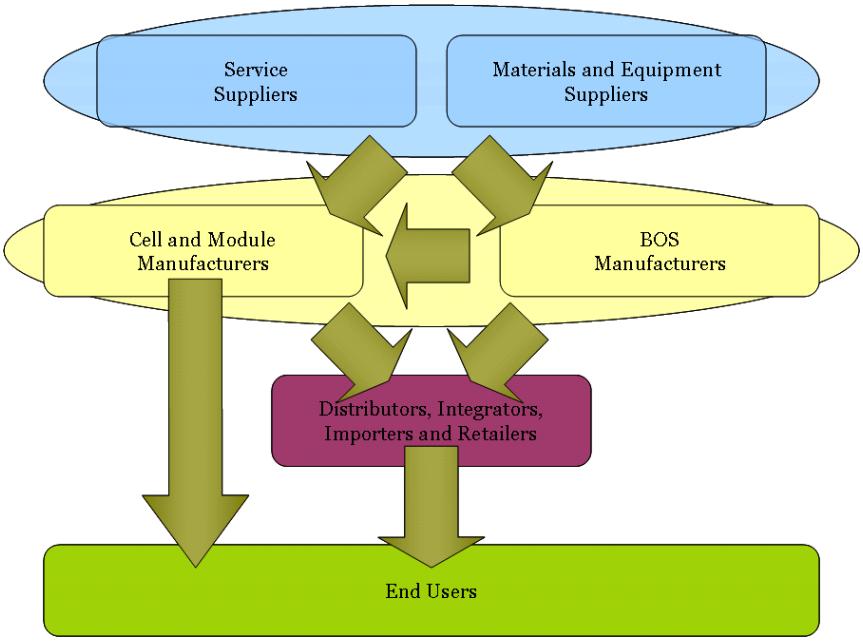

Exhibit 7 summarizes the results of analysing the Energy Source Trade Directory for PV-related businesses.[11] It indicates that in Canada there are approximately 4 equipment manufacturers who supply the original equipment manufacturers (OEMs, 2 material manufacturers who are suppliers to the OEMs, 14 module manufacturers (OEMs), 5 PV cell manufacturers (OEMs), 12 power system manufacturers (BOS), 9 controller manufacturers (BOS), 7 module importers, 9 PV system importers, 67 PV system retailers, 7 controller retailers, 5 PV cell retailers, 5 lighting manufacturers, and 11 water pumping dealers. It is noted that a single company operates in many parts of the sub-segments, there are approximately 114 PV-related businesses operating in a total of 157 spots in the various sub-segments. It is understood that the information may be subject to some errors because companies do not accurately list themselves and the businesses are changing structure rather quickly, e.g., through mergers, acquisitions, and new names.

[10] Adapted from Greenjobs.com.
[11] http://energy.sourceguides.com

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Exhibit 7
Number of Firms Operating in the PV Sub-segments

Sub-Segments	Businesses
Photovoltaic Cell Manufacturing Equipment Manufacturers	4
Photovoltaic Cell Material Manufacturers	2
Photovoltaic Module Manufacturers	14
Photovoltaic Cell Manufacturers	5
Solar Electric Power System Manufacturers	12
Solar Electric Charge Controller Manufacturers	9
Photovoltaic Module Import Businesses	7
Solar Power System Importers	9
Photovoltaic System Retailers	67
Solar Electric Charge Controller Retail Businesses	7
Photovoltaic Cell Retail Businesses	5
Solar Lighting System Manufacturers	5
Water pumping System Dealers	11

According to the NSR (2007)[12], the cell and module manufacturers are expected to show strong growth in the Canadian PV segment. The three major cell/module manufacturers based in Canada, Centennial Solar, Day4 Energy Inc., and ICP Global Inc., have a total capacity for producing over 93 modules. The OEMs of medium- to large-sized firms may have their own in-house accounting departments, legal support, production line and assembly operators, staff for office cleaning, maintenance, etc. Contracting out is another option.

Besides OEMs, there are several other manufacturers and suppliers of other components ranging from inverters and controllers to batteries, normally referred to as balance of system (BOS) components. The firms design, develop and fabricate equipment, electronics, and devices to monitor, control, and ensure quality or provide a utility interface to the electrical power produced by PV modules.[13] Many of the firms are members of CanSIA. According to the National Survey Report 2007, the Canadian PV manufacturing and associated supplier sectors include over 200 organizations offering a variety of direct and indirect jobs (direct standing for occupations directly related to OEMs). The report also mentions examples of Canadian firms gaining prominence because of leadership and innovation. Canadian-based Timminco Limited and Becancour Silicon Inc. are likely to be significant contributors to the production of solar grade silicon. Xantrex Technology Inc. is making a mark in the programmable power market.

[12] *National Survey Report of PV Power Applications in Canada 2007*, 06 June 2008
[13] *Occupational Profiles for the Solar Industry*, Interstate Renewable Energy Council (IREC), March 2007.

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The CEOs of many of the solar electric companies are innovative entrepreneurs with special technical training, extensive management experience, and high energy. As the organizations mature, there emerges a need for CEOs with leadership and high level business skills. In the early stages, the CEO may also be involved in domestic and international marketing to promote the image of the organization. While the CEO is responsible for strategically navigating the company, in medium enterprises he/she may employ a business professional with experience in strategic plan development and monitoring.

The manufacturing organizations may also have someone responsible for sourcing supplies, making negotiations with contractors and ensuring the company's operations have a continuous flow of supplies on an as needed basis.

Like any business organization, other jobs found in the manufacturing sector would include Human Resources, Accounting and Finance, and Information Technology.

In manufacturing organizations of reasonable size, there will be a core technology group headed by someone with special expertise in the area. Research and Development for product differentiation and innovation will be conducted within the technology group. The technologists may include material scientists, chemists, physicists, and engineers.

In Canada, there are a few large solar distributors carrying a wide range of modules, sometimes from several manufacturers. Others are SMEs (small or medium enterprises). While some distributors do not install, others work with installers to complete turnkey installations in the commercial and residential sub-segments. The personnel require knowledge of different market segments, for example, consumers, groups for micro-grids, and utilities. The medium and larger enterprises employ engineers, designers, and others involved in assembly, installation and maintenance of systems.

Most organizations in the value chain will have some type of sales and customer service personnel. The key sales person has to be endowed with technical competence and understand the attributes of the product that they are selling.

Some organizations integrate systems before they sell them. Designers and engineers help in systems integration.

Installers are much needed to complete the value chain. Since the final part of customer satisfactions rests with proficient installers, there is a push towards certifying the installers. CanSIA, for example offers a PV Technician certificate in partnership with an educational institution (such as Seneca College). The program offers an understanding of electrical theory relevant to the fundamentals of the PV system. In addition it deals with solar theory, batteries, charge controllers and

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Balance of System (BOS) components. The Canadian Electrical Code for PV systems is also part of the curriculum and this is followed by a practical review of equipment, e.g., PV standalone systems and PV Grid Connected systems. In the U.S. the North American Board of Certified Energy Practitioners (NABCEP) has done a task analysis of solar electric installers and has a certification program.[14] NABCEP offers certifications and certificate programs to renewable energy professionals throughout North America. It has developed a certification program for solar electric installers.[15] A comparison of the basic requirements for CanSIA's PV technician certificate and NABCEP's PV installer certification shows that the NABCEP aims to certify the technician that already has field experience whereas CanSIA 's program is intended for the novice aiming to become a technician.[16] It is noted that all PV installations have to meet local regulatory requirements in terms of obtaining proper permits. Graduates of CanSIA's program cannot obtain permits unless they have or acquire other appropriate provincial designations (e.g., Master or licensed electrician, etc.).

The information on the types of businesses and jobs will form the basis for the next step in this study, which is a survey of industry participants to understand their current and future employment requirements.

6. Training and Education

The growth in employment in the PV-related organizations in Canada should parallel the growth of the PV industry. Also, greater specialization and training will be required to compete globally. The demand will be in all areas of the value chain. It is expected that the current number of qualified personnel within the industry will not be sufficient to meet the growing demands of the industry. The PV segment like other clean energy sectors will require training and education of a new group of clean energy personnel ready to meet the different skill needs of the industry, e.g., from semi-skilled field workers to highly qualified scientists, researchers, management professionals and CEOs. This need for training and education of personnel is being recognized across the world. Studies are being conducted on the labour market impact of clean energy; PV is included in most of them.[17] In addition studies are being conducted on the training necessary.[18]

Most professionals who work in these industries have qualified through regular degree and professional examinations in the sciences, engineering or one of the

[14] *PV Installers Task Analysis – Technical Committee Document*, North American Board of Certified Energy Practitioners, Approved 04 June 2002.
[15] http://www.nabcep.org/
[16] CanSIA, Certification Study, March 31, 2008.
[17] *Report of the Renewable and Appropriate Energy Laboratory – Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?*, Daniel M. Kammen/Kamal Kapadia/Matthias Fripp, Energy and Resources Group, Goldman School of Public Policy, 31 January 2006.
[18] *Occupational Profiles for the Solar Industry*, Interstate Renewable Energy Council (IREC), March 2007.

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many business disciplines. Their clean energy industry expertise has accrued from work experience. This will continue in the future, however, it is expected that the proportion of professionals in the technology areas (science and engineering) with industry specific knowledge and perhaps qualifications in PV or material sciences will be on the rise.

In Canada several post-secondary organizations offer training in renewable energy. CanSIA has a list of them on its website.[19] A list of colleges and institutes offering studies in renewable energy is also found on the Association of Canadian Community Colleges' website.[20] For example, Centennial College in Toronto offers a two and three-year diploma program in energy systems and a number of applied technology workshops, such as a hands-on-solar workshop. Humber College offers a three-year, full-time program in wind, solar, and earth energy generation, low carbon, energy efficient building design, heating, cooling, ventilation and lighting systems. Business skills are also imparted to participate in the green economy. Lakeland College in Alberta offers a program that includes introduction to solar power along with wind energy, geothermal and biofuels. Apprenticeship programs do not consistently offer solar programs.

While several of the highly paid jobs in these industries are likely to be filled by college graduates it must be understood that the businesses also require less highly skilled people for jobs such as assembly line workers, laboratory assistants, clerical assistants, etc. Above all, the need for installers is ever growing.

C. Solar Thermal Systems Segment

1. Industry Growth

The Solar thermal (ST) systems segment, which includes solar hot water heating, solar air heating and cooling, and solar pool heating, has shown an increase of annual domestic collector sales from 20,368 square metres in 1998 to 60,910 square metres in 2007 (Exhibit 8).

Exhibit 8
Collector Sales in Square Metres in Canada[21]

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Collector sales for Canada (m^2)	20,368	27,246	31,153	28,275	34,536	37,757	53,571	61,559	61,795	60,910

[19] http://www.cansia.ca/Default.aspx?pageId=143685.
[20] http://www.accc.ca/inventory/index.php.
[21] *Final Report – Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2006 and 2007)*, Science Application International Corporations (SAIC Canada) – Renewable Energy and Climate Change Program, March 2008.

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The solar air heating sub-segment of the industry is stronger in Canada compared to other nations; most collectors in this category installed in Canada are also manufactured in Canada. Outdoor pool heating segment of the industry is very diverse. There are large manufacturers in Canada and the U.S. and shipments flow both ways across the border. The general water heating segment uses a mix of collectors of Canadian and foreign origin. Distribution is mainly through solar channels. Several types of solar collectors were sold in Canada: unglazed, liquid plastic collectors; unglazed air collectors; glazed liquid collectors; evacuated tube liquid collectors; and glazed, air collectors.

The sales volume (Domestic and Exports) for all types of collectors in 2007 was 91,467 square metres compared to 76,042 in 2004, a 20.3% increase. Greenhouse gas (GHG) emissions avoided from all solar thermal systems operating in Canada during 2007 were estimated at 37,932 tonnes of CO2.

2. Applications

The solar thermal technology applications vary by type of collectors. The revenue by collector type indicates that the unglazed collectors have applications in the pool heating area. The glazed and evacuated tube collectors have applications in residential domestic water heating, residential space heating, space and water heating combined and ICI (industrial, commercial, institutional) domestic water heating. The air collectors have applications in ICI space heating. Exhibit 9 shows major solar heating applications by collector type and sector type. As mentioned earlier, the solar air heating sub-segment of the industry is stronger in Canada compared to other nations.

Exhibit 9
Applications of Solar Thermal Technology by Collector Type and Sector

Revenue by Solar Heating Application	Unglazed		Glazed/ Evacuated		Air	
	2006	2007	2006	2007	2006	2007
Residential pool heating	99%	99%				
Residential domestic water heating			63%	58%		
Residential space heating			12%	7%	21%	20%
Residential combined space and water heating			8%	5%		
ICI domestic water heating			17%	30%		
ICI space heating					63%	70%
ICI combined/other					16%	10%

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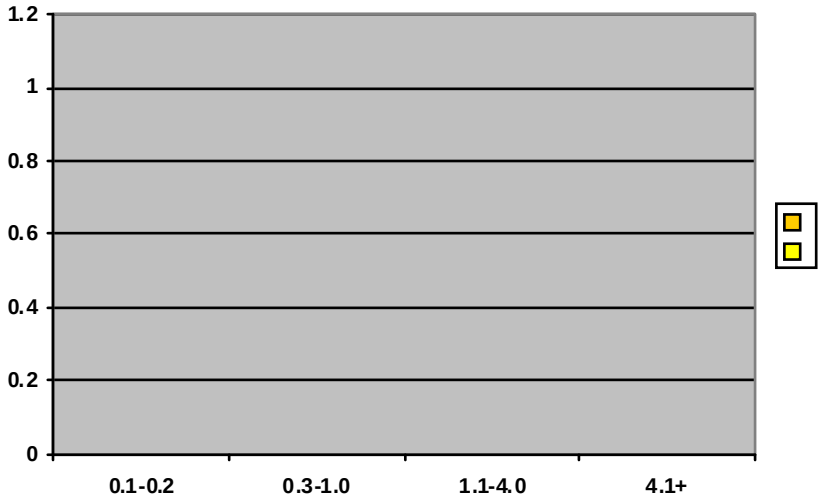
3. Full-Time Employee Equivalents

The distribution of companies based on the number of employees per company responding to the annual STC survey of 2006 and 2007 undertaken by NRCan is shown in Exhibit 10.[22]

Exhibit 10
Distribution of Solar Thermal Companies by Number of FTEs



This exhibit shows that there were 7 companies in 2007 that had more than 4.1 FTEs. In California, it is estimated that solar thermal jobs are about 4% of PV jobs.[23] However, the number of employees in this segment in Canada is to be determined.

4. Supply Chain and Types of Jobs

Based on an analysis of the Renewable Energy Source Trade Directory, the supply chain in the Solar Thermal Systems industry segment consists of 3 Solar Air Heating Manufacturers, 3 importers and 16 retailers. The water heating sub-segment consists of 19 manufacturers and 55 retailers. The pool heating sub-segment consists of 8 manufacturers and 23 retailers. There are 6 solar roof distributors. In total there are about 88 companies operating in a total of 133 spots in the sub-segments. In addition to the overlap between sub segments there is an overlap with the PV segment. The types of businesses found in this segment include

[22] *Final Report – Survey of Active Solar Thermal Collectors, Industry and Markets in Canada (2006 and 2007),* Science Application International Corporations (SAIC Canada) – Renewable Energy and Climate Change Program, March 2008.
[23] *Report of the Renewable and Appropriate Energy Laboratory*, 31 January 2006.

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collector manufacturers, component manufacturers, collector importers, component importers, wholesalers, and retailers.

The types of jobs are similar to those of the photovoltaic segment except that the area of expertise will be in solar thermal. This information on the industry participants and types of jobs will be used to prepare for the labour force survey, which is the next step of this study.

5. Training and Education

According to the German Energy Agency (DENA), high growth in the renewable energy industry, specifically the solar industry, creates job growth, which in turn triggers a "thirst for talents" with the demand for highly qualified professionals exceeding the number available. The educational sector is most often reactive rather than proactive in developing courses tailored to meet the demands of the new industry. [24]In Canada some steps are being considered to improve the educational and training opportunities necessary to meet the needs of a growing solar industry.

CanSIA offers a Canadian Solar Hot Water System Installer (Level 1) Certification. The aim of the certification is to ensure that SDHW installations are undertaken by trained installers. The cognitive and psychomotor skills that are required to install solar domestic hot water systems are the same as specified in the North American Board of Certified Energy Practitioners' task analysis for Solar Water and Pool Heating Systems Installation Contractors.[25] The job includes such tasks as: working safely with solar hot water and pool heating systems; identifying systems and their components; adapting a system design; conducting a site assessment; installing solar collectors; installing water heater and storage tanks; installing piping, pipe insulation and connecting system piping; installing mechanical/plumbing equipment and other components; installing electrical control systems; installing operation and identification tags and labels; performing a system check out; and maintaining and trouble-shooting a solar thermal system. SDHW systems requiring electrical wiring require a qualified electrician.

An experienced applicant with two years experience in SDHW systems or an accredited plumber could complete a roof/fall safety workshop, a course offered by a qualified manufacturer, CanSIA or other training institution and successfully complete a written examination to obtain the certificate. Workshops are also held to provide the cognitive skills required to install SDHW systems. The workshop is an approved training course for the CanSIA Canadian Solar Domestic Hot Water System Installer Certification Program.

[24] *Preliminary Report on Ontario IPSP*, DENA, German Energy Agency, July 31, 2008.
[25] http://www.cansia.ca/Default.aspx?pageId=143389

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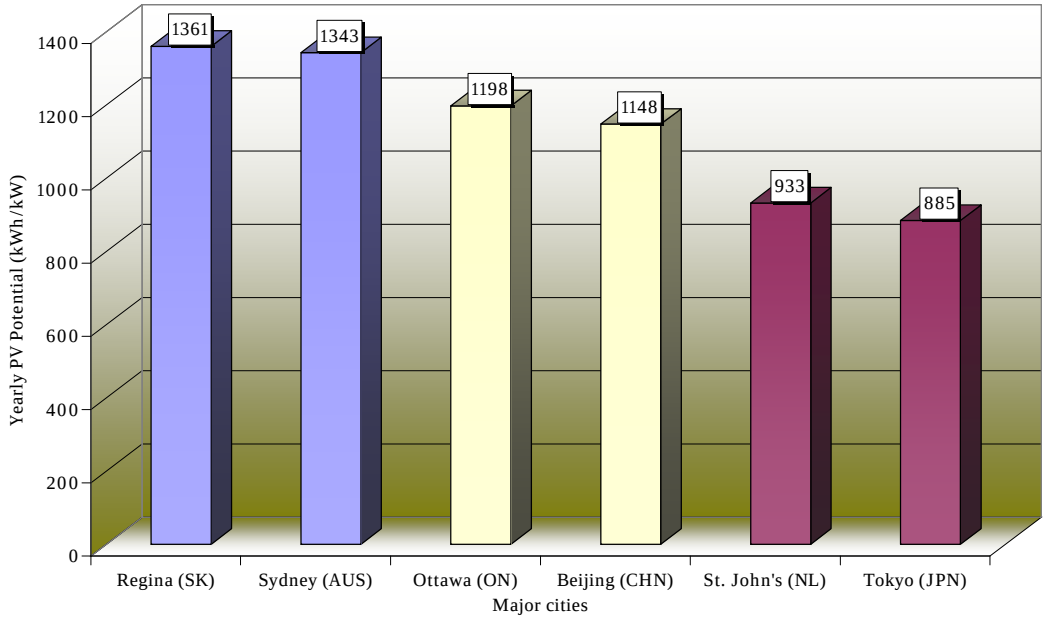
D. Factors Conducive to Growth of Solar Energy in Canada

The Canadian solar industry is facing the same drivers that are behind the outstanding growth of solar energy among our trading partners, specifically, international focus and action on climate change, energy security, demand for improved air quality, technological advances, and energy deregulation.[26] Several factors are conducive to growth of solar energy in Canada. For example, some Canadian cities have solar potential comparable to some sunny parts of the world (Exhibit 11).

Exhibit 11
Solar Potential of Canadian Cities Compared to Other Parts of the World[27]



The solar industry in Canada has shown growth over the last 8 to 10 years in the PV and ST segments; however, it is lagging behind other industrial nations and trading partners. Recently there has been more optimism in the solar industry. This is because Canadian manufacturers of PV cells and modules are expecting to produce to near capacity and have significant export potential. Grid connect is becoming a reality while consumer awareness of the advantage of solar power and solar water heating and solar air heating and cooling is on the rise. The strength of the Canadian dollar affects the domestic industry either positively (when it is high) or negatively (when it is low). Consumer awareness and acceptance has a positive impact on the industry. Both consumers and commercial organizations are more interested in alternative sources of energy due to the uncertainties surrounding traditional energy sources. The retail and installer market in Canada is well established and there are commercially sound operations offering reliable

[26] Solar Energy Technologies, Industry Canada, http://www.ic.gc.ca/epic/site/rei-ier.nsf/en/nz00112e.html
[27] "The Potential for Solar PV Power In Canada" – CanSIA/NRCan PV Forum, CanSIA, 12 February 2008.

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services to customers before, during and after installation. DENA, the German Energy Agency in its report to CanSIA lists factors responsible for growth of PV in any country[28]:

- PV is a clean and quiet technology and when used as an alternative energy source; it can, thereby, reduce greenhouse gas emissions and contribute to a cleaner environment;

- The costs of PV production have come down and will continue to go down further because of the economies of scale; Germany is a good example;

- Solar energy offers many economic advantages, for example in Germany, the domestic economic activity from the growth of the PV industry installations and operations resulted in regional prosperity, new and challenging jobs and higher quality of life;

- Growth in solar industry spurs investment and creates new business models involving both public and private sector funds;

- Consumer awareness is on the rise everywhere and "going green" is a major trend; people tend to be visibly proud of an environment saving feature such as a solar roof while they do well for themselves through cost savings;

- Grid connectivity is increasing the demand for PV; the Suzuki foundation for example, states that grid connected PV capacity of 13,778MW is feasible by 2025 in just the province of Ontario provided there are appropriate legislative and policy frameworks;

- It is expected that through appropriate planning, PV can reduce peak load and thus allow for savings because it does not need investment in transmission lines and new plants.

The recent introduction of government support for solar energy as demonstrated by the Renewable Energy Standard Offer Program (RESOP) program in Ontario is also a factor in favour of market penetration of PV. The ecoENERGY for Renewable Heat program is a $36 million investment over 4 years aiming to provide incentives to industrial and commercial establishments and institutions to use renewable solar thermal energy. By 2011, it is expected to promote solar thermal energy in 700 organizations.[29] Incentives in the area of solar water heating comes from projects like Natural Resources Canada's (NRCan's) ecoENERGY ST pilot project with a funding of $9 million to test various large-scale strategies for deploying solar water heating systems in the Canadian residential sector. The goal of the pilot is to determine the most efficient and effective

[28] *Preliminary Report on Ontario IPSP*, July 31, 2008.

[29] ecoEnergy for Renewable Heat, http://www.ecoaction.gc.ca/ecoenergy-ecoenergie/heat-chauffage/index-eng.cfm

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ways to market solar water heaters to homeowners. Over 8000 deployments in solar water heating is expected to occur and will help toward achievement of Canada's climate change mitigation and clean air objectives.[30]

One can expect Canada to have a much higher rank in annual PV power sold for domestic consumption if factors promote the sustainability of the industry. Availability of government support, raw materials, technically qualified professionals, semi-skilled tradesman involved in various nodes of the supply chain, collaboration from utilities and awareness and acceptance of customers in both industrial and residential sectors will accelerate growth. With increase in volume of installed solar power, the price of solar energy will come down thus making it financially viable. For Ontario, the study by DENA states: " In particular with respect to solar PV, we are proposing a road map that targets both, grid parity and power sector aspects, and the build-up of a local manufacturing industry that will be globally competitive."

E. Barriers to Solar Energy in Canada

A major barrier to the growth of solar energy in Canada (PV and ST) is the absence of a unified national roadmap. The provinces have their own approaches and level of priority given to solar energy. There are no explicit targets to be reached. The growth in solar energy happens in spurts based on global dynamics; as a result, there is no strategic plan to mobilize resources for the industry, especially human resources. Training and education of people to enter careers in solar technologies are not accorded high priorities. The marketing of solar energy is not widespread; as a result, consumers are not fully aware of the benefits of adopting solar energy. Barriers also stem from policy and structural problems. The utilities in Canada have not encouraged net metering and until the recent introduction of RESOP by Ontario, there have been no incentives. Even the RESOP program may have administrative barriers, such as cumbersome application processes, inconsistency in local zoning requirements, and connection costs thus discouraging potential operators of small systems from applying.[31] A recurrent barrier discussed for solar PV is the cost barrier. As is the case of most new technologies, the "chicken and egg" dilemma prevails. It is known that for solar power to be affordable, costs have to come down; however, for costs to come down there needs to be a wide scale adoption of solar power. Exhibit 12 shows that although Canada's potential is high enough, the installed power lags behind other nations.

[30] Eco-Energy for Renewable Heat, Solar Water Heating Deployment Pilot http://www.ecoaction.gc.ca/ecoenergy-ecoenergie/heat-chauffage/deployment-miseenoeuvre-eng.cfm

[31] *Supplementary Report on Ontario IPSP*, DENA, August, 2008.

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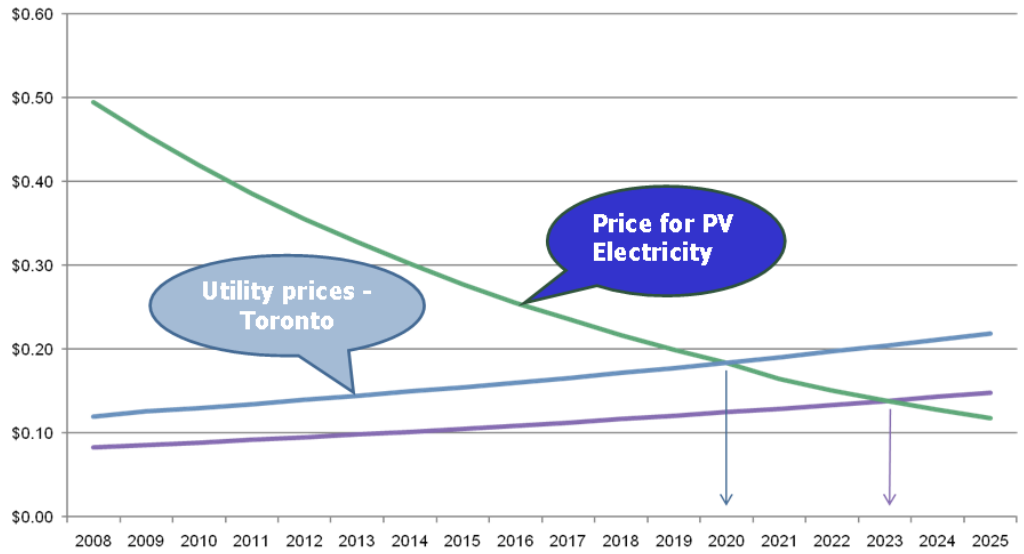
Exhibit 12
PV Potential vs. Estimated Total Installed PV Capacity[32]

	Yearly PV potential (kWh/kW)	Estimated Total Installed PV Capacity (2006) in MW
Canada Average	1150	20
California (San Francisco)	1410	200
New Jersey (Newark)	1220	30
Japan (Tokyo)	885	1700
Germany (Berlin)	848	2500

It is expected that if all factors conducive to growth and sustainability are made available, Canada's installed PV power could far exceed its current installed PV power. The increase in volume will lead toward grid parity. The chart below (Exhibit 13) indicates that if current trends in growth and PV costs are followed, Grid parity will be reached by 2023. This would be much sooner if policy frameworks assist solar power in the near future.

Exhibit 13
Solar PV Technology – Towards Grid Parity[33,34]



The German Energy Agency DENA has undertaken a grid parity analysis with respect to Ontario (Exhibit 14). Two important factors that affect this analysis are the price forecast for electricity in the future and the cost of PV as well. Their analysis also takes into

[32] *The Potential for Solar PV Power In Canada* – CanSIA/NRCan PV Forum, CanSIA, 12 February 2008.
[33] *The Potential for Solar PV Power In Canada* – CanSIA, 12 February 2008.
[34] International Solar PV – CanSIA/NRCan PV Forum, Christopher Cook, SVP Regulatory Affairs and New Markets, CanSIA, 12 February 2008.

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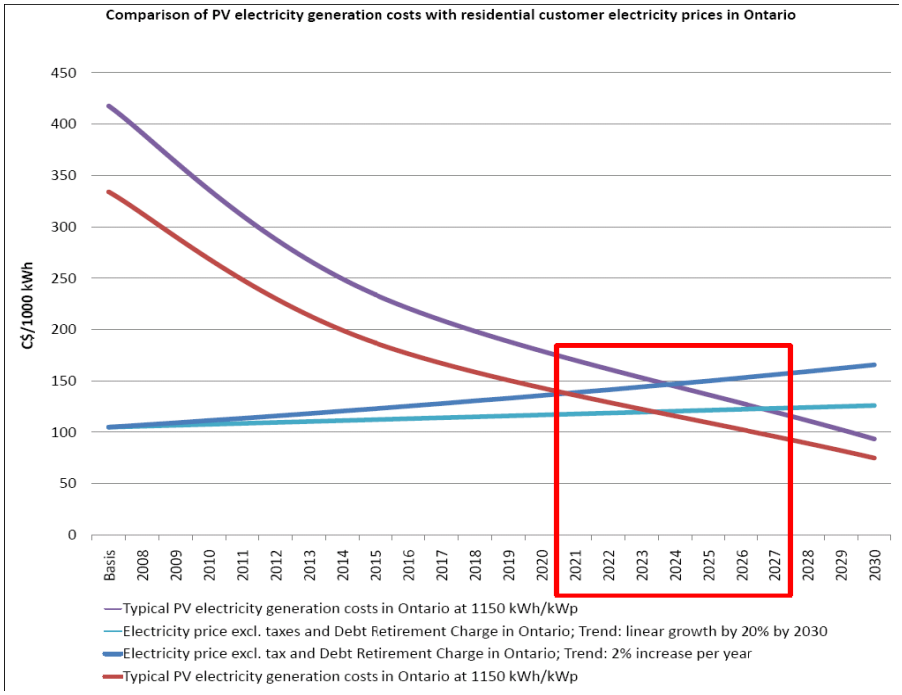
account the type of user e.g., small residential customers, larger volume customers e.g., commercial and institutional, and very large wholesalers. Grid parity will be reached first for the residential customer (2024-2027) and last for the wholesaler (2027-2029). DENA also states that for residential customers, grid parity can be attained even as early as 2022, depending on the price of electricity.

Exhibit 14
Grid Parity Analysis for Residential Customers[35]



F. Summary

This profile of the solar industry indicates that:

- Both the PV and solar thermal collector industries show growth in revenues and installed capacity.
- Export potential is high.
- New manufacturers have arrived on the scene and are showing positive positions in the industry.

[35] Supplementary Report on Ontario IPSP, DENA, August, 2008.

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- Domestic awareness and acceptance is higher although this could be further accelerated through policy and industry association leadership such as that of CanSIA.

- More collaboration between the solar industry and utilities promoted through government incentives would be desirable.

- Improved availability of qualified personnel may attract investment in Canada's PV industry.

- Education and training necessary to meet the human resources needs must be identified and put in place in colleges, universities, apprenticeship programs and other sources.

- Continued R&D in CSP (concentrating solar power) will find less expensive solutions.

- Canada has the opportunity to be the world leader in solar energy.

- If it lets go of this opportunity, it faces the threat of lagging behind the trading partners, high energy prices, inflation, a struggling economy, and a far less "green" and clean Canada.

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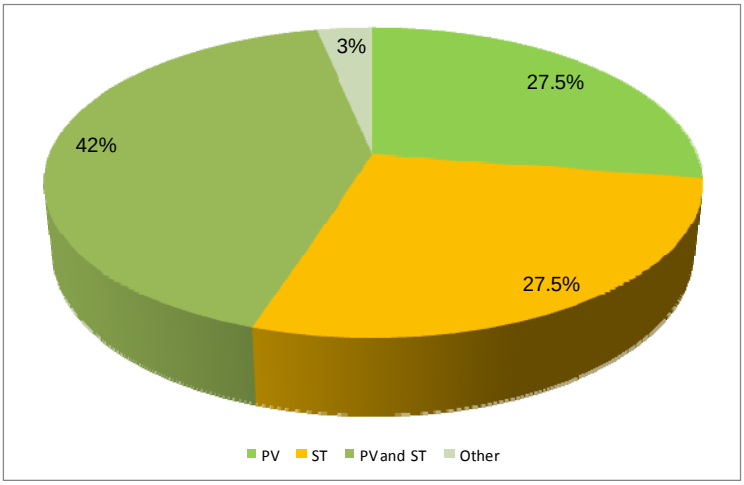
3 Survey Results

A. Industry Segments

As shown in Exhibit 15, the 91 survey respondents represented the PV (Photovoltaic) and ST (Solar Thermal) segments equally. There were 25 respondents (27.5%) from the PV-only segment, 25 (27.5%) from the ST-only segment, 38 (42%) from both the PV and ST segments, and 3 (3%) from other renewable energies.[36]

Exhibit 15
Industry Segments



B. Business Categories

Exhibits 16 and 17 display the business categories represented by the PV segment and ST segment, respectively.

The 63 PV segment companies operate in multiple business categories. The business categories mentioned more frequently were: systems integrator (48%), installer (46%), and dealer/retailer (43%).

[36] The photovoltaic (PV) segment uses technology (solar cells) to convert sunlight directly into electricity. The solar thermal (ST) segment uses technology for harnessing solar energy for thermal energy (heat). Other renewable energies include green energy alternatives such as wind, hydro (water), and biomass, i.e., energy that is produced and used in ways that have relatively less environmental impacts.

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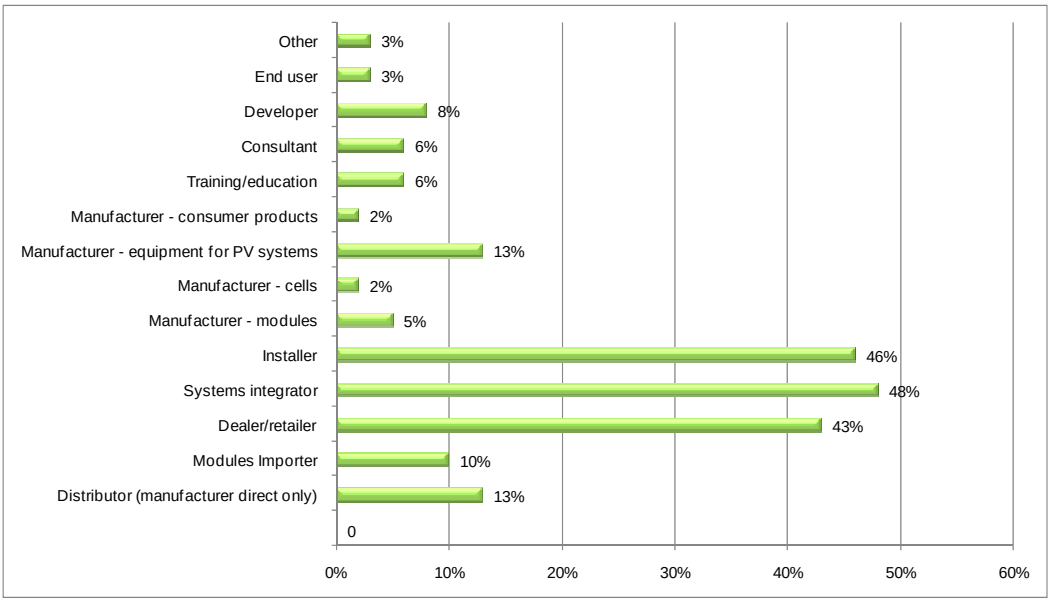
Exhibit 16
Business Categories in the PV Segment



The 63 ST segment businesses also operate in multiple business categories. The business categories mentioned most frequently were installer (62%) and retailer (46%).

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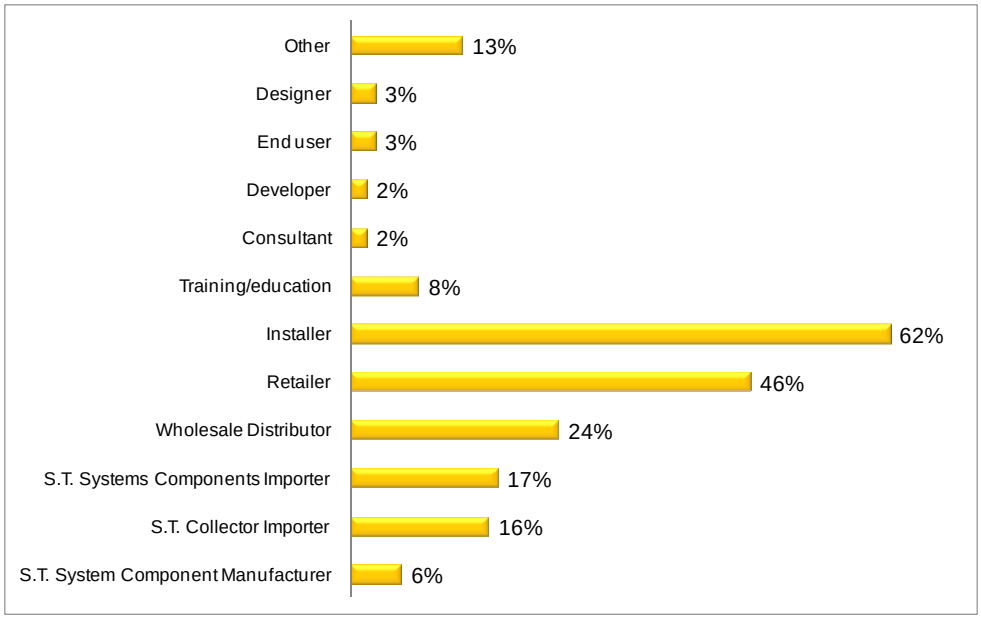
Exhibit 17
Business Categories in the ST Segment

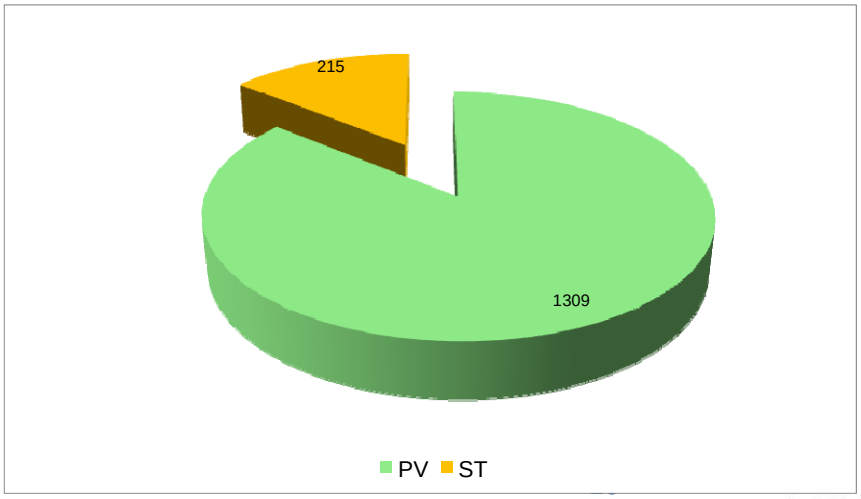


The distribution of business categories in Exhibits 16 and 17 indicate that the installer business category was more prevalent in the ST segment (62%) compared to the PV segment (46%).

C. Number of FTEs in 2008 and Forecast for 2011

The 88 respondents participating in the PV or ST segments reported a total of 1,524 full-time equivalents (FTEs) in 2008. As indicated in Exhibit 18, the PV segment reported 1,309 FTEs while the ST segment reported 215 FTEs.

Exhibit 18
FTEs by PV and ST Segments in 2008



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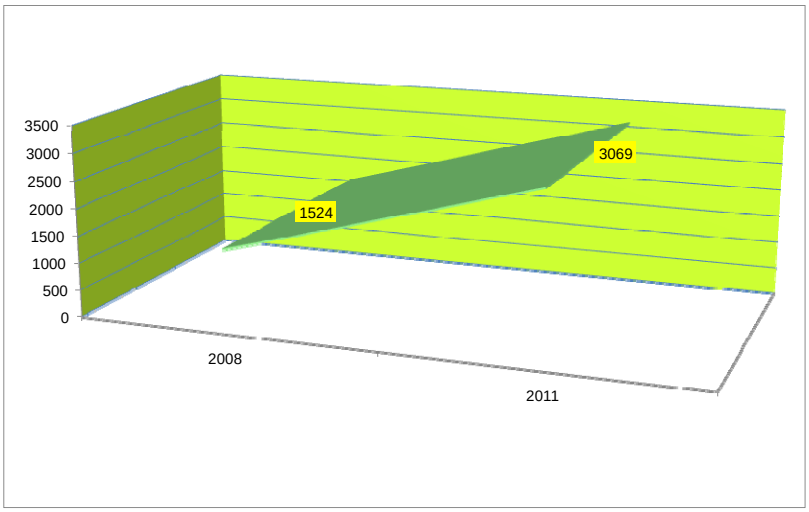
When asked to provide a forecast for the number of FTEs in 2011, the 88 respondents projected an average growth of 101%, from 1,524 FTEs in 2008 to 3,069 FTEs in 2011 (Exhibit 19).

Exhibit 19
Total FTEs Projected for Both PV and ST Segments



D. Workers Engaged in Solar Activities by Functions

Respondents were asked to allocate the total time spent by all workers engaged in solar activities (PV and/or ST) to several functions, including general management, project management, supply management (procurement), warehousing, administration, accounting, legal, technical areas, engineering, research, manufacturing operations, quality control, systems design and integration, sales, installation, etc. Exhibit 20 shows the distribution of FTEs by function in 2008 in the 88 responding companies. Seven functions – manufacturing operations, sales, research, quality control, project management, installation and engineering – accounted for 65% of the FTEs in 2008.

Comparing the distributions between the PV and ST segments, the functional split of FTEs was similar (less than 5% difference) across most functions. However, installation was very high in the ST segment (19%) compared to the PV segment (5%). Other areas of difference are quality control (9% in PV versus 3% in ST) and research (11% in PV compared to 5% in ST). Exhibit 21 provides a comparison of the distribution of FTEs by functions in the PV and ST segments, respectively.

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Exhibit 20
Distribution of FTEs by Functions (PV & ST segments)

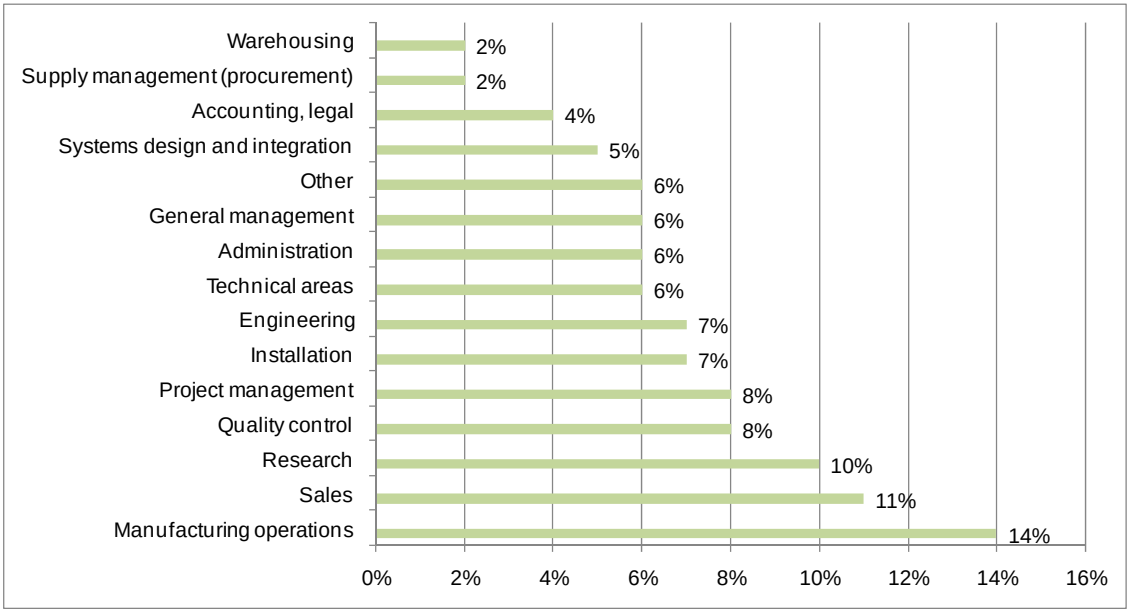
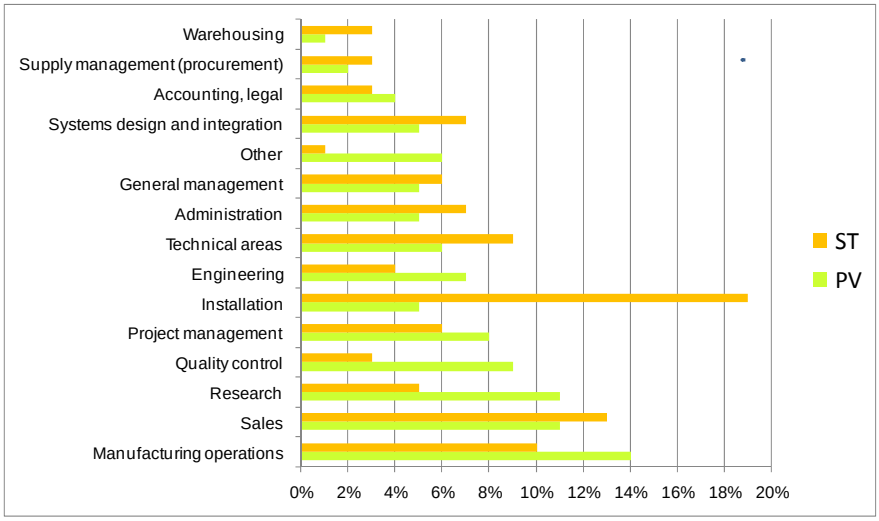


Exhibit 21
Comparison of Distribution of FTEs by Functions in the PV and ST Segments



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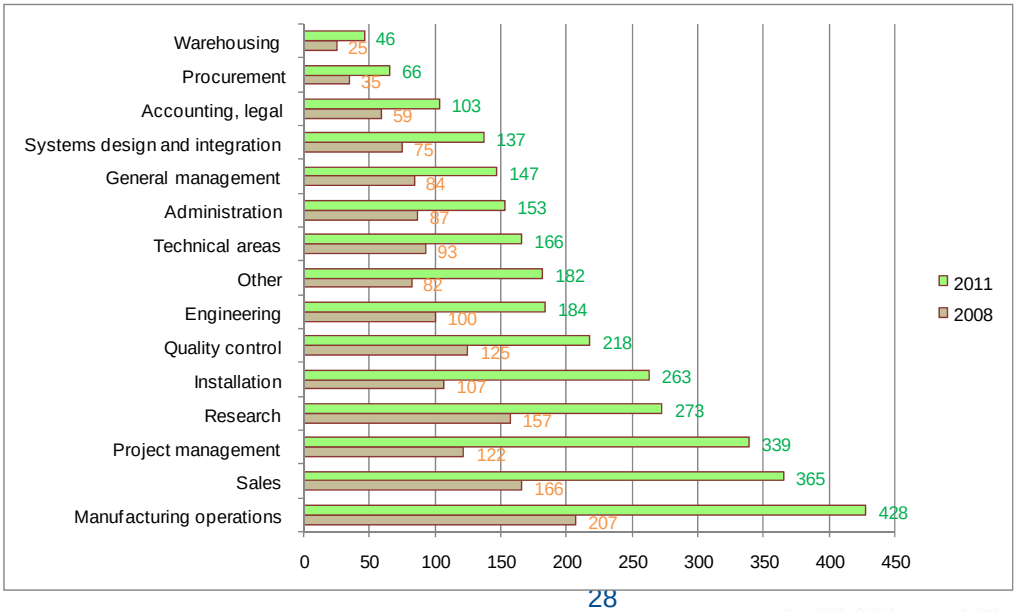
Functions	PV	ST
ST Manufacturing	14%	10%
Sales	11%	13%
Research	11%	5%
Quality control	9%	3%
Project management	8%	6%
Installation	5%	19%
Engineering	7%	4%
Technical areas	6%	9%
Administration	5%	7%
General management	5%	6%
Other	6%	1%
Systems design and integration	5%	7%
Accounting/legal	4%	3%
Supply management	2%	3%
Warehousing	1%	3%

Companies were asked to look ahead 3 years (i.e., to December 2011) in order to project how much growth (or decrease) in the number of FTEs they expect to see in each function. Exhibit 22 shows the distribution of FTEs by functions in 2008 versus 2011.

Exhibit 22
Comparison of Distribution of FTEs by Functions in 2008 versus 2011



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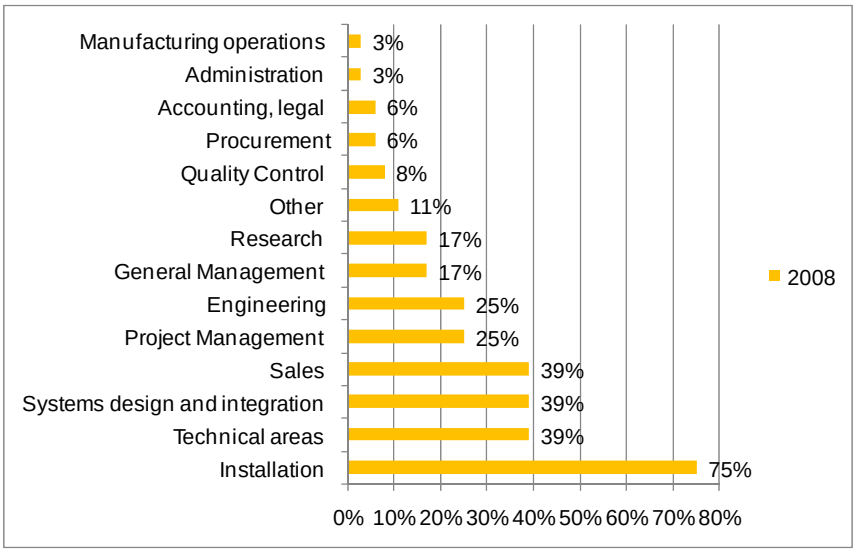
Companies are projecting the highest growth rate over the next 3 years for the project management function (178% growth, from 122 in 2008 to 339 in 2011). The other functions expected to see a very high growth rate are installation (146%), from 107 in 2008 to 263 in 2011, followed by sales (120%) and manufacturing (107%).

E. Shortages of Appropriately Qualified Personnel in 2008

Respondents were asked if they were currently experiencing any shortages of qualified personnel with the requisite skills in the PV and/or ST area. Of the 88 respondents, 36 (41%) stated that they were currently experiencing a shortage. Those companies that were experiencing a shortage were then asked to check off those functions in which they had experienced a labour shortage in 2008. As shown in Exhibit 23, the main shortages were in: installation (75% of 36 respondents), followed by technical areas (39%), systems design and integration (39%), sales (39%), project management (25%), and engineering (25%).

Exhibit 23
Functions Experiencing Shortage of Appropriately Qualified Personnel in 2008



Companies were then asked if they anticipate shortages in the number of qualified personnel over the next 3 years. The number of companies anticipating shortages in 2011 rose to 45 (51%) compared to 36 (41%) in 2008. Respondents were then asked to check those functions in which they anticipate a shortage in 2011. As shown in Exhibit 24, most (78%) of the 45 respondents anticipate a shortage of appropriately qualified personnel in the installation function. This is followed by systems design and integration (51%), project management (40%), engineering (40%), sales (38%) and technical areas (36%).

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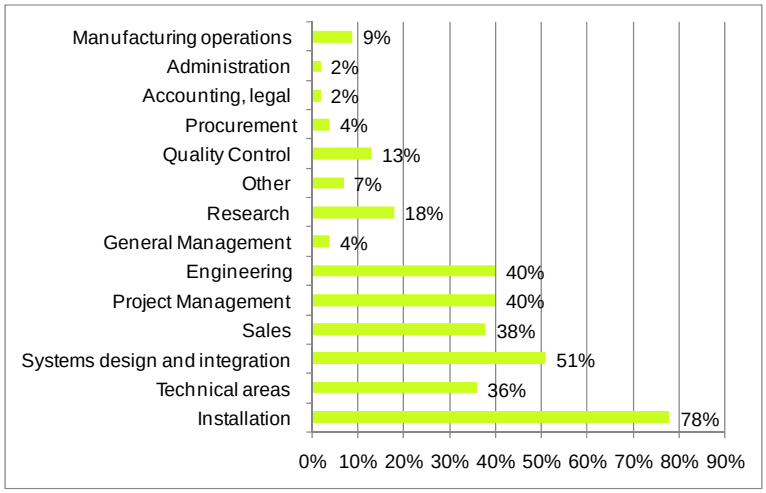
Exhibit 24
Functions Expected to Experience Shortage of Qualified Personnel in 2011



Next, using a 1 to 5 rating scale where 1 means "not all critical" and 5 means "very critical", respondents were asked to indicate how critical the shortage of personnel is to their company's growth over the next 3 years. Over the next 3 years, 51% of 53 respondents to this question considered the shortage to be critical, while one-third (34%) were neutral and only 15% did not think that the shortage was critical (Exhibit 25).

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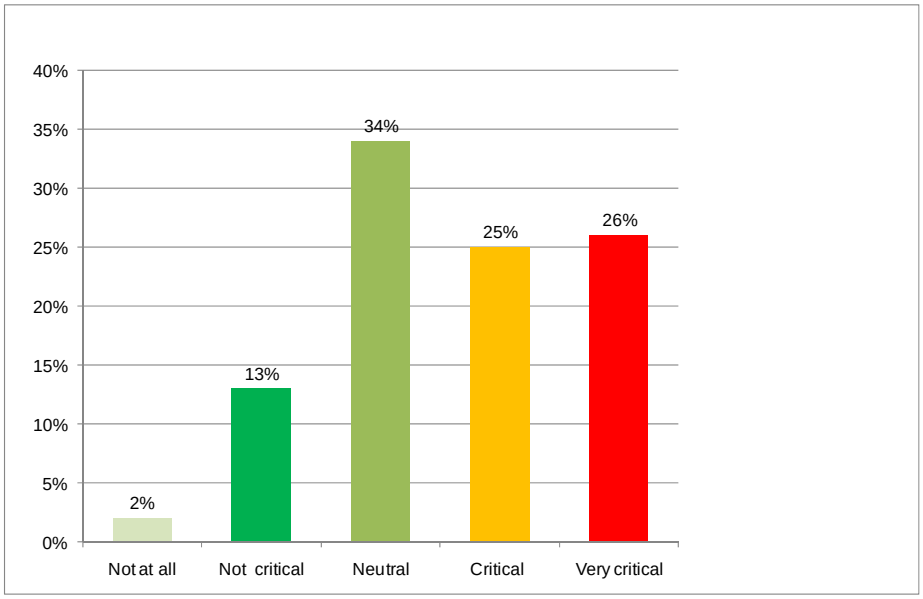
Exhibit 25
Extent to Which the Shortage of Personnel is Critical over the Next 3 Years



F. Suggestions for Policies and Programs to Address Shortage

Respondents were asked to provide any suggestions for policies and programs that could be developed by industry, government, and/or the education sector to address the shortages of qualified personnel facing the solar industry. A total of 54 respondents offered suggestions. Exhibit 26 lists the main suggestions. The suggestion to add solar studies in the technical and professional curricula at colleges and universities and the suggestion to promote a high quality, standardized, nationwide certification program for installers received the highest number of mentions (24% each). About 19% of the respondents suggested that the government should have a consistent, long-term policy to promote the solar industry and stimulate the market prior to considering an HR policy. Other suggestions included introducing solar certification to other trade certifications such as plumbers, electricians, etc. (15%), encouraging apprenticeship programs at trade and management levels (9%), government providing direct incentives for apprenticeship programs (6%), and retraining of dislodged workers from other industries with similar skill sets (3%).

Exhibit 26
Unprompted Suggestions for Policies and Programs to Address Shortage

Training at Tech Colleges and Universities	24%
National Certification Program for installers	24%
Government incentives to promote market	19%

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Solar certification to be added to other trades (electricians,	15%
Apprenticeship programs at trade and management levels	9%
Government incentives for apprenticeship	6%
Retraining of dislodged trades people	3%

Respondents were asked to indicate their level of agreement with several statements using a 1 to 5 scale, where 1 meant "strongly disagree" and 5 meant "strongly agree." The results are provided in Exhibit 27 for the statements receiving a mean agreement rating of 3.8 and above on the rating scale.

The results show that the following four statements had the highest level of agreement:

1. Incorporating solar energy technologies and research in the technical and engineering curricula of colleges and universities.

2. Encouraging apprenticeship programs in technical areas.

3. Providing a Canadian certification program for ST installers.

4. Providing a Canadian certification program for PV installers.

The above statements were mentioned by the respondents frequently in their unprompted suggestions (see Exhibit 26). The other suggestions that also received a high degree of support were:

5. Encouraging project management programs in colleges and universities to include practical training with Renewable Energy firms.

6. Ensuring that the growth in Solar Industry is supported by adequate human resources.

7. Introducing apprenticeship programs for management students to work with the solar industry firms.[37]

8. Including Solar Hot Water or PV installation with other trade certification programs.

[37] The conventional definition of apprenticeship as paid work-based training combined with post-secondary education leading to a certified journey person was broadened in the survey The questionnaire used the term "apprenticeship" in a broad context, to include management students e.g., it probed on whether apprenticeship programs for solar energy should be encouraged in management areas.

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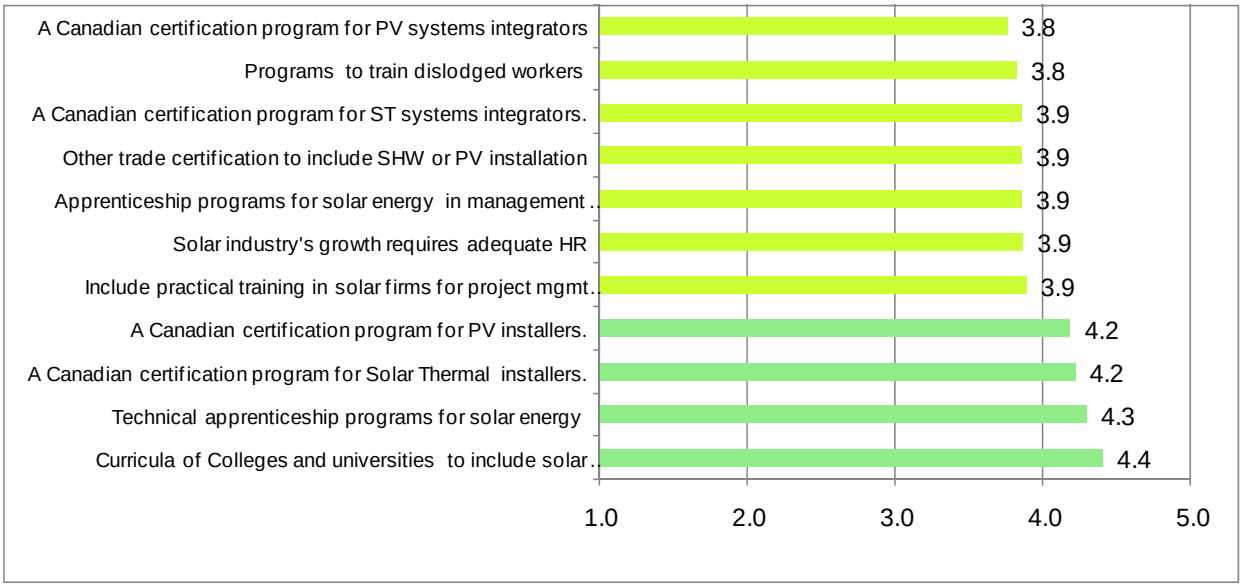
9. Providing a Canadian certification program for Solar Thermal system designers and integrators.

10. Training dislodged workers from other industries in Solar Thermal.

11. Providing a Canadian certification program for PV systems integrators.

Exhibit 27
Statements with High Level of Support (mean ratings on 5 point scale)



G. Implications of the Survey Results

In terms of policy programming it appears that two types of initiatives have to be implemented to fulfil the major industry needs for qualified personnel:

1. Initiatives aimed at curricula changes, i.e., inclusion of solar studies and technologies at the university and college levels. This initiative should also address apprenticeship for project management and technical areas.

2. A nationwide, standardized Canadian Certification program of high quality that would be widely accepted by the industry for both PV and ST installers.

1. Curricula Changes and Apprenticeships

This initiative would address the needs of the industry, specifically, those of manufacturers that are looking for qualified personnel in research, engineering, quality control and project management. As a business category, “manufacturer”, was selected by 22% of the PV segment and 6% of the ST segment respondents.

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Manufacturing, research and engineering FTEs come primarily from the manufacturing organizations (32% of FTEs). The growth in manufacturing, research, and engineering is also high. In addition, the respondents projected high growth by the end of 2011 in the project management function (178% from 122 in 2008 to 339 in 2011). Manufacturing operations related functions were expected to grow 107%. In terms of shortages in 2011, engineering was mentioned by 40% of respondents, project management by 40%, and research by 18%. The results suggest that research and engineering should receive focus in the university and college programs. Secondly, manufacturing companies will also need quality control and project management capabilities. These needs could be met by including apprenticeship in solar companies as part of university and college management and engineering programs.

2. A Nationwide Certification Program for Installers in PV and ST

This initiative would address the shortage for installers currently experienced by the industry and which is expected to be accentuated by 2011. Installer, as a business category, was mentioned by 46% of the PV segment respondents and 62% of the ST segment respondents. The installation FTEs are projected to grow at a high rate to 2011 (146%). In terms of shortage of qualified personnel now and in 2011, installation was mentioned by 75% of 36 respondents, and 78% of 45 respondents, respectively.

Certification of PV and ST installers is a major issue and was rated next to curricula changes in colleges and universities and apprenticeship programs in technical areas. A national certification program with high standards for installers was also mentioned in the unprompted suggestions.

Exhibit 28 shows the results of the answers provided by 46 respondents to the question: “How does your company currently train its installers?” It is noted that of the 36 respondents, 72% used CanSIA’s solar hot water (SHW) system certification. These were all from the ST only and ST mixed segments. A detailed table is provided in Appendix B, which provides the split between, PV only, ST only and the mixed segments. The table shows that 81% to 85% of the ST segment respondents use the CanSIA training program for SHW.

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Exhibit 28
Current Training Sources for Installers

Training Sources for Installers	Number of Companies	Percent
CanSIA Solar Hot Water System Certification	33	72%
Manufacturer's/Distributor's Product Training	31	67%
In-house training programs	25	54%
Apprenticeship at your firm	23	50%
College training programs in solar (PV/ST)	10	22%
Certification in solar hot water as part of another trade	7	15%
Apprenticeship at another organization	2	4%
Other	2	4%
Total	**46**	**100%**

The CanSIA SHW certification is used by many companies involved in ST technologies. The question is, how could this become a more robust, nationwide certification program?

It appears that there is a definite need for a Canadian certification program similar to the NABCEP for PV installers.[38] Currently, training for PV installers appears to be via manufacturer and distributor training (Appendix B). The question is how to implement a nationwide, high quality standardized certification program for PV installers? Would the NABCEP model be of any use? Who should offer this certification? These are questions for further examination by CanSIA and the Electricity Sector Council.

[38] North American Board of Certified Energy Practitioners (NABCEP)Web site, http://www.nabcep.org/

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H. A Final Note

The bullish predictions for labour growth in the solar industry reported by survey respondents were made despite the fact that the survey was conducted in October/November 2008 as a severe global economic downturn was commencing. The positive outlook of the industry may be due to the fact that beyond the current economic crisis situation, the outlook for the solar industry is positive. The "Coming of Cleantech," a report published by Merrill Lynch in November 2008, states that a sixth revolution will be initialized by "cleantech" technologies.[39] Factors such as rising energy costs (despite a temporary decrease in the price of oil), increasing demand for energy, need for energy independence and security, as well moderate global warming are the prime reasons. And with the arrival of President Obama in early 2009, the political environment for green technologies also looks encouraging in the U.S.

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[39] "The Sixth Revolution: The Coming of Cleantech", Merrill Lynch, November 17, 2008.

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Appendix A – Survey Questionnaire

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The Electricity Sector Council and the Canadian Solar Industry Association (CanSIA) together have launched an important initiative to examine the labour market trends and issues facing the Canadian solar industry.

The Electricity Sector Council is assessing available labour market information as part of a three-year project to build a comprehensive database of human resources figures, trends and influences. CanSIA wants to ensure that appropriate education and training programs will be in place to support the industry in the years to come.

As a first step, Kelly Sears Consulting Group, in partnership with the survey firm, Elemental Data Collection Inc., is conducting this online survey of human resource trends and issues in the Canadian solar industry. **For the survey results to be accurate and useful, it is important that your company participate in this study.** All individual company data will be held in confidence by Kelly Sears and Elemental Data Inc. and only aggregate information will be published.

The results of this study will be presented at the CanSIA industry conference to be held in Toronto in December 2008. They will also be highlighted on the Electricity Sector Council's Labour Market Information website.

A summary of the study results will be emailed to you once the study is completed.

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Introduction

Thank you for agreeing to complete this solar industry survey. The purpose is to identify the human resource needs of the solar industry, specifically, to identify the areas in which people with requisite skills are not available today or may become unavailable in the short- to medium-term.
This survey will take approximately 15 minutes to complete.
If you experience any technical problems with the online questionnaire, please contact: _____
If you have any questions about the study itself, please contact any of the following:

Michelle Branigan Senior Project Manager Electricity Sector Council Ottawa	Elizabeth McDonald Executive Director CanSIA Ottawa	Garry Sears Managing Director Kelly Sears Consulting Group Ottawa

Business Profile and Employees of Your Company

1. In which of the following business segments does your company operate? Select all that apply:

- Photovoltaic (PV) ☐
- Solar Thermal (ST), which includes solar hot water heating, solar air heating/cooling, and solar pool heating ☐
- Other renewable energy ☐

2. ASK IF PV SELECTED IN Q.1: If you operate in the PV segment, in which of the following business categories is your company active? Select all that apply:

Business Categories-PV	
a. Distributor (manufacturer direct only)	☐
b. Modules Importer	☐
c. Dealer/retailer	☐
d. Systems integrator (click here for a definition)[40]	☐

[40] Systems integrators design and sell complete photovoltaic systems for use in buildings or solar power plants, e.g., solar power air conditioner systems, power generation systems, power measurement and control systems. Systems integrators also install panels/modules.

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e. Installer	☐
f. Manufacturer – modules	☐
g. Manufacturer – cells	☐
h. Manufacturer - inverters/power conditioners	☐
i. Manufacturer - storage batteries	☐
j. Manufacturer – controllers	☐
k. Manufacturer – equipment for PV systems	☐
l. Manufacturer – manufacturing and test equipment	☐
m. Manufacturer – consumer products	☐
n. Producer – solar grade silicon	☐
o. Other, please specify: _____	☐

3. ASK IF ST SELECTED IN Q.1: If you operate in the Solar Thermal segment (including solar hot water heating, solar air heating/cooling, and solar pool heating), in which of the following business categories is your company active? Select all that apply:

Business Categories-ST	
a. S.T. Collector Manufacturer	☐
b. S.T. System Component Manufacturer	☐
c. S.T. Collector Importer	☐
d. S.T. Systems Components Importer	☐
e. Wholesale Distributor	☐
f. Retailer	☐
g. Installer	☐
h. Other, please specify: _____	☐

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4. How many people, as measured by the number of "full-time equivalents" (FTEs), are currently engaged in solar-related activities (PV or ST) in your company? Please include employees, seasonal workers and contractors in your count. For the definition of an FTE, click here [41].

Total number of FTEs in 2008: _____

5. Looking to the future, how many people, as measured by the number of full-time equivalents, do you expect will be engaged in solar-related activities three years from now?

Total number of FTEs in 2011: _____

6. ASK IF BOTH PV and ST selected IN Q.1: If you are operating in both the PV and ST segments, please provide a breakdown of total FTEs (in 2008) by segment:

- PV _____
- ST _____
- TOTAL FTEs _____ INSERT TOTAL FTEs FROM Q. 4.

7. Please allocate the total time spent by all workers engaged in solar activities (PV and/or ST) to the following functions. (Note: In a small company, one person typically performs many functions; we are interested in the percentage of total time spent on each function).

Functions	**% of Total FTEs**
a. General Management	
b. Project Management	
c. Supply management (procurement)	
d. Warehousing	
e. Administration	

[41] **Definition of Full-Time Equivalents (FTEs):** *The term "full-time employee equivalent" (FTE) is a way of measuring the number of people who work in an organization. An FTE of 1.0 means that the person is equivalent to a full-time worker, while an FTE of 0.5 means that the worker is only half-time. FTE is defined as the number of total hours worked divided by the maximum number of compensable hours in a work year. For example, if the work year is defined as 2,080 hours, then one worker occupying a paid full-time job all year would consume one FTE. Two people working for 1,040 hours each would consume one FTE between the two of them.*

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f. Accounting, legal	
g. Technical areas	
h. Engineering	
i. Research	
j. Manufacturing operations	
k. Quality Control	
l. Systems design and integration	
m. Sales	
n. Installation	
o. Other, please specify: _____	
TOTAL	100%

Employment Needs and Anticipated Gaps in Supply of Qualified Personnel

8. Looking ahead 3 years (i.e., to December 2011), how much growth (or decrease) in the number of FTEs do you expect in each function? Please estimate total growth in percentage terms. For example, if you expect that your FTEs in 3 years will be twice as many as today for a particular function, the growth would be 100%; on the other hand, you may anticipate no growth and then it would be 0%; or, if you think it will be lower for certain functions, then insert a negative percentage (e.g., -20%).

Functions	**FTE Growth(decrease) in % to December 2011**
a. General Management	
b. Project Management	
c. Supply management (procurement)	
d. Warehousing	

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e. Administration	
f. Accounting, legal	
g. Technical areas	
h. Engineering	
i. Research	
j. Manufacturing operations	
k. Quality Control	
l. Systems design and integration	
m. Sales	
n. Installation	
o. Other, please specify: _____	

9. Is your firm currently experiencing any labour shortages in appropriately qualified personnel with the requisite skills in the PV and/or ST area?

☐ Yes ☐No

10. ASK IF "YES" IN QUESTION 9.

For each of the following functions, select those functions in which you currently have a shortage in supply of appropriately qualified personnel.

Functions	Shortage today?
a. General Management	☐
b. Project Management	☐
c. Supply management (procurement)	☐
d. Warehousing	☐

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e. Administration	☐
f. Accounting, legal	☐
g. Technical areas	☐
h. Engineering	☐
i. Research	☐
j. Manufacturing operations	☐
k. Quality Control	☐
l. Systems design and integration	☐
m. Sales	☐
n. Installation	☐
o. Other, please specify: _____	☐

11. Looking ahead three years from now, do you expect to experience shortages in the number of appropriately qualified personnel with requisite skills in the PV/ST area?

☐ Yes ☐ No

12. ASK IF "YES" IN QUESTION 11.

For each of the following functions, check those functions in which you anticipate a shortage in three years in the supply of appropriately qualified personnel.

Functions	**Shortage in 3 years?**
a. General Management	☐
b. Project Management	☐
c. Supply management (procurement)	☐

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d. Warehousing	☐
e. Administration	☐
f. Accounting, legal	☐
g. Technical areas	☐
h. Engineering	☐
i. Research	☐
j. Manufacturing operations	☐
k. Quality Control	☐
l. Systems design and integration	☐
m. Sales	☐
n. Installation	☐
o. Other, please specify: _____	☐

Shortages and Some Possible Solutions

ASK IF "YES" TO QUESTION 9 or 11.

13. On a scale from 1 to 5 where 1 means "not all critical" and 5 means "very critical", how critical is the shortage of personnel to your company's growth over the next 3 years?

Not at all critical **1**	**2**	**3**	**4**	**Very critical** **5**
☐	☐	☐	☐	☐

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14. Please provide any suggestions you may have for policies and programs that could be developed by industry, government, and/or the education sector to address the shortages of qualified personnel facing the solar industry in Canada:

_____
_____
_____

15. ASK IF" INSTALLER" SELECTED IN QUESTIONS 2 OR 3. How does your company currently train its installers? Check all that apply:

	Training for installers	
a.	College training programs in solar (PV/ST)	☐
b.	CanSIA Solar Hot Water System Certification	☐
c.	Certification in solar hot water as part of another trade certification, such as plumbing	☐
d.	Apprenticeship at your firm	☐
e.	Apprenticeship at another organization	☐
f.	In-house training programs	☐
g.	Manufacturer's/Distributor's Product Training	☐
h.	Other, please specify.....	☐

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16. Finally, on a scale from 1 to 5 where 1 means “strongly disagree” and 5 means “strongly agree”, please indicate your level of agreement with each of the following statements:

Statement	Strongly disagree 1	2	3	4	Strongly agree 5
a. Canadian colleges and universities should incorporate solar energy technologies and research in their curriculum for technical and engineering studies.	☐	☐	☐	☐	☐
b. There should be a Canadian certification program for PV installers.	☐	☐	☐	☐	☐
c. There should be a Canadian certification program for Solar Thermal installers.	☐	☐	☐	☐	☐
d. Other trade certification should include solar hot water installer or PV installer certification, e.g., plumbing and electrician certification, respectively	☐	☐	☐	☐	☐
e. There should be a Canadian certification program for PV systems integrators (click here for a definition)[42].	☐	☐	☐	☐	☐
f. There should be a Canadian certification program for ST systems integrators.	☐	☐	☐	☐	☐
g. Apprenticeship programs for solar energy should be encouraged in technical areas.	☐	☐	☐	☐	☐

[42] Companies that design and sell complete photovoltaic systems for use in buildings or solar power plants e.g., solar power air conditioner system, power generation system, power measurement and control system etc. Systems integrators also install panels/modules.

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Statement	Strongly disagree 1	2	3	4	Strongly agree 5
h. Apprenticeship programs for solar energy should be encouraged in management areas.	☐	☐	☐	☐	☐
i. Our company faces barriers in having apprenticeship programs.	☐	☐	☐	☐	☐
j. Our company already has a successful apprenticeship program in critical areas.	☐	☐	☐	☐	☐
k. The project management program available in colleges and universities should include practical training with renewable energy companies.	☐	☐	☐	☐	☐
l. Immigration should be readily available for qualified personnel to fill labour shortages in the solar industry.	☐	☐	☐	☐	☐
m. Programs should be developed to train dislodged workers for highly-skilled sales and project management positions within the solar energy sector.	☐	☐	☐	☐	☐
n. Without adequate human resources, the Canadian solar industry's growth may be significantly hampered.	☐	☐	☐	☐	☐
o. Our company is already looking into the issue of shortage in personnel with adequate skills and has found some solutions.	☐	☐	☐	☐	☐
p. Our company is aware of the shortage of qualified personnel in certain areas but has not found a solution.	☐	☐	☐	☐	☐

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Statement	Strongly disagree 1	2	3	4	Strongly agree 5
q. Our company has not looked into the issue of possible shortage of qualified personnel in some areas.	☐	☐	☐	☐	☐

Thank you for completing the survey! If you are interested in receiving a summary report from this survey, please provide your e-mail address:

E-mail address: _____

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Appendix B – Current Training for Installers by Segment

Sources of Training for Installers	PV		ST		PV and ST		PV, ST and other renewable energy		Totals	
	#	%	#	%	#	%	#	%	#	%
CanSIA Solar Hot Water System Certification			11	85%	13	81%	9	82%	**33**	**72%**
Manufacturer's/Distributor's Product Training	5	83%	8	62%	11	69%	7	64%	**31**	**67%**
In-house training programs	4	67%	9	69%	7	44%	5	45%	**25**	**54%**
Apprenticeship at your firm	4	67%	7	54%	7	44%	5	45%	**23**	**50%**
College training programs in solar (PV/ST)	1	17%	3	23%	3	19%	3	27%	**10**	**22%**
Certification in solar hot water as part of another trade			3	23%	2	13%	2	18%	**7**	**15%**
Apprenticeship at another organization	1	17%					1	9%	**2**	**4%**
Other	1	17%			1	6%			**2**	**4%**
Totals	**6**	**100%**	**13**	**100%**	**16**	**100%**	**11**	**100%**	**46**	**100%**

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