*FINAL REPORT*

# Oregon Solar Thermal Market Characterization

## Prepared for:
## Energy Trust of Oregon, Inc.

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# Executive Summary

Solar thermal energy systems use collectors to gather heat from the sun to heat water or air for use in commercial or residential buildings. The most common applications are to heat water for domestic purposes or for swimming pools and spas. For more than 20 years the State of Oregon has provided a solar energy tax credit for residences and businesses that install solar thermal energy systems. Over 17,000 residences have received these tax credits since 1978, while 115 businesses have received these credits since 1981. Many systems were installed during the early 1980s when a Federal tax credit was available.

In mid-2003 the Energy Trust of Oregon (Energy Trust) initiated an assessment of the solar thermal marketplace to gauge the market in Oregon and to provide the Energy Trust with information to help design their solar thermal programs. Phase 1 of this assessment included interviews with 17 key informants representing Oregon utilities with solar programs, energy and industry organizations, manufacturers, and installers. We also analyzed Oregon Department of Energy tax credit data for solar water heating systems and conducted a limited web-based review of information on solar water heating systems and programs in Oregon.

In Phase 2 of the assessment, we collected data from recent purchasers of solar water heating systems to better understand their purchase decisions, to gauge satisfaction with their systems, and to draw insights about their characteristics. In early 2004, we conducted 10 in-depth interviews and 135 shorter surveys with households that had received a tax credit between 2000 and 2003. We also interviewed seven of the eleven businesses that had received a tax credit during the same period.

### *Phase 1 Key Findings: Market Characteristics*

Industry experts held these views about the solar water heating market in Oregon:

- **The market is flat** with 200-400 installations per year and no growth in demand in the last ten years.
- **The market is geographically concentrated** in four general areas: Eugene, Medford/Ashland, Bend, and the greater Portland area.
- **A limited number of market players** are concentrated in the few geographic areas listed above. Most installers are small firms that have been in business for many years. No manufacturers of solar equipment are in Oregon.
- **The technology is stable** and has changed little in the last 20 years. Most manufacturers remaining in the market have been in business for many years.
- **Residential retrofits are the primary market**. Some people in the industry see opportunities in new home construction and in a few commercial applications with high water use.

- **Tax credits are important to buyers,** helping to make the systems more economically viable. The state tax credit was crucial to the survival of the solar water heating market in Oregon after the Federal tax credit was removed.
- **Concern for the environment and the desire for energy independence also motivate buyers.**
- **Market barriers are significant.** Compared to conventional water heating systems, many consumers perceive solar water heaters as expensive, complicated, unattractive, and not applicable in many locations.

### *Phase 2 Key Findings: Purchaser Insights*

Key insights from interviews with purchasers of solar thermal systems included:

- **Experience is important.** Purchasers had often known about the technology for many years (10 or more) prior to the purchase of their system.
- **Contractors are the most important information source.** In Lane County, where two local utilities have active solar water-heating programs, purchasers also identified utilities as an important source of information and support.
- **Economic factors motivated businesses to buy their systems,** including reduced energy costs and the Oregon Energy Tax Credit**.**
- **Both economic and environmental factors motivated residential buyers.** In addition to economic factors cited for businesses, homeowners cited environmental benefits as part of their motivation to buy systems, including reducing greenhouse gas emissions and dependence on conventional fuel sources.
- **Only small proportions of residential buyers identified major purchase barriers.** However, findings suggest that system cost, finding a good contractor, and uncertainty about system reliability could be key barriers among less motivated buyers.
- **Buyers are highly satisfied with their systems and with their contractors.** Over three quarters of residential and business buyers were very satisfied with both.
- **Residential buyers saw themselves as both frugal and handy,** allowing them to be motivated by the savings, but not intimidated by the technology.
- **Although most residential buyers said they engaged in pro-environmental behaviors, some did not see themselves as "environmentalists."**
- **Residential buyers tended to be older, well educated, and live in older homes.**
- **Business buyers in our sample were small and locally owned.** Most had swimming pools or high hot water demands such as laundries, showers, or kitchens.

### *Recommendations*

Many of the elements for fostering growth in the solar thermal market exist in some form, but need to be integrated to create a more robust solar thermal industry that both encourages and supports increased demand for solar hot water heating systems. We recommend the following approaches for creating demand for solar water heating systems and developing the solar thermal industry in Oregon.

*Creating Demand*

Creating demand for solar water heating requires both marketing efforts to raise awareness about available programs and educational efforts that give people the opportunities to experience solar water heating and how it works. Hands-on, community based, targeted efforts that build familiarity and trust in the technology are more likely to work than broad informational campaigns. Incentives are also needed to address potential purchase barriers.

- **Marketing:** Marketing messages should balance the practical economic benefits of the systems (savings, frugality) with factual (not overly zealous) environmental benefits. This should allow the materials to appeal both to those who see themselves as environmentalists and those who engage in environmentally supportive behaviors for other reasons (i.e., that they are frugal, handy, or pragmatic). When marketing to businesses, the Energy Trust should work with contractors and business organizations to be sure that the financial information a business owner needs to make a good decision is available.
- **Education:** Education that personalizes the solar water heating experience should be provided through partnerships with community-based education and environmental groups that people know and trust (e.g., local governments, utilities, extension services, neighborhood associations). Examples of experience based education include: displays that actively show systems operate, demonstrations at home shows, tours of existing solar water heating applications, and developing and profiling visible solar applications (particularly for businesses).
- **Targeting:** The research shows that solar water heating system owners are likely to purchase other energy efficient products. Thus, targeting participants in other energy efficiency programs may be a way to reach potential markets for solar water heating. For business applications, any program should first promote systems that are simpler to install, have a lower cost, and provide quicker payback, such as those for pools/spas.
- **Incentives:** Incentives help overcome the relatively high initial costs for solar water heating systems, the barrier that system purchasers most often mentioned. The Energy Trust should continue its incentives to purchasers of solar water heating systems to stimulate demand and should consider low interest loans, particularly for commercial customers.

*Developing the Solar Thermal Market*

The solar thermal industry has served the existing, but limited, market demand well. However, the industry is small and localized and to support any growth in demand it will need to expand while maintaining high quality and credibility. Growing the market will be a delicate balance of bolstering and adding to suppliers and increasing consumer demand. Three factors are likely to support market growth:

- **Standards and Certification:** These are valuable tools for increasing consumer confidence in solar water heating. Equipment standards are in place, utility programs have installation requirements, and a Heating and Cooling Installer License will be required on July 1, 2004 for system installers. As much as possible, the Energy Trust should support efforts by the solar industry to develop and maintain standards and certification programs and should take advantage of these tools in their programs.
- **Training and Support:** While there may be enough installers to serve the current market, more installers will be needed if demand increases. In addition, we found a number of long-time installers who may be nearing retirement. The Energy Trust should work with peer organizations and manufacturers to provide the training and support necessary for new contractors to enter the market.
- **Programs:** The availability of program incentives and other support for purchasers from organizations like the Energy Trust can help existing solar contractors grow and encourage new contractors to enter the market. To best support solar industry growth it is very important for programs to be stable and predictable over the long term.

This report provides a snapshot of the solar water heating market in Oregon, both from those in the solar industry and system owners. The information obtained from key members of the solar industry identifies market characteristics, issues and trends. Owners of solar hot water systems gave us valuable insights into why they purchased their systems, their satisfaction, and some of their personal characteristics. These results contribute to a better understanding of the solar water heating system market in Oregon and provide a sound foundation for further program development at the Energy Trust.

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# 1. Introduction and Approach

In June 2003 Dethman & Associates initiated a two-phase assessment of the marketplace for solar thermal energy systems in Oregon for the Energy Trust of Oregon (Energy Trust). The purposes of Phase 1 were to:

- Gauge the current solar thermal market in Oregon
- Provide information to the Trust to help design their solar thermal programs
- Suggest methods to track this market in the future.

The purposes of the Phase 2 research were to:

- Understand how purchasers made their decisions to install these systems
- Gauge satisfaction with recently purchased systems
- Draw insights from this group that might assist the Trust in supporting expansion of the market for solar thermal products.

### *Description of Solar Thermal Energy Systems*

Solar thermal energy systems use collectors to gather heat from the sun to heat water or air for use in commercial or residential buildings. The most common applications are to heat water for domestic purposes or for swimming pools and spas. Our research focuses on solar water heating systems. In addition to the collectors, most solar water heating systems have a storage tank to store the heated water for use as needed. A conventional electric or gas water heating system provides any necessary additional heating. Other system components depend on the type of solar thermal system used.

Two main types of water heating systems are used in solar thermal systems: active and passive. Active systems use electric pumps, valves, and controllers to circulate water or other heat-transfer fluids through the collectors, and include:

- Direct systems where pumps circulate water through the collectors. These systems are appropriate in areas that do not have freezing temperatures for long periods and do not have hard or acidic water.
- Indirect systems that pump heat-transfer fluids, such as a mixture of glycol and water antifreeze, through collectors. Heat exchangers transfer the heat from the fluid to the water stored in the tanks.
- Drainback systems – a type of indirect system – use pumps to circulate water through the collectors. When the pump stops, the water in the collector loop drains into a reservoir tank providing freeze protection.

Passive solar water heating systems move water or heat-transfer fluid through the system without pumps, and include:

- Integral collector storage (ICS) systems with one or more storage tanks placed in an insulated box with a glazed side facing the sun. During the winter, the connecting piping must be protected from freezing or drained.
- Thermosiphon systems that rely on the natural convection of warm water rising to circulate water through the collectors and to the tank, which is located above the collector. As water in the solar collector heats, it becomes lighter and rises naturally into the tank above. Meanwhile, the tank's cooler water below flows through the pipes to the bottom of the collector, causing circulation throughout the system.

Solar pool water heating systems are typically active systems that are integrated into the existing pool filtration system. Systems used only in the summer can be simple direct systems that are drained at the end of the season. Solar pool water heating systems used year-round or that might be exposed to freezing temperatures need some method of freeze protection.

### *Research Approach*

We conducted the Phase 1 market characterization from June 2003 through September 2003. The approach for this market characterization included:

- A limited web-based review of information on solar thermal systems and programs (see Appendix A for a list of relevant web-sites).
- Analysis of Oregon Department of Energy (ODOE) solar thermal tax credit data.
- Interviews with 17 key market informants, including: representatives from solar programs in utilities and energy and industry organizations (7); manufacturers (3), distributors (1); and installers (6).

Although the scope of this review was limited, we feel the information gathered presents a reliable picture of the solar thermal market in Oregon. The State of Oregon has provided a tax credit (see Appendix B) for residences and businesses that install solar water heating systems for more than 20 years. Since most of those installing solar water heating systems in Oregon apply for a tax credit, this is a good source of data on the systems installed. In addition, our respondents were very experienced and knowledgeable about the solar thermal market and because the market is small, they represent a significant portion of the market players.

Phase 2 of the solar water heating market assessment relies on interviews and surveys conducted in early 2004 with households and businesses that were issued tax credits for their solar water heating system from January 1, 2000 to December 31, 2003. Our sample was designed to be of sufficient size to allow for reliable

estimates to the population of purchasers[1]. Table 1 summarizes the population and completed interviews for the project.

**Table 1. Population, Sample Sizes, and Completed Interviews**

| | Population: Oregon Solar Energy Tax Credit Data | | | | Total | In-Depth Interviews | | Phone Survey | |
|---|---|---|---|---|---|---|---|---|---|
| | 2000 | 2001 | 2002 | 2003 | | Target | Actual | Target | Actual |
| **Residential** | | | | | | | | | |
| Active | 29 | 112 | 89 | 59 | 289 | 3 | 4 | 40 | 50 |
| Passive | 60 | 152 | 54 | 20 | 286 | 3 | 3 | 40 | 45 |
| Pool/Spa | 76 | 128 | 88 | 73 | 365 | 3 | 3 | 40 | 40 |
| Total Res. | 165 | 392 | 231 | 152 | 940 | 9 | 10 | 120 | 135 |
| **Business** | | | | | | | | | |
| Active | 0 | 5 | 4 | 2 | 11 | 7 | 7 | N/A | N/A |

The residential sample was stratified by type of solar water heating system. Pool/spa systems were slightly underrepresented in the final sample while active systems were slightly overrepresented. The distribution of survey respondents approximated the geographic distribution of systems which are concentrated in Bend/Eastern Oregon, Greater Portland Region, Lane County, and Southwest Oregon.

Reaching the business sector presented a challenge. Business tax credits for solar water heating systems are uncommon, with only eleven issued by the ODOE between January 1, 2000 and December 31, 2003. We attempted to reach all eleven cases and were able to complete seven in-depth interviews.

We designed and implemented the survey of households as follows:

1. We conducted ten in-depth interviews by phone to inform development of a more close-ended survey instrument for a larger phone survey
2. Market Trends, a market research firm in Seattle, Washington, conducted 135 telephone interviews (about 15 minutes each) to obtain information from households about their purchase decision, satisfaction, and personal characteristics. The response rate to the phone survey was almost 60%.[2]

The initial in-depth interviews included questions about the purchase decision, satisfaction with the installation and performance of the system, and consumer characteristics (see Appendix C). The purpose of this last group of questions was to develop a better understanding of the attributes of these buyers.

[1] The error range at 95% confidence is $\pm$ 7.8%.

[2] We asked screening questions to be sure the person we were talking to was knowledgeable about their system and whether the household was still operating their solar water heating system. There were six cases that said no, which is four percent of the completed interviews.

The results of these in-depth interviews allowed us to design a more targeted telephone survey questionnaire (see Appendix D). The telephone survey also has a series of questions on the decision to purchase a system, including how long the person has known about solar water heating, sources of information or experience, motivations for purchasing a system, and potential obstacles to the purchase. This is followed by a series of questions on the installation and performance of the system. The last set of questions asks about consumer attributes, such as environmental orientation, tendency to purchase energy efficient products, frugality, sense of self as "handy", and sense of self as an innovator.

The business in-depth interview guide (see Appendix E), like the other interviews and surveys, asks the purchaser about decision-making and satisfaction. It also asks the purchaser for information on their solar systems and about the characteristics of their business that make them a good candidate for a solar water heating system.

Results from Phase 1 of our research may be found in:

- *Section 2, Installation and Cost Trends* presents the information from the solar tax credit data for Oregon on number of installations and costs.
- *Section 3, Market Characteristics* describes the market for solar thermal systems in Oregon including key market players, key market segments, and technology characteristics
- *Section 4, Market Trends and Issues* identifies trends regarding market growth, technology, consumer motivations, market barriers, and opportunities.

Phase 2 results are found in:

- *Section 5, Household Survey* presents the results from the in-depth interviews and telephone surveys of Oregon households that received energy tax credits for solar water heating systems.
- *Section 6, Business Interviews* describes the results of interviews with business owners that received business energy tax credits for solar water heating systems.
- *Section 7, Summary and Recommendations* reviews key findings from our research and offers recommendations for the Energy Trust and other organizations promoting the use of solar water heating systems.

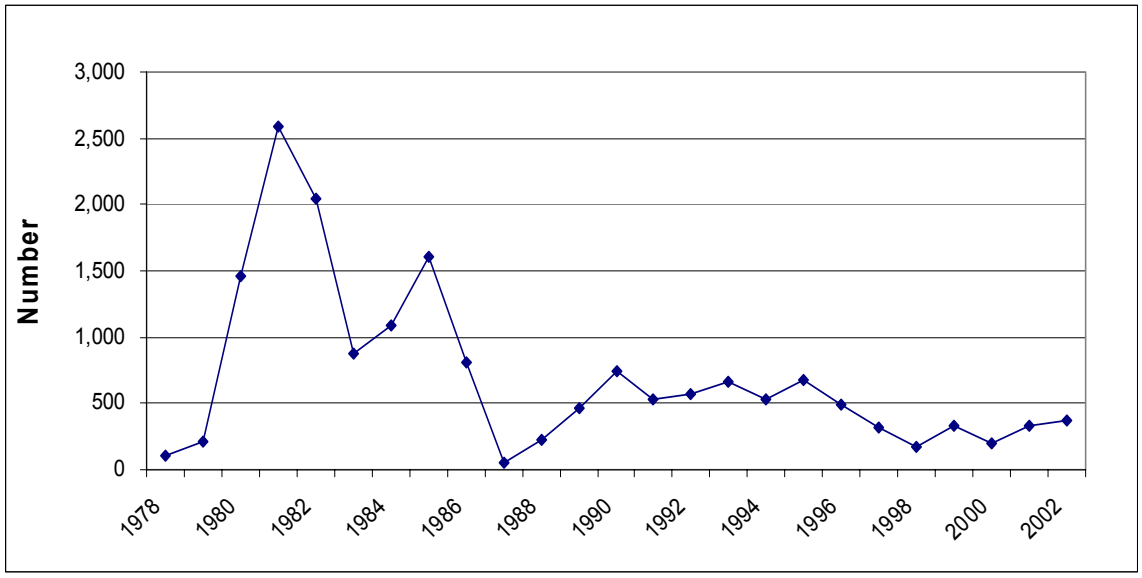
# 2. Installation and Cost Trends

We used data supplied by ODOE from Oregon solar energy tax credit applications to analyze the number, type, cost, and location of the systems installed, as well as the fuel displaced. The tax credit information served as a reliable proxy for all installations.

### *Installations*

The vast majority of solar thermal water heating systems installed in Oregon have been residential systems. Over 17,000 residential systems have received tax credits in Oregon since 1978, including domestic hot water and pool/spa systems (see Figure 1). Many of the systems were installed during the early 1980s when a Federal tax credit was available. The market collapsed in 1987 after the Federal tax credit was removed, but rebounded to around 500 installations per year through 1996. Since then, 200-400 residential solar thermal water heating systems have been installed each year in Oregon.

**Figure 1 Residential Solar Thermal Water Heating System Installation Trends***




*Source Data: ODOE Solar Tax Credit Records

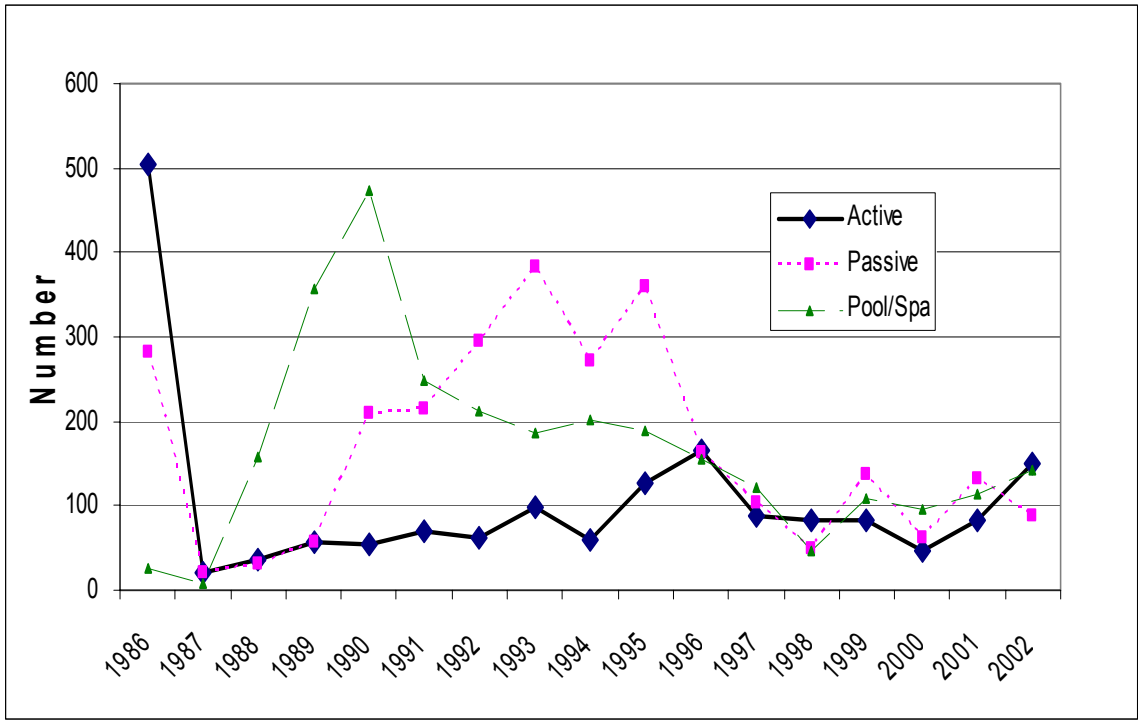
Since 1981, 115 solar thermal water heating systems have received business energy tax credits. In recent years, less than 5 systems have received a tax credit in any given year. Individuals we interviewed in the solar industry confirmed the low number of commercial installations, saying that long system paybacks and high upfront costs keep these systems from being attractive to businesses.

In comparison, just over1,600 residential solar thermal space heating systems have been installed in Oregon since 1978. Like the hot water systems, most were installed in the early 1980s, with only 96 systems installed in the past ten years.

### *Installations by System Type*

Figure 2 shows the trends, since the mid-1980s, for the three types of residential solar thermal water heating installations: active domestic hot water, passive domestic hot water, and pool/spa systems. After the market collapsed in 1987 there was a surge in pool/spa systems, followed by an increase in passive domestic hot water system installations. In the last five years there has been a fairly even mix of active, passive, and pool/spa systems with some evidence of an increase in active domestic hot water system installations in the last couple of years.

**Figure 2. Residential Solar Thermal Water Heating System Installation Trends by System Type***




*Source Data: ODOE Solar Tax Credit Records

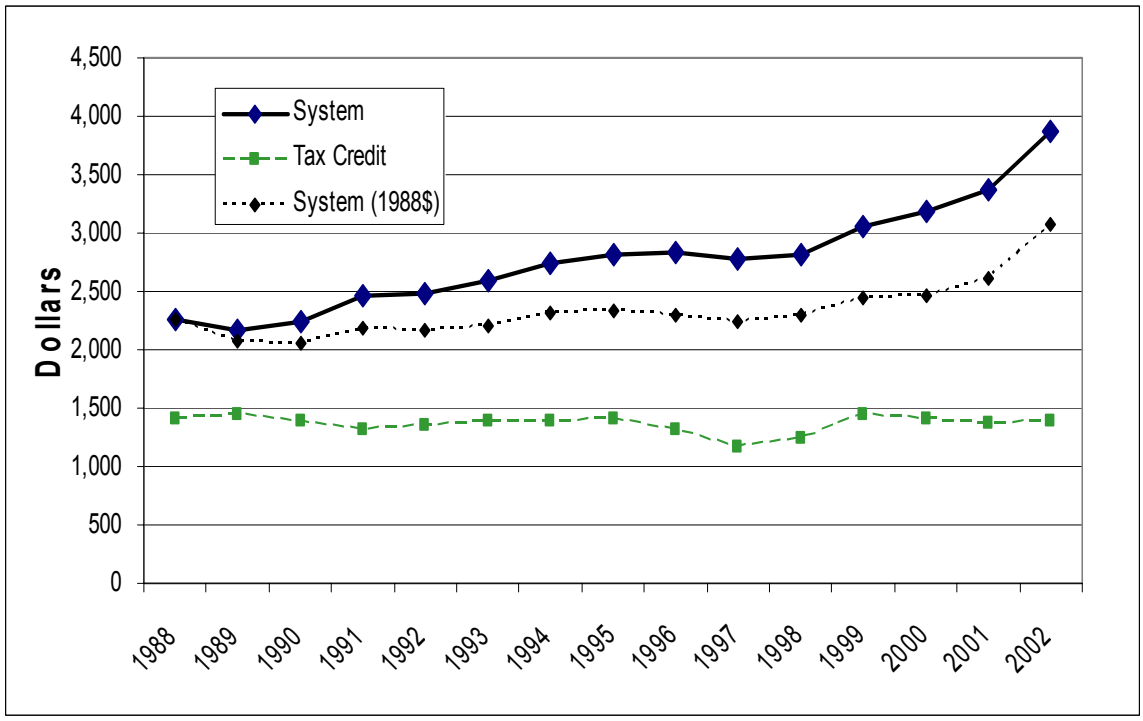
### *Cost Trends*

Residential solar thermal water heating system costs have been fairly stable over the years, showing a modest upward trend (see Figure 3). Note that changes in the average costs shown in the figure can reflect changes in the mix of systems installed as well as overall changes in system costs. Thus the increase in cost in

2002 could be partly due to the larger relative market share of more expensive active systems. Most homeowners receive the maximum tax credit of $1,500, which has not changed, but rising costs mean that the tax credit covers a declining portion of the system costs.

The costs from the ODOE tax credit data are consistent with costs reported by those we interviewed in the solar industry. Solar water heater system costs range from $3500 - $5500, depending on system size and type, and difficulty of installation. Solar domestic water heating systems can be several thousand dollars more expensive than pool systems, generally costing $4,500 to $5,000 for an active system. The solar equipment generally accounts for 60-70% of total system cost and installation accounts for 30 to 40%.

**Figure 3. Residential Solar Thermal Water Heating System Costs and Tax Credit Amount***




*Source Data: ODOE Solar Tax Credit Records

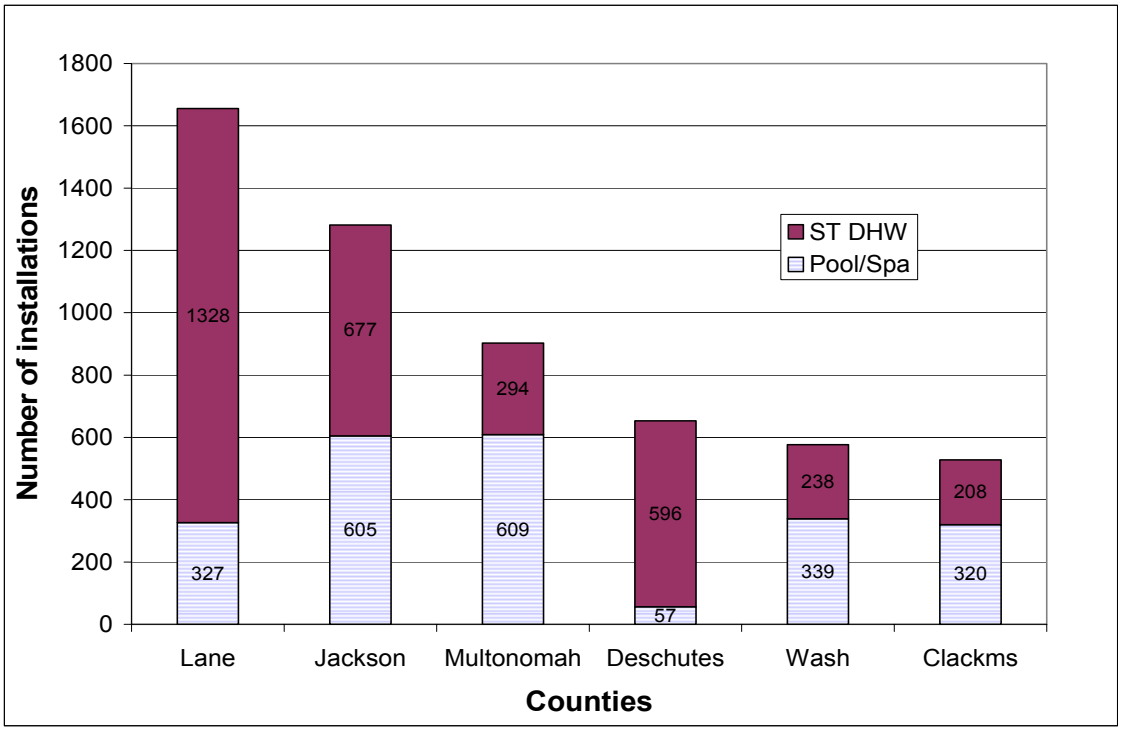
Among the installers and manufacturers interviewed, all but one anticipated that costs would increase over the next 2 and 5 years, in line with, or exceeding inflation, based in part on commodities prices, labor, taxes, and health insurance costs for the small business owner.

### *Installation Locations*

As shown in Figure 4, most installations since 1986 have been in Lane County (Eugene), Jackson County (Ashland/Medford), Deschutes County (Bend), and in

the Portland area (Multnomah, Washington, and Clackamas Counties). The most active market is in Lane County where Emerald Public Utility District (PUD) and Eugene Water and Electric Board (EWEB) operate solar thermal incentive programs.

**Figure 4. Geographic Distribution of Residential Solar Thermal Water Heating Systems, 1986-2003***

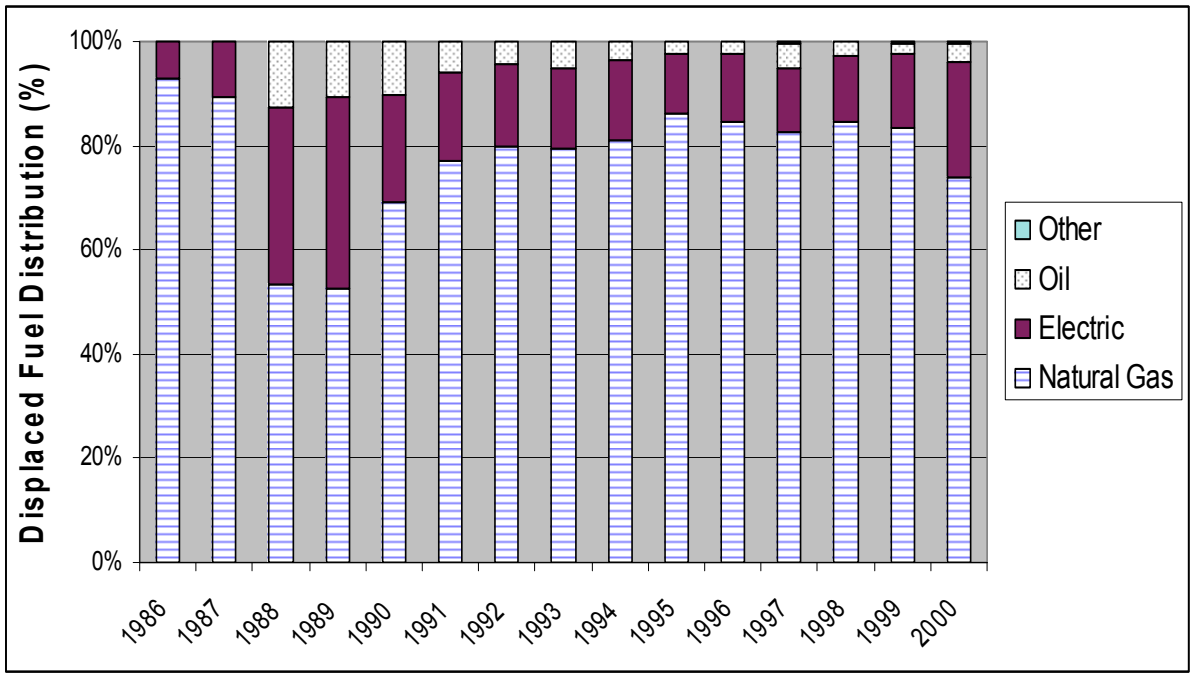



*Source Data: ODOE Solar Tax Credit Records

### *Fuel Displaced*

Figure 5 shows the fuels that residential solar water heating systems have displaced over the years, highlighting that natural gas has been the dominant fuel displaced. During the late 1980s, electricity accounted for a slightly larger share of the fuel displaced. This likely reflects the larger proportion of pool/spa systems installed during that period and that these systems, compared to domestic hot water systems, were more likely to be have been electrically heated.

**Figure 5 Fuels Displaced by Residential Solar Thermal Water Heating Systems***




*Source Data: ODOE Solar Tax Credit Records

# 3. Market Characteristics

Today, the market for solar thermal water heating systems is far different from the burgeoning one that existed in the early to mid 1980s. The installers interviewed for this study, without exception, have all been in the business since the early 1980s and can be regarded as industry survivors. The manufacturers interviewed also have longevity, with at least 15 years of industry experience.

### *Key Players*

Installers, distributors and manufacturers, and utility/state programs are the key players in the Oregon solar thermal water heater market. There are neither retail outlets in Oregon, nor manufacturers.

*Installers*

Based on the ODOE list, only 14 certified solar thermal installers are currently (August 2003) working in Oregon. The six installers interviewed for this research all had 20+ years in the industry and primarily run small, sole proprietorships. A small number have 2-3 employees or use contract labor. Several stated it was no longer profitable for them to install the domestic hot water systems and they were concentrating on pool/spa systems and/or photovoltaics (PV). Others focus on maintenance and repair of solar thermal systems rather than on new installations.

Most installers said they do little active marketing, due to limited time and/or financial resources. Most of their customers come from referrals or yellow pages advertising. Many installers were unsure how many customers had contacted them due to their listing on the Oregon Solar Energy Industries Association (OSEIA) or the ODOE websites. One installer commented that recent conversion rates from leads have been declining due to the poor economy. Those who do actively market solar water heating systems said they use a combination of system type, service, experience and pricing as ways to differentiate themselves in the marketplace.

The business locations of the installers, both interviewed and not interviewed correspond to where installations are concentrated, but active utility programs have also influenced the geographic spread. Most installers said they work only within their territories, but some will travel to other Oregon locations for projects.

*Distributors and Manufacturers*

There are no Oregon-based manufacturers and very few distributors. Out of several hundred solar thermal equipment manufacturers in the U.S. in the 1980s, fewer than 10 remain today. Technology, pricing, track record, product quality and good customer service are some of the selling points that these firms use to differentiate themselves in their marketing efforts.

*Utility/State Programs*

Industry respondents frequently mentioned the Oregon tax credit, in existence for more than 20 years, as important, if not critical, to the survival of the solar industry in Oregon. Respondents less frequently mentioned Bright Way, a program first developed by the EWEB that provides financial incentives (discounts and/or loans) to promote installations of solar water and pool heating systems. Eligible program contractors must install qualifying systems and the fuel displaced must be electricity[3]. Other utilities, such as the City of Ashland, have either adopted Bright Way, or offer something similar (e.g., Emerald PUD and Central Electric Co-op in Redmond). BPA has recently purchased the rights to Bright Way and is providing it to electric utilities that want to offer a solar thermal water heating program.

### *Distribution and Supply*

In general, installers will order their equipment either from a distributor or directly from the manufacturer. Occasionally, homeowners will order the materials directly from the manufacturer and outsource the labor or do it themselves. The equipment can be costly to ship due to its weight, and is shipped by common carrier, usually taking anywhere from one to three weeks to arrive.

Manufacturers tend to have a preferred network of installers but they also distribute directly to installers or even to the end-user. One manufacturer we spoke with is reinstating 3-4 day training seminars for its installers, certifying them upon completion. They are doing this partly to reinforce quality control, since some installers use a variety of equipment from different manufacturers, and partly to train new entrants to the industry.

Several installers said they preferred certain manufacturers, based on quality of equipment, stability, and customer service, including Sun Earth and Heliodyne, both California-based. Several installers also mentioned Bobcat and Sun Solar, a system distributor in Bend.

While most respondents thought the supply of solar equipment was adequate, some disagreed. Two cited the lack of local sources for equipment and consequent delays in obtaining goods, as well as high shipping costs. Another decried the lack of manufacturers in general and the resulting lack of equipment options. Also, since it is more economical to buy equipment in quantity, the inability to do so presents an additional hardship to someone who only does 4-10 installations per year.

### *Market Segments*

The large majority of installations for the contractors are within the residential market, with retrofits edging out new construction. Only one installer said that a

[3] See the EWEB website for further information: http://www.eweb.org/energy/solar/index.html.

significant (20%) share of his business was in the commercial sector, with campgrounds, pools and condominiums comprising that business.

None of the six installers we spoke with rely only on new solar hot water system sales. Three installers do a lot of solar hot water system work, with one focusing on pool system installation, one focusing on maintenance and service, and the third doing a mix of domestic hot water, pool, and PV system installation along with radiant floor heating systems. The other three install some solar hot water systems, but the bulk of their business involves radiant floor heating, PV, or geothermal system installation. In 2002, based on ODOE data, 62% of the solar hot water system installations were for domestic hot water and 38% were for pools and spas.

Most installers report that customer satisfaction rates are high, although there have been problems with systems from the 1980s that were poorly designed or installed or that have not been maintained. Installers also said that homeowners who inherit systems on newly purchased homes are more prone to express dissatisfaction with systems, particularly if the systems were unwanted and/or prove troublesome.

### *Technology and Reliability*

Most respondents agree that the technology for solar water heating systems has remained stable and has seen little innovation during the last 5 years. Installers report that the size of systems has remained constant for the last 15-20 years. Most of the installers currently favor active solar water heating systems – indirect anti-freeze systems and drainback systems. Some installers have not changed the type of system they use but others said they started out with the drain down system, now obsolete, but have switched to drainback. Some contractors prefer only one system ("I use a cookie cutter approach with my systems") but others use both drainback and anti-freeze systems, depending on the installation requirements. (Note: The majority of systems, over time, have been passive solar systems, but passive systems accounted for only 37% of solar domestic hot water systems in 2002.)

The average solar water heater system panel lasts about 20-25 years, while those with high quality components can last longer. Pumps last about 10-12 years and tanks about 20 years. Several contractors described drainback systems as more reliable, having fewer parts to break. However, they are somewhat more complicated to install and more expensive.

The most common system failures cited by respondents are leaks associated with various system connections and pumps. Pump replacement costs about $200. Suggested maintenance includes annual collector cleaning, a tank flushing and change of the antifreeze every 3-4 years for antifreeze systems, and an inspection every 5 years. Average repair costs range from $75 – 300, depending on whether a part has to be replaced.

Since most systems are installed on roofs, roof integrity is another factor that must be considered with solar water heating systems. Most installers were not too concerned about roofs ("if done properly there is little risk to roofs") and said that most clients are not too concerned about them either, except for the aesthetics of the solar thermal systems. One installer commented that "a lot of people don't have a clue about roofs" and will recommend roof replacement prior to installation if it is warranted.

However, several installers pointed out that if a roof with a solar water heating system does require replacing, it costs about $500 to remove the system and then restore it once the new roof is in place. Some homeowners, particularly if they are not the original system owner and are not wedded to the solar system, opt out of restoring the system. Further, this removal/restoration process may be an additional cost that is not calculated in payback estimates.

Since the amount of repair/maintenance can affect an individual's decision whether to replace a solar thermal water system, installers believe that those who had bad experiences in the 1980s, and/or have been "nickled and dimed" with repair costs, are more reluctant to replace their systems.

# 4. Market Trends and Issues

Based upon our interviews with market observers, installers, distributors and manufacturers, as well as our limited literature review, we have summarized below salient market trends and issues in Oregon. These include:

- General market trends
- Technology trends and perspectives
- Consumer motivations, market barriers, and opportunities

### *General Market Trends*

Overall, the market actors described the current market as flat, stagnant, or even somewhat declining. The tax credit data from the ODOE confirms this (see Figure 1). Only one Bend-based installer said it was growing slightly. The manufacturers had different perspectives: one described it as uniformly flat; another concurred, except for Hawaii and Oregon (which he attributed to the incentives offered in Oregon); and the third described it as growing nationally.

Several mentioned that the market heyday of the 1980s, in which many solar thermal systems were sold with either poor quality components or poor installation, produced a lingering bad impression of the technology, and that the industry had done a poor job of policing itself. One manufacturer, however, noted being tired of hearing complaints about the 1980s situation and wanted to move beyond it.

Most people we spoke with thought the market would not change much in the future or would experience slow steady growth. Some were hopeful that new programs, like those being developed at the Energy Trust, or the return of the Federal Tax Credit, would significantly increase market growth.

### *Technology Trends and Perspectives*

Recent advances in solar thermal water heating technology, with the exception of the evacuated tube system, were described as fairly minimal. The refrain was that the technology has been stable for some 20 years and is expected to remain so. As one respondent put it, "The technology has become more robust." No one, including the manufacturers, mentioned looming technological innovations. Possible incremental improvements are anticipated, perhaps due to improved manufacturing methods. Some mentioned improvements in the quality of system components and better system integration, all aimed at improving system reliability. One installer commented that he noticed some fittings were now being manufactured in China and thought the quality had slipped.

*Standards*

The Solar Rating and Certification Corporation (SRCC) has developed certification, rating, and labeling programs for solar collectors, and complete solar water and swimming pool heating systems. The stated purpose of such programs, called the OG300 program for solar water systems (or OG300 standards for short), is to ensure product safety, reliability and performance. For systems to be eligible for the Oregon tax credit they must meet OG300 standards.

The program requires nationally accepted equipment tests on solar equipment by independent laboratories, which are accredited by the SRCC. The SRCC then evaluates the test results and product data to determine if the minimum standards for certification are met. Equipment, which has been certified and rated by SRCC, is required to bear the SRCC certification label showing the performance rating for that product.

Market observers and manufacturers have been more accepting of equipment standards than the installers. Still, one observer said installers have helped improve equipment quality, since poor quality only leads to more problems for installers. Installers, just like consumers, will not continue to purchase equipment and/or systems if they have had poor experiences with them. Others in favor of standards commented that, while good, standards also raised the cost of systems. One installer said he thought OG300 standards benefited manufacturers more than installers, and that he would like to be able to use any equipment available in the market. The manufacturers we spoke with did not uniformly support standards. One manufacturer noted that solar thermal equipment is over regulated and there is concern that too many non-solar professionals are developing standards.

*Installer Certification/Requirements*

At present, there are no certification requirements for solar thermal installers. To be listed as a certified solar contractor by ODOE for the tax credit program, the contractor must agree to follow ODOE rules regarding tax credits and professional conduct, but professional competence is not addressed. According to information on the Oregon Solar Energy Industries Association (OSEIA) website (see Appendix A), however, a new Solar Heating and Cooling Installer License will be required in Oregon on July 1, 2004. The training program requirements for this license are currently being developed.

Views about the usefulness of certification varied among our respondents. On the positive side, the distributor said certification is critical and that consumers should insist on manufacturer-certified installers. A manufacturer noted he wanted to train installers when they enter a market. Three installers supported certification but also had reservations. One said it helped prevent the industry from getting a black eye, but also increases costs. Another installer was concerned the requirements could become too rule-driven and onerous. A third thought certification could have a

similar effect to OSHA rules – "they can help weed out the bad ones" - but overall was "down on certification," saying that some requirements were imposed by "edict rather than good judgment".

On the negative side, one installer felt new certification requirements, particularly those requiring many hours of training, will increase the difficulty of entering the field. In a flat market he thinks there is insufficient work to enable new installers to acquire the necessary hours to attain certification. He suggested developing a limited license that would allow an in-person test to be substituted for training hours. Another installer does not want to see the Trust (or others) involved in policing the industry. He feels that experienced installers are being "punished" with all of the regulations, and said that "Peer review should determine standards, not an agency like the ETO."

### *Consumer Motivations, Market Barriers and Opportunities*

The modest, but steady demand for solar water heating systems suggests that a small market of customers is motivated to buy these systems. Industry experts felt a variety of barriers discourage most consumers, but agreed there are market opportunities that could be developed.

*Motivations*

Market actors did not feel that the economic benefits of solar thermal are sufficiently compelling to motivate consumers to buy the systems. Although one installer thought that low interest rates created a more favorable return on investment, others thought that an emphasis on economics works against creating market demand. Some of the primary motivating factors respondents identified for consumers purchasing a solar water heating system include:

- **Environmental benefits.** Solar hot water systems provide environmental benefits like other renewable energy sources and they tend to be more accessible and cost-effective than other renewable options.
- **Tax credit and other financial incentives.** Incentives are important for easing the investment in a solar hot water system.
- **Energy independence.** Some consumers find creating their own energy and reducing dependence on outside energy sources attractive.
- **Desire for new technology.** Other consumers are interested in technology and like to tinker and work with technology.
- **Previous experience with solar energy.** Previous experience provides the knowledge that solar works.

Some of these motivations are reflected in the marketing message of one solar installer – "You gotta pay for the energy anyway – wouldn't you rather it came from the sun?"

*Market Barriers*

Market observers, installers, distributors and manufacturers cited a variety of barriers to help explain the relatively modest demand for solar water heating systems. Some key barriers cited include:

- **Long payback and relatively large initial cost.** Paybacks can be as short as 5 years, but often are 10-15 years.
- **Complicated systems.** Relative to a conventional water heating system, solar water heating systems are complicated and require some maintenance.
- **Aesthetics**. Many homeowners do not like the appearance of solar water heating systems, especially if they are poorly installed.
- **No tangible increase to home value**. In addition, many homeowners do not value an inherited system in a newly purchased home.
- **Lack of available sun for specific installations.** Many homes may not have good sun access due to shading or building orientation.
- **Solar "doesn't work in Oregon."** Respondents universally cited this consumer perception as a barrier to growing the market, despite technical evidence to the contrary. And despite improved equipment and installation, respondents said consumers were still concerned about poor system reliability due to problems in the 1980s. A Bend-area installer said consumers in his area were sophisticated about the effectiveness of solar, but he also noted the Bend area has a great deal of sunshine.

The experience in Ashland is consistent with these observations. Ashland purchased the Bright Way program from EWEB in 1996, but to date there have been fewer than 10 installations. When program response was analyzed by the city of Ashland, the findings showed these market barriers: an insufficient pool of installers; limited solar access for many residences; high gas water heater market share (which reduces the value of energy savings), particularly in new home construction; and the complexity and cost of retrofitting existing homes.

*Opportunities*

The majority of installers agreed that the residential new construction market provides an important opportunity. Programs like the Earth Advantage Program[4] may help encourage this. While the retrofit market will likely continue as a primary focus, designing homes to more easily incorporate solar water systems could reduce costs and improve performance. However, one installer said that the prevalence of gas water heating systems in new homes, and the lower cost of gas fuel, has made that market less feasible. Pools and spas are another key market

[4] Earth Advantage is a program run by Portland General Electric to promote sustainable homes and buildings. For information see their website at: http://www.earthadvantage.com/.

segment. These systems are generally more cost effective than domestic hot water systems.

Several installers and market observers thought that the commercial market had great potential ("it's a great untapped market"), but was hampered by the long payback period, making it an impossible sale. However, several niches with potential were mentioned by many, including hotel/motels (with and without pools), laundries, college dormitories, and prisons. The large amount of hot water used by these businesses provides a good potential application for a solar hot water system. There could also be potential marketing benefits for these businesses for using solar energy. Emphasizing institutional applications may be a way to overcome the short payback periods many businesses have.

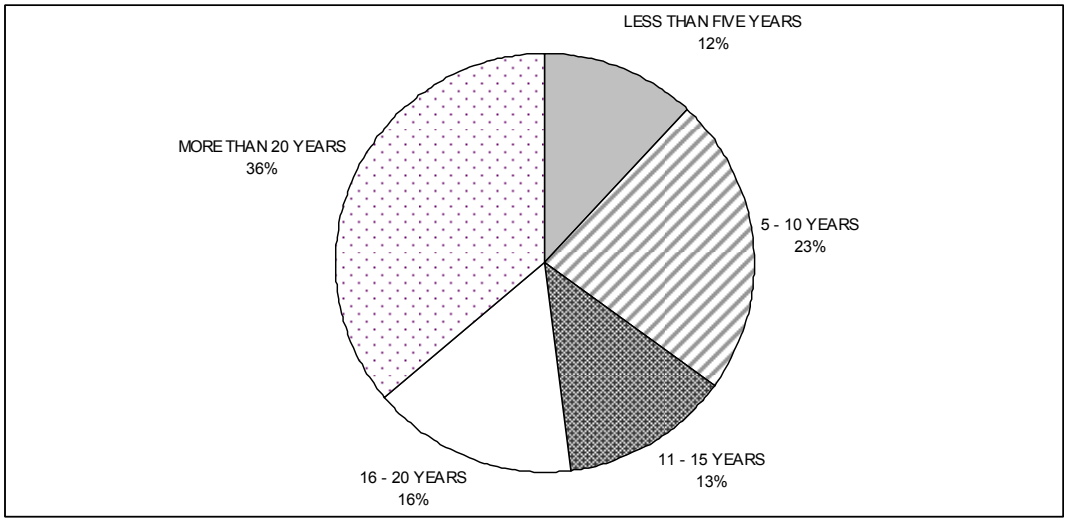
The majority of installations occur in the Willamette Valley and the Portland area, the population centers in Oregon. However, there may be some value in encouraging installations in Eastern and Southern Oregon where more sun may create more positive perceptions for solar energy. Many of these areas appear to be underserved by the solar thermal industry.

# 5. Household Survey

### *Factors Affecting the Purchase Decision*

The ten in-depth interviews with residential purchasers indicated that personal experience with solar water heating was an important factor in the purchase decisions. We thus asked purchasers in the telephone survey questions that gauged how personal experience was related to buying a system. As Figure 6 shows, most buyers had known about solar water heating for a long time. More than one-third said they had known about solar water heating for more than twenty years, and almost two-thirds said they had known for more than ten years.

**Figure 6. How long owners have known about solar water heating systems**




n = 135

When respondents rated the importance of ten possible sources of information or experiences in their decision to install a solar water heating system, the top three categories involve personal experiences and relationships (see Table 2). Solar contractors had the highest proportion of high importance ratings (45%), with almost three-quarters of respondents rating contractors as an important source of information, considerably higher than any other source. Thirty-one percent said owning or using a system in the past had high importance, and 28% said learning about systems from others who have them was of high importance. These findings are consistent with the in-depth household interviews where several respondents told us they had experience with solar water heating systems in California before moving to Oregon.

**Table 2. Important Sources of Information/Experience in Purchase Decisions**

| Source | High Importance | n |
|---|---|---|
| Solar water heating contractor | 45% | 134 |
| Owning or using a solar water system in the past | 31% | 125 |
| Other people who have them | 28% | 134 |
| Environmental or solar organization | 24% | 135 |
| Home show | 19% | 135 |
| Local utility | 19% | 132 |
| Installing or helping to install solar water systems for others | 15% | 130 |
| Website | 14% | 133 |
| Your work, profession, or career provided knowledge | 14% | 134 |
| Magazine or newspaper | 9% | 135 |

Second tier information sources with high important ratings included environmental or solar organizations (24%), home shows, and local utilities (both 19%). Notably, in Lane County, 37% of system owners said information from their utility had high importance and 30% said it had medium importance. This shows how the utility programs in Lane County (Emerald Public Utility District and the Eugene Water and Electric Board) positively affected consumers. Third tier information sources included installing systems for others, websites, work experience, and magazines or newspapers.

Table 3 shows the motivators that purchasers identified as very important to their purchase decisions. Financial considerations, like lowering the energy bill and the Oregon Energy Tax Credit, were very important motivators. Both a majority of buyers also rated non-financial factors, such as environmental benefits and reducing dependence on conventional fuel sources, as very important. Most respondents said both financial and environmental factors were very important with about 15% identifying only financial reasons as very important.

**Table 3. Important Motivations for Purchasing a Solar Water Heating System**

| Motivation | Very Important | N |
|---|---|---|
| Lowering your energy bill | 74% | 135 |
| Reducing your dependence on conventional fuel sources | 66% | 135 |
| State tax credit | 62% | 135 |
| Environmental benefits such as reducing fossil fuel use or greenhouse gas emissions | 59% | 135 |
| How long the system would take to pay for itself through reduced energy costs | 30% | 135 |
| Rebates or low interest loans from your local utility | 25% | 131 |
| The need to replace an existing water heating system | 20% | 133 |
| Building or purchasing a new home | 18% | 129 |
| Remodeling an existing home | 13% | 130 |

Utility rebates or low interest loans were rated as "not important" for most respondents, except for those in Lane County where 41% of purchasers said the utility incentive was very important and 35% said it was somewhat important. These findings again reflect the strong impact of utility programs for solar water heating. Other motivations, such as buying a new house, remodeling an existing home, or replacing a water heating system, were rated as less important. However, 34% of respondents rated at least one of these motivations as "very important" in their decision.

During the telephone survey we asked buyers to rate the significance of various potential obstacles that might have impeded their purchase (Table 4). Findings show that few purchasers agreed on major obstacles (although 90% of respondents identified at least one major obstacle). However, 67% of respondents identified cost as a major or minor obstacle, and over 40% said that finding a contractor and system reliability were either a major or minor obstacle. Bearing in mind that these respondents were motivated buyers, their ratings suggest factors that may be significant market barriers to the wider market.

**Table 4. Potential Obstacles to the Purchase of a Solar Water Heating System**

| Obstacle | Major Obstacle | Minor Obstacle | n |
|---|---|---|---|
| The cost of the system | 16% | 47% | 133 |
| Finding a good contractor | 14% | 35% | 132 |
| Uncertainty about solar water heating system reliability | 10% | 33% | 134 |
| The lack of adequate solar access | 6% | 30% | 134 |
| The condition of my roof or other structural issues | 6% | 27% | 133 |
| Concern about the resale value of your home | 6% | 16% | 135 |
| The maintenance requirements for the system | 4% | 36% | 134 |
| The appearance of solar water heating systems | 2% | 25% | 134 |

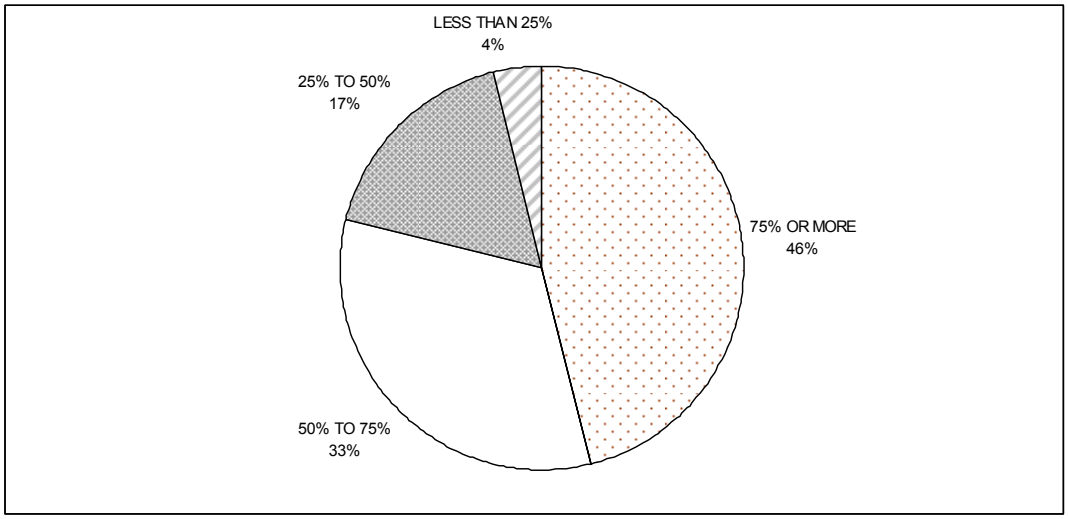
### *Ratings of Satisfaction and System Performance*

The large majority (88%) of respondents used a contractor to install their system, while only 4% installed the system themselves and 7% installed the system with help from a contractor. Most (76%) said they were very satisfied with the installation of their system and 21% said they were somewhat satisfied. Reasons for their high levels of satisfaction included that the installation was fast, efficient and prompt; the contractor was professional and did good work; the system worked well and there were no problems; and the contractor answered questions and explained things. Less than 10% identified installation problems such as incorrect installation, roof problems, the process taking too long, scheduling problems, and contractors having wrong parts (2%).

Most purchasers (84%) said they were also very satisfied with the performance of their solar water heating systems and 13% were somewhat satisfied. Pool/spa system owners were more likely to say they were very satisfied (97%) than passive system owners (64%). The primary reasons given for high satisfaction with system performance were the amount of hot water produced, the savings in energy cost, and the fact that the system had no problems. Less than 10% complained that the system did not provide enough hot water, they had equipment problems, and the system did not sufficiently lower the energy bill.

Almost 80% of the respondents believe their solar water heating system provides more than half of their hot water or pool water heating needs (Figure 7). Pool and spa owners more often reported that their systems met their three-quarters or more of hot water needs that non-pool system owners (71% to 33%). Since pool hot water needs are usually less than non-pool hot water needs and pool heating is often limited to the time of year when solar energy is most abundant, this result is not surprising.

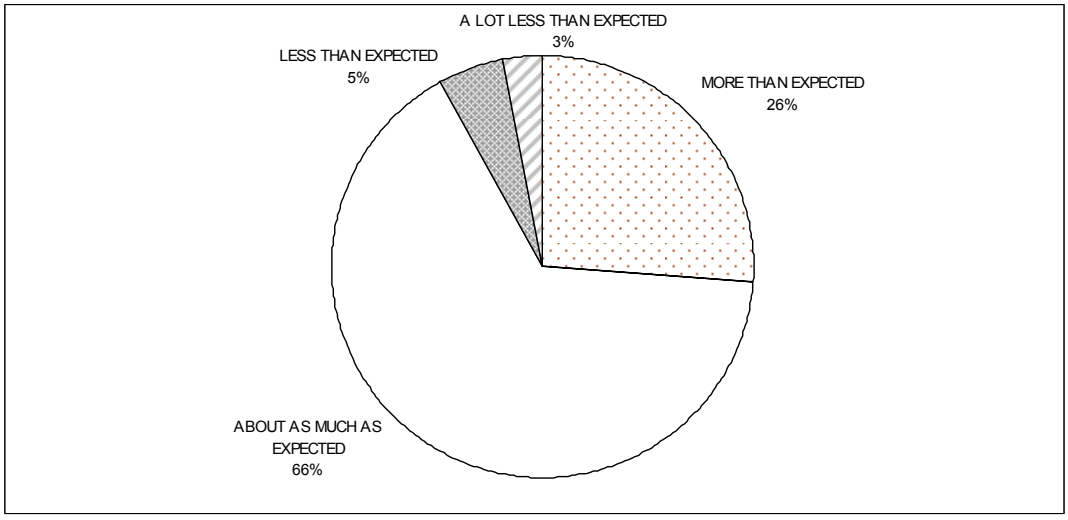
**Figure 7. Share of Hot Water Needs from Solar Water Heating System**




n = 127

Over 90% of those surveyed said that their solar water heating system was providing more than or about as much hot water as they expected (Figure 8). The distribution of responses was very similar across different types of systems.

**Figure 8. Production of Hot Water**




n = 130

### *Purchaser Characteristics*

To inform marketing efforts, one of the goals of our research was to learn more about the attributes of solar water heating system purchasers. Phase 1 research suggested that solar water heating system owners would have a strong environmental orientation. The in-depth interviews we conducted suggested system owners also tended to view themselves as frugal and handy. Using these results, the respondents to indicate the extent to which they agreed with a series of statements, as shown in Table 5.

**Table 5. Respondent Behavior Ratings**

| | **Agree strongly** | **n** |
|---|---|---|
| It's a high priority for me to buy energy efficient products for my home | 60% | 135 |
| I like to look for ways to save money even when I don't need to | 59% | 133 |
| If something needs repair at my house, I like to try to fix it myself | 56% | 135 |
| I believe my individual actions can make the world a better place | 50% | 135 |
| It's a high priority for me to buy green or environmentally friendly products | 48% | 134 |
| I actively support environmental causes or organizations | 37% | 133 |
| I like to do things somewhat differently than other people | 26% | 133 |
| I like to try out new or alternative products before other people do | 14% | 134 |

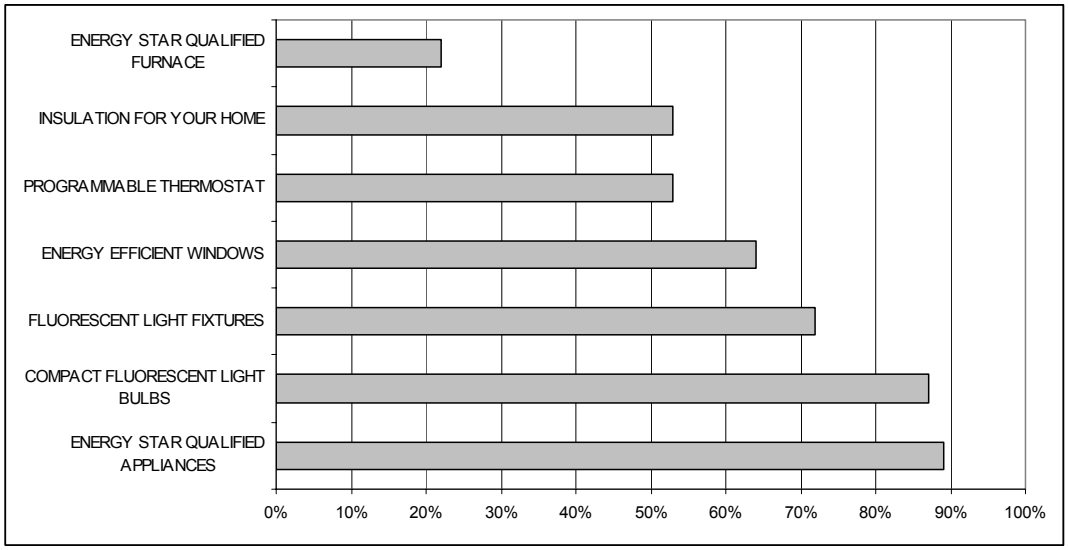
More than half of the respondents strongly agreed with statements relating to environmental behaviors, saving money, and making repairs around the house. None of the statements received negative ratings (disagree somewhat or strongly) from more than half the respondents. Still, the last three statements in the table had more negative ratings than the other statements – trying out new products (46% negative) and supporting environmental causes and doing things differently (both

36% negative). These findings suggest that system owners were not as likely to view themselves as innovators as they were to see themselves as handy, frugal, and supportive of environmental values.

Findings also suggest that a group of system owners have a strong environmental orientation, but that another a group is less interested in the environment and are more inclined to describe themselves as frugal or handy. About 25% of system owners showed strong environmental leanings, agreeing strongly with all four environmental statements. However, 23% of the respondents did not agree strongly with any of the four environmental statements (many did agree somewhat). System owners in Lane County were more likely to strongly agree with environmental statements (particularly purchasing green products), while those in Bend and Eastern Oregon were more likely to strongly agree with statements about saving money.

We also asked the respondents about their purchase of energy efficient products. All respondents said they had purchased some energy efficient products in the last five years and, in most cases, a majority had purchased the products listed in Figure 9. Energy Star® appliances and lighting were the purchases most often cited.

**Figure 9. Energy Efficient Product Purchases**




n = 135

Our survey of households concluded with a series of demographic questions. Results showed that purchasers were:

- Educated, with 71% of respondents had at least a college degree.
- Older, with 38% over the age of 60 and 86% over the age of 45.

- Spread across income levels, with 31% reporting annual incomes of less than $50,000, 44% between $50,000 and $100,000, and 24% over $100,000. Pool/spa owners and Portland residents tended to be more affluent.
- Living in older homes, with 54% of homes over 25 years old. However, 17% of homes were less than five years old. Homes were older in Portland and newer in Bend/Eastern Oregon.
- Living in homes of various sizes, with the average home about 2,100 square feet. Sizes from under 1,500 square feet (20%) to over 3,000 square feet (20%) were also represented.

# 6. Business Interviews

Only eleven businesses received Oregon Energy Tax Credits for solar water heating systems between January 1, 2000 and December 31, 2003. We completed interviews with owners of seven of the businesses to learn more about their systems, their purchase decision, satisfaction, and business characteristics.

### *System Characteristics*

The businesses tended to have 8 -12 panels (compared to residential systems with one or two panels). Most systems cost between $5,000 and $7,600, although one system cost almost $20,000.

### *Decision to Purchase a System*

All seven of the business owners we spoke with said they had known about solar water systems for years prior to installing their own. In two cases, the business owners also had solar systems on their homes. In three cases, those interviewed had, through acquaintances, through residing there, or through owning condominium units there, been exposed to systems in California, Florida, and Hawaii. One business had an existing system that had been in place for many years, but was not working.

The purchase decision for most of the businesses was driven by economic reasons. In several cases high and/or increasing natural gas or propane bills motivated them to take action. One business owner thought the system would help attract tenants for her rental and a pool system owner thought it would extend the period they could use the pool. Saving energy and the associated environmental benefits were important for some of those interviewed. As one person explained, "one of my aims was to show people that it works." For many of the businesses, environmental benefits tended to be secondary to economic factors in the purchase decision. The Oregon Business Energy Tax Credit was important for four of the seven businesses, while others said it was "a nice benefit."

Most of the business owners interviewed said they spent time collecting information on solar water heating and considering the options available to them before making the purchase. A few said they did research on the Internet, contacted their utility, or obtained information from magazines like Home Power. In all cases the contractor was the most important source of information for making the decision to install a system. Several business owners mentioned economic analyses that were prepared by the contractor to show them the energy and cost savings. One owner noted that the contractor provided an analysis estimating energy and cost savings "using a standard government type computation so it

wasn't biased." None of the owners identified any significant barriers to their decision to install a solar water heating system.

### *Satisfaction and System Performance*

All but one of the businesses we spoke with used a contractor to install their solar water heating system. Several used contractors they knew from a previous installation at their business or home. A couple used referrals from a utility company. Only one obtained multiple bids and another mentioned checking references for his contractor. All thought the installation went very smoothly and were very satisfied with the work done by the contractors: "It was a piece of cake. The contractor did it over a weekend." Only the more expensive domestic hot water system took more than several days to install, and even in this case, the business owner indicated there was not much disruption.

The one self-installed system was done over a two - three month period. This business owner indicated that, "it was a learning process" and that he used a contractor for some advice and to install the racks for the solar panels. Because the system has not worked as he intended, he has used the contractor to make some repairs. This same owner, however, said that the solar water heating system is still delivering more energy savings than expected.

The other six business owners were very happy with their systems: "It is working as advertised. I'm fully satisfied." Performance was exceeding the expectations of four of the business owners. One noted a 25% reduction in his business's energy bill and another said he realized a three-year payback on his investment. Several mentioned that in the summer the system could heat the water to a higher temperature than needed and that they turned the system off or tempered it.

Five of the business owners mentioned needing minor repairs on their system, such as having a leak fixed, replacing a sensor, replacing a valve, and modifying some fittings. In all of these cases, the original contractor made the repairs. As noted earlier, the self-installed system required some repairs by a contractor to correct problems in the initial installation. Maintenance or reliability was not a problem for any of the owners. Several mentioned the winter shutdown of their systems (primarily pool systems). One contractor noted that, for pool systems, "maintenance is common sense. Most pool owners know what to do or learn quickly, because they already have a pool (which requires maintenance and attention)."

In addition to the energy savings, some business owners mentioned other benefits from their solar systems. Two pool owners said that hot water from the solar system allowed them to extend the period when their pools are open. Two mentioned the public relations benefits from having the systems. Another owner

interviewed, however, said he did not want to put up a sign drawing attention to his system, noting: “I didn’t want it announced – I was involved in local politics.”

### *Purchaser Characteristics*

The seven business owners interviewed all represent small businesses. One is a non-profit. They range in size from one employee to 100. The hotel/motels and residential psychiatric facility are the largest employers. All but two have been in business for more than ten years.

Four of the seven businesses have swimming pools and the solar water heating systems provide hot water for the pools. In one of these businesses (a motel), the owner also installed a system to provide hot water for the laundry, showers, and other domestic hot water uses. A fifth business, a residential psychiatric care facility, uses the solar system to help meet the high hot water needs of the laundry, kitchen, and showers. The other two businesses, an office and rental house, were not high hot water users.

Four of the business owners identified other energy efficiency actions they had taken, such as installing compact fluorescent lights, timers, double pane windows, and insulation. Two business owners mentioned that they were involved with environmental organizations, two mentioned not using pesticides, and one said his business recycled. Still, even for business owners that expressed an interest in the environment, it was a secondary factor in their decision to install a solar system.

When asked what types of businesses, in general, would be good applications for solar water heating, three owners said businesses that use lots of hot water – motels, apartment complexes, restaurants, hospitals, and car washes – are good candidates. Two said businesses with pools are good applications and two thought any business could potentially benefit from a solar system.

# 7. Summary and Recommendations

In this section we summarize our key research findings and offer recommendations for designing and developing programs to promote the adoption of solar water heating.

### *Phase 1 Key Findings: Market Characteristics*

Our research found agreement among industry experts on a number of characteristics of the solar water heating market in Oregon, including:

- **The market is flat.** There have been 200-400 installations per year, and no growth in demand for solar water heaters has occurred in the last ten years.
- **The market is geographically concentrated**. Installations have been concentrated in four general areas: Eugene, Medford/Ashland, Bend, and the greater Portland area.
- **There are a limited number of market players**. Market actors are concentrated in the few geographic areas listed above. Most installers are small firms that have been in business for many years. There are no manufacturers of solar equipment in Oregon.
- **The technology is stable.** The technology has changed little in the last 20 years, although there have been incremental improvements that have improved quality and reliability. Most of the manufacturers remaining in the market have been in business for many years.
- **Residential retrofits are the primary market.** Some people in the industry see opportunities in new home construction and in a few commercial applications with high water use. But the commercial market is hard to reach because of long paybacks for solar water heating systems.
- **Tax credits are important to buyers,** helping to make the systems more economically viable. Most people we talked with thought the state tax credit was crucial to the survival of the solar water heating market in Oregon after the Federal tax credit was removed.
- **Environmental concerns and the desire for energy independence motivate residential buyers.** Solar water heating also provides consumers with an opportunity to adopt a renewable energy technology.
- **Market barriers are significant.** Members of the solar industry told us that relative to conventional water heating systems, consumers think that solar water heaters are expensive, have long paybacks, are complicated and unattractive, that solar does not work in many applications (or in Oregon in general), and that economic benefits are not strong enough to motivate them to buy a system.

### *Phase 2 Key Findings: Purchaser Insights*

*The Purchase Decision*

Purchasers learned about solar water heating through their personal experiences and contractors and generally had known about it for a long time. They reported that economic and environmental factors motivated them and identified few barriers to purchase and installation of the systems.

- **Experience is important.** Purchasers of solar water heating systems had often known about the technology for many years (10 or more) prior to the purchase of their system. Almost one-third said owning or using a system in the past had high importance in their decision to install a solar water heating system. A similar number also rated learning from others with systems as having high importance. Personal relationships and experiences were important factors in purchaser willingness to consider a solar water heating system.
- **Contractors are the most important information source.** Purchasers identified the solar water heating system contractor as the most important source of information. Other sources cited included environmental organizations, the local utility, and home shows. In Lane County, where several local utilities have active solar water-heating programs, owners identified utilities as an important source of information and support.
- **Economics factors motivated business owners.** Businesses were more strongly motivated by economic criteria than homeowners and did a little more research to justify their purchase.
  - Business owners said reducing energy costs was a key motivation for purchasing their solar water heating system.
  - Four of seven said the Oregon Energy Tax Credit was an important factor.
  - Business owners indicated that environmental motivations were a secondary factor or not important in their business decision.
- **Economic and environmental factors motivate residential owners.** Homeowners were more likely than business owners to identify environmental benefits as important, with many noting that both environmental and economic factors were important motivators.
  - Homeowners said reducing their energy costs and the Oregon Energy Tax Credit were important factors in their purchase decision.
  - The majority of homeowners that lived in locations with active utility programs also identified utility incentives as important.
  - Most homeowners cited environmental motivations as important including the desire to be less dependent on conventional fuel sources and reducing greenhouse gas emissions.
- **Purchasers cited few major purchase barriers**: Businesses and households we spoke with did not identify many major barriers to their purchase of a solar

water heating system. More than half of residential buyers did cite high system cost as a major or minor barrier, and over 40% each cited reliability of systems or contractors as a potential major or minor barrier. These barriers are likely to be more prominent among a wider residential market.

*Satisfaction*

Respondents reported high satisfaction with the systems and with contractors.

- **Installation:** Contractors installed almost all of the solar water heating systems. All the business owners and the large majority of surveyed homeowners (76%) were very satisfied with the work of the contractors. Only 2% of households said they were not too satisfied.
- **Performance:** All but one of the business owners and most of the homeowners (84%) indicated they were very satisfied with the performance of their systems. Several business owners and a quarter of homeowners also reported that the production of hot water from their systems exceeded their expectations.
- **Repairs:** Five of the seven business owners we interviewed had needed very minor system repairs. Only 4% of homeowners said they had experienced equipment problems.

*Purchaser Characteristics*

Many purchasers tended to have an environmental orientation, but they also displayed other characteristics important to marketing and educational efforts.

- **Households:** The majority of homeowners surveyed saw themselves as both frugal and handy. Although a majority also indicated they engaged in pro-environmental behaviors, some did not necessarily see themselves as "environmentalists." About a quarter of those surveyed strongly identified with all four pro-environmental statements in the survey, but almost a quarter did not strongly identify with any of the environmental statements. Homeowners with solar water heating systems also tended to be older, well educated, and live in older homes.
- **Businesses:** The businesses in our sample were small and locally owned. Most had swimming pools or high demands for hot water in laundries, showers, or kitchens. While two owners could be described as supportive of environmental causes, environmental reasons were not an important part of the purchase decision in most cases.

Purchasers of solar water heating systems placed a greater emphasis on economic motivations for their purchase than industry experts (contractors and key informants). This may be due to a tendency by purchasers to identify economic reasons like energy savings and economic incentives to justify the capital expenditure they have made. While industry experts noted the economic benefits

from a solar water heating system are not compelling, they were compelling enough for purchasers, along with other motivations. However, there are few solar water heating system owners and for many other consumers the economic benefits are likely to be much less compelling and the barriers more significant. However, as industry experts note,

### *Program Recommendations*

The solar water heating market and industry in Oregon are small and localized. Owners of solar water heating systems represent a very small and unique segment of households and businesses. The information we obtained from purchasers and members of the solar industry provides insights for developing the solar market, but may not capture all the issues that inhibit wider adoption of solar water heating. To encourage growth, the demand for solar water heaters must increase as well as the number of solar water system installers. This is a delicate balance to achieve. Many of the elements for fostering growth exist in some form, but need to be brought together to create a more robust solar thermal industry that both encourages and supports increased demand for solar hot water heating systems. We recommend the following approaches for creating demand for solar water heating systems and developing the solar thermal industry in Oregon.

*Creating Demand*

Creating demand for solar water heating requires both marketing efforts to raise awareness about available programs and educational efforts that give people the opportunities to experience solar water heating and how it works. Hands-on, community based, targeted efforts that build familiarity and trust in the technology are more likely to work than broad informational campaigns. Incentives are also needed to address potential purchase barriers.

- **Marketing:** Current marketing for solar water heating systems is quite limited. Installers have little time for marketing and rely largely on referrals. The utilities generally do not actively promote their programs, although the Bright Way program has developed some quality information and materials that target the motivations of consumers and could be used in a more active marketing effort.
  - Marketing Messages: Environmental messages are an important part of promoting solar water heating systems, but using only pro-environmental messages overlooks important market segments. Marketing messages need to identify the practical economic benefits of the systems (frugality). Environmental messages need to be carefully phrased to be more factual than zealous, so that they don't sound overly "green." For example, messages about using energy wisely and reducing dependence on conventional fuel sources appeal both to those who see themselves as environmentalists and those who engage in environmentally supportive behaviors for other reasons (i.e., that they are frugal or pragmatic).

  - Making the Business Case: When marketing to businesses, credible information showing economic justification for the purchase needs to be available. One business owner emphasized the importance of seeing a cost-benefit analysis and recommended that tools from unbiased sources be available to conduct this analysis. The Energy Trust should work with contractors and business organizations to be sure that the information a business owner needs to make a good decision is available.

- **Education:** According to the members of the solar industry we spoke with, many consumers have perceptions that solar technologies do not work in Oregon. Education that provides a personal experience of solar water heating is a way to counter these perceptions and give consumers a basic understanding of solar water heating.
  - Local Education Sources: Educational efforts could be provided through partnerships with community based education and environmental groups that people know and trust (e.g., local governments, utilities, extension services, neighborhood associations). One installer in Bend noted that a local environmental center has done a lot of education in the area and that local consumers are pretty sophisticated in their understanding of solar water heating.
  - Promote Experiences: Education that allows for experience with solar thermal should be stressed, rather than just "classroom" approaches. Displays showing the performance of operating systems, demonstrations at home shows, tours of existing solar water heating applications, and developing and profiling visible solar applications (for instance, installing solar systems at local swimming pools) would all be useful. Businesses oriented to home improvement might also become partners in this effort, given the handy orientation of many consumers.
  - Increasing Visibility of Business Applications: Business applications of solar water heating are almost non-existent. More examples of successful applications will reduce perceived risks and promote additional applications. The Energy Trust should take steps to get some systems installed in visible applications. Partnering with business organizations to develop appropriate applications and profile the results will likely facilitate success.

- **Targeting:** Certain groups of consumers and applications are more likely to provide opportunities for solar water heating. We found that solar water heating system owners are likely to purchase other energy efficient products. Thus, targeting participants in other energy efficiency programs may be a way to reach potential markets for solar water heating. For business applications, any business that uses a lot of hot water is a potential

candidate for a solar system. However, given the small number of existing solar systems in businesses, any program should first promote systems, such as those for pools/spas, where systems are simpler to install, have a lower cost, and provide quicker payback. Pool system owners are already experienced in pool maintenance and should be able to manage a solar system. For heated outdoor pools, the solar system can extend the period of pool use. In addition, pool systems are very visible and are often associated with businesses such as motels, which also have high hot water use for other purposes.

- **Incentives:** Incentives help overcome the relatively high initial costs for solar water heating systems, the barrier most likely to be mentioned by system purchasers. The Oregon Energy Tax Credit was clearly important for many purchasers and should be continued. Utility programs were also important in Lane County, where EWEB offers rebates and low interest loans. Some people we talked to felt that low-interest or zero-interest loans are the most effective incentive because a loan allows a consumer to purchase a system with little or no upfront investment and can produce a positive cash flow from the beginning. The Energy Trust should continue providing incentives for solar water heating to stimulate demand and should consider low interest loans, particularly for commercial customers.

*Developing the Solar Thermal Industry*

The solar thermal industry has served the existing market well. Recent system purchasers are very satisfied with the installation and performance of their systems. However, the industry is small and localized and to support any growth in demand it will need to expand while maintaining high quality and credibility. In order to grow beyond a very small niche market, purchasers will need to be able to find contractors that can ensure trouble-free installation and reliable long-term system performance.

- **Standards and Certification:** These are valuable tools for increasing consumer confidence in solar water heating. Equipment standards are in place and seem to have been accepted by the market. Utility programs have installation requirements that must be met before systems qualify for incentives. Some manufacturers offer training for their installers and a Heating and Cooling Installer License will be required on July 1, 2004 for system installers. While these efforts can benefit consumers, some industry respondents expressed concern that requirements were being driven by those outside the solar industry. They saw a need for more peer review and industry-developed best practices. As much as possible, the Energy Trust should support efforts by the solar industry to develop and maintain standards and certification programs and should take advantage of these tools in their programs.

- **Training and Support:** While there may be enough installers to serve the current market, more installers will be needed if demand increases. In addition, we found a number of long-time installers who may be nearing retirement. The Energy Trust needs to identify approaches for bringing new players into the market. This likely will involve working with peer organizations and manufacturers to help provide the training and support for new market entrants. Along with training, testing, and certification this could include the provision of tools and marketing materials that support contractor success. The Energy Trust uses trade allies in many of its programs and this may be a good mechanism for supporting the solar industry. Given the importance of contractors in the purchase decision, the Energy Trust needs to develop relationships with contractors and identify opportunities to effectively support them. It is also important that programs to encourage solar water heater adoption do not have requirements that discourage installers from participating or entering the solar water heating market.
- **Programs:** The availability of program incentives and other support for purchasers from organizations like the Energy Trust can help existing solar contractors grow and encourage new contractors to enter the market. However, the availability and then withdrawal of incentives can negatively impact the market, as the experience with Federal tax credits in the 1980's illustrates. To best support solar industry growth it is important for programs to be stable and predictable over the long term. To best support solar industry growth it is important for programs to be stable.

This report provides a snapshot of the solar water heating market in Oregon, both from those in the solar industry and system owners. It identifies market characteristics, issues and trends and offers valuable about the purchase decision, purchaser satisfaction and purchaser characteristics. These results contribute to a better understanding of the solar water heating system market in Oregon and provide a sound foundation for further program development at the Energy Trust. As the Trust deploys a solar program and evaluates progress, we suggest the following:

- **Conduct a more thorough analysis of successful markets elsewhere.** A more robust solar water heating market exists in other states, including California, Hawaii, and Florida. While more sun and higher energy prices tend to make these markets more favorable to solar water heating than Oregon (although the amount of sun in Southeastern Oregon is comparable to Florida, Hawaii, and Northern California; most of the rest of Oregon, except the coast, receives just a little less sun), there may be things that could be learned from reviewing the experience in these markets. This might include how the markets were developed and industry best practices.

- **Collect information from non-participants.** This research relied on input from members of the supply-side of the solar market and recent system purchasers. This provided insights about the market and the decision to purchase a system, but we need to learn more about why other consumers are not purchasing systems. Interviews with non-participants would help to identify approaches for increasing program participation and expanding the market for solar water heating systems.
- **Use and expand upon residential tax credit data.** The Oregon residential tax credit data for solar water heating systems is a rich source of information on installations in Oregon and could be used to track progress in the future statewide. This could supplement information collected by the Energy Trust about their program participants and allow comparisons with other parts of the state. The information presented in section 2 is tracked by ODOE and is available. Additional information such as system configuration, brand, size, and first year savings is contained on the tax credit application form (see Appendix B). This information is not currently tracked, but if any of it were important to the Energy Trust, arrangements could be made to track some of it.

# Appendix A: Solar Thermal Web-sites of Interest

Oregon Office of Energy

- Basics – Solar Water Heating
  http://www.energy.state.or.us/renew/solar/SDHW.htm
- Support for Solar Energy (tax credits, loans, certified installers)
  http://www.energy.state.or.us/renew/solar/Support.htm

Oregon Solar Energy Industries Association

- A non-profit industry organization
  http://www.oregonseia.org

U.S. Department of Energy, Energy Efficiency and Renewable Energy

- State Energy Alternatives – Solar Thermal Technologies
  http://www.eere.energy.gov/state_energy/technology_content.cfm?techid=6
- Fact Sheet on Residential Solar Heating Collectors
  http://www.eere.energy.gov/erec/factsheets/heat.html

Eugene Water and Electric Board

- Solar Water Heating: The Bright Way to Heat Water
  http://www.eweb.org/energy/solar/index.html

Bonneville Power Authority

- http://www.bpa.gov/Energy/N/projects/briteway/

Emerald Peoples Utility District

- http://www.epud.org

City of Ashland

- http://www.ashland.or.us

Central Electric Co-op

- http://www.centralelectriccoop.com

Alternate Energy Technologies

- http://www.aetsolar.com

Heliodyne

- http://www.heliodyne.com

Sun Earth Inc.

- http://www.sunearthinc.com

# Appendix B: Oregon Solar Energy Tax Credit Information

The Oregon Residential Energy Tax Credit Program provides a tax credit for solar domestic water heating systems of 60 cents per kilowatt hour (kWh) saved during the first year of operation, up to $1,500. Spa and pool heating systems are eligible for a tax credit of 15 cents per kWh saved, up to 50% of the cost, with a maximum tax credit of $1,500. To qualify for a tax credit, you must have an Oregon income tax liability and the solar water heating system must be located in an Oregon dwelling that is your primary or secondary residence. The application can be accessed at: http://www.energy.state.or.us/res/tax/3164.pdf.

Oregon businesses and others that invest in renewable energy projects can get a state tax credit. A tax credit recipient must have an Oregon tax liability. Applicants (project owners) that do not have an Oregon tax liability (such as non-profit organizations, schools and other public entities) must use the pass-through option of the Business Energy Tax Credit. The tax credit is 35% of eligible project costs. You file the credit over five years: 10% in the first and second years and 5% each year thereafter. For projects with eligible costs of $20,000 or less, the tax credit may be taken in one year. Unused credits can be carried forward up to eight years. The application can be accessed at:
http://www.energy.state.or.us/bus/tax/RenewAp.doc

# Appendix C: Household In-depth Interview Guide

## Solar Thermal Water Heating Market Assessment
### Consumer Interview Guide

Case Number: _____

Contact Name: _____

System Type: _____

City & County: _____

Telephone: _____

Contractor: _____

Introduce myself and background information on Energy Trust of Oregon (ETO):

- Tell them my name and representing ETO, with assistance from **the Oregon Office of Energy.**
- We are assisting ETO in learning more about the current market for solar water heating systems in Oregon and are interested in your experiences as a purchaser and owner of a solar water heating system. This information will help us to improve the effectiveness of ETO's programs.
- If they ask about ETO:
    - The Trust invests in energy efficiency and renewable energy on behalf of private utility customers in Oregon;
    - The Trust has programs that serve businesses and homes.

Ask to speak to the person most familiar with the purchase, installation, and operation of the solar water heating system.

Ask if they still have an operating solar water heating system *[If no, ask what prompted them to take out their system (or why it is not operating) and end the interview.]*

Start the interview or schedule a convenient callback time (interview should take approximately 20-30 minutes)

Note date and time of scheduled interview: _____

Note date and time of actual interview: _____

## A. Decision Making

*First, I would like to learn a little about your decision to install a solar water heating system.*

1. How did you first learn about solar water heating systems? What first caught your attention about *[interest in]* them? Do you recall about what year that was?

2. *[Encourage the person being interviewed to share the story of their decision to install a solar water heating system.]* I'd like you to think back from the time you first got interested in solar hot water systems to the time you purchased one. Could you tell me, step by step as you recall it, how you came *[decided]* to install one at your home?

*[Depending on the response to Q2 use Q3-Q6 as prompts]*

3. How did you learn more about solar water heating systems? What information sources did you use?

4. What types of systems did you consider? What type of solar hot water system did you select *[active, passive, pool, other]*? Why did you select this type of system?

5. What finally motivated you to purchase a solar water heating system?

*6.* What were the key factors in your decision? *Potential factors might include:*
   - *tax credit*
   - *payback*
   - *energy savings*
   - *greenhouse gas savings*
   - *other environmental benefits*
   - *reliability of the system*
   - *contractor credentials*
   - *other* _____

*7.* Were there any obstacles or barriers to your purchase decision? *[Ask about the difficulty of finding contractors, price, and complexity of the potential installation.]*

8. Do you recall how much your system cost? Do you remember the split between the equipment and the installation cost?

## B. Satisfaction with Solar Water Heating Contractors and Systems

*The next set of questions is about your satisfaction with the installation and performance of your solar water heating system.*

9. *[Encourage the person being interviewed to share the story of their installation experience.]* Please tell me about the installation of your solar hot water heating system from the purchase of the system to getting it operating and heating water at your home.

*[Depending on the response to Q9 use Q10 – Q14 as prompts]*

10. Was installation part of a remodel or new construction?

11. Did you use a contractor to install your system? Why or why not? How was the contractor selected? Did you consider multiple bids?

12. How did installation go? *[prompt about: any issues with the roof – life of existing roof, structural supports; time for installation from initial order; any installation problems]*

13. When was the installation of your system completed? *[The tax credit database has the date when the application was received, but does not have the installation date.]*

14. *[If not self-installed]* How satisfied were you with your installation contractor (both during and after installation)?

15. *[Encourage the person being interviewed to talk about the performance and operation of their solar hot water heating system.]* How satisfied are you with your solar water heating system? Is it exceeding your expectations in any way? Is it falling short of your expectations in any way?

*[Depending on the answer to Q15 use Q16 – Q20 as prompts]*

16. Is your solar water heating system delivering the expected energy savings? If not, what do you think might explain this?

17. Is your solar water heating system producing the expected *[adequate]* amount of hot water?

18. Does your solar water heating system need any periodic or regular maintenance? Do you do this work yourself or find a contractor to do it? Have you been able to find someone to do this work? Please describe this regular maintenance and its cost.

19. Has your solar water heating system needed any repairs (have there been any equipment failures)? Did you make the repairs yourself or find a contractor to do it? Were you able to find someone to do this work? Please describe the repairs and their costs.

20. Have there been any other benefits or problems with your solar water heating system?

21. Have you ever recommended solar water heating to others? If not, would you? If no, why not? *[If yes to either]*
    - What would you tell other people who are thinking about installing a solar water heating system in their homes?
    - Do you have any suggestions about what might be done to help or encourage other people to get their own solar water heating system?

22. Do you plan to continue using your solar water heating system in the future?

## C. Lifestyle Questions

*We'd like you to help us figure out more about the types of people who might be interested in buying solar water heating systems.*

23. Since most people do not own solar water heating systems, do you think people that choose to have a solar water heating system installed at their home are different *[unique]* in some ways from others? Please describe any differences.

24. What characteristics about you make you the type of person that would choose a solar water heating system for your home?

*I'm wondering how well some of the following descriptions fit you.*

25. Are you someone who purchases more energy efficient products than most people? What types of energy efficient products have you purchased?

26. Other than energy efficient products, do you tend to purchase more green or environmentally friendly products than most people? What types of environmentally friendly products do you purchase?

27. Would you describe yourself as a handy or do-it-yourself type person? In what ways?

28. Are you active in any environmental organizations? In what ways?

29. Would you consider yourself to be frugal? In what ways?

30. Do you believe that your individual actions can make the world a better place? In what ways?

31. Do you consider yourself an innovator? In what ways?

*To complete our interview, we would like to ask you several demographic questions that will be used to analyze the results of our survey.*

32. Approximately how old is your home?

33. What is the approximate square footage of your home? *[some people may not know]*

34. Which of these categories best describes your annual household income in 2003?
    - ☐ Less than $50,000
    - ☐ $50,000 - $75,000
    - ☐ $75,000 - $100,000
    - ☐ $100,000 or more

35. Which of these categories best describes your age?
    - ☐ Less than 25
    - ☐ 25 – 34
    - ☐ 35 – 44
    - ☐ 45 – 54
    - ☐ 55 – 59
    - ☐ Over 59

36. Note the person's gender.
    - ☐ Male
    - ☐ Female

37. That completes our interview. Are there any other experiences with your solar water heating system that we haven't talked about that you believe should be noted?

*Thank them for their input!*

# Appendix D: Household Phone Survey

## Solar Thermal Water Heating Market Assessment
### Consumer Interview Guide

Hello, my name is _____ and I'm calling on behalf of the Energy Trust of Oregon and the Oregon Office of Energy. We are doing follow-up interviews with selected households in Oregon that have installed solar water heating systems since 1998. Could I please speak to the person most familiar with your solar water heating system? [If needed: The interview will take about 10 minutes.]

[If no one in the household is familiar, terminate politely. Arrange for call back if needed. When the correct person is on the phone, repeat the introduction as needed and continue]

A. To double check, are you familiar with the buying and installing of your solar water system?

1. Yes
2. No

[Terminate politely if not familiar with buying and installing.]

B. And, are you still operating your solar water heating system at your home?

1. Yes
2. No

C. IF NO, could you tell me why you aren't operating the system?

_____

[Terminate politely if not operating the system]

1. About how long have you known about solar water heating systems? Would you say…

   1 Less than five years
   2 5-10 years
   3 11-15 years
   4 16-20 years
   5 More than 20 years
   6 DK/NA

2. How important were each of the following sources of information or experiences in your decision to install a solar water heating system at your home? Would you say (insert a-j) had high, medium, low, or no importance.

| | **High Importance** | **Medium Importance** | **Low Importance** | **No Importance** | **DK/NA** |
|---|---|---|---|---|---|
| a. Owning or using a solar water | | | | | |

| | High Importance | Medium Importance | Low Importance | No Importance | DK/NA |
|---|---|---|---|---|---|
| system in the past | | | | | |
| b. Installing or helping to install solar water systems for others | | | | | |
| c. Knowing about solar water systems because of your work, profession, or career | | | | | |
| d. Learning about solar water systems from other people who have them | | | | | |
| e. Receiving information or assistance from your local utility | | | | | |
| f. Receiving information from an environmental or solar organization | | | | | |
| g. Collecting information at a home show | | | | | |
| h. Obtaining information from a magazine, or newspaper | | | | | |
| i. Obtaining information from a website | | | | | |
| j. Learning about solar water systems from a solar water heating contractor | | | | | |

3. Were there any other important sources of information or experience about solar water heating systems that we haven't mentioned that helped you decide to install your system?

   1 No
   2 Yes -- Specify:
   _____

4. How important were the following factors in motivating you to purchase a solar water heating system? Would you say (insert a-i) was very important, somewhat important, not too important, or not at all important?

| | Very Important | Somewhat Important | Not too important | Not at all important | DK/NA |
|---|---|---|---|---|---|
| a. Building or purchasing a new home | | | | | |
| b. Remodeling an existing home | | | | | |
| c. The need to replace an existing water heating system | | | | | |
| d. Lowering your energy bill | | | | | |
| e. The state tax credit | | | | | |
| f. Rebates or low interest loans from your local utility | | | | | |
| g. How long the system would take to pay for itself through reduced energy costs | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| h. The environmental benefits such as reducing fossil fuel use or greenhouse gas emissions | | | | | |
| i. The desire to be less dependent on conventional fuel sources | | | | | |

5. In considering whether or not you would install a solar water heating system, were any of the following factors potential obstacles to moving ahead with your project? Would you say (insert a-g) was a major obstacle, a minor obstacle, or not an obstacle?

| | **Major Obstacle** | **Minor Obstacle** | **Not An Obstacle** | **DK/ NA** |
|---|---|---|---|---|
| a. The cost of the system | | | | |
| b. Finding a good contractor | | | | |
| c. Uncertainty about the reliability of a solar water heating system | | | | |
| d. The appearance of solar water heating systems | | | | |
| e. Concern about the resale value of your home | | | | |
| f. The condition of my roof or other structural issues | | | | |
| g. The maintenance requirements for the system | | | | |
| h. The lack of adequate solar access | | | | |

6. Which of the following best describes who installed your solar water heating system? Was it . . .
    1. A contractor
    2. Yourself with help from a contractor
    3. Yourself [Note to interviewers: This could include friends or others too.]
    4. DK/NA

7. How satisfied were you with the process of <u>installing</u> your solar water heating system? Would you say . . .
    1 Very satisfied
    2 Somewhat satisfied
    3 Not too satisfied
    4 Not at all satisfied
    5 DK/NA

8. Why do you say (insert rating from question above)

    _____

9. How satisfied are you with the <u>performance</u> of your solar water heating system?

1 Very satisfied
2 Somewhat satisfied
3 Not too satisfied
4 Not at all satisfied
5 DK/NA

10. Why do you say (insert rating from question above)

_____

11. What share of your household or pool hot water needs would you say your solar hot water system provides? Would you say it's providing…

- 75% or more
- 50 to 75%
- 25 to 50%
- less than 25%
- don't know

12. Is your solar water heating system producing the amount of hot water you had expected? Would you say it is providing

- more than expected
- about as much as expected
- less than expected
- a lot less than expected
- don't know

13. How strongly do you agree or disagree with each of the following statements about yourself? The first one is (insert a – h) .Do you agree strongly, agree somewhat, disagree somewhat, or disagree strongly

| | **Agree strongly** | **Agree somewhat** | **Disagree somewhat** | **Disagree strongly** | **DK/NA** |
|---|---|---|---|---|---|
| a. It's a high priority for me to buy energy efficient products for my home | | | | | |
| b. It's a high priority for me to buy green or environmentally friendly products | | | | | |
| c. I actively support environmental causes or organizations | | | | | |
| d. I believe my individual actions can make the world a better place | | | | | |
| e. If something needs repair at my house, I like to try to fix it myself | | | | | |
| f. I like to look for ways to save money even when I don't need to | | | | | |
| g. I like to do things somewhat differently | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| than other people | | | | | |
| h. I like to try out new or alternative products before other people do | | | | | |

14. Have you purchased any of the following energy efficient products in the last five years?

| | | | | |
|---|---|---|---|---|
| 1. | Compact fluorescent light bulbs | Yes | No | DK/NA |
| 2. | Fluorescent light fixtures | Yes | No | DK/NA |
| 3. | Energy Star qualified appliances | Yes | No | DK/NA |
| 4. | Energy Star qualified furnace | Yes | No | DK/NA |
| 5. | Programmable thermostat | Yes | No | DK/NA |
| 6. | Insulation for your home | Yes | No | DK/NA |
| 7. | Energy efficient windows | Yes | No | DK/NA |

These last questions are just to help us analyze our data better and are completely confidential.

15. Approximately how old is your home? Is it . . .

1 Less than 5 years old
2 5 – 10 years
3 11 – 15 years
4 16 – 20 years
5 21 - 25 years
6 More than 25 years old
7 DK/NA

16. About how large is your home in square feet, excluding your garage? Is it . . .

1 Less than 1,500 square feet
2 1,500 – 2,000 square feet
3 2,000 – 2,500 square feet
4 2,500 – 3,000 square feet
5 More than 3,000 square feet
6 DK/NA

17. Which of these categories best describes your annual household income in 2003? Would it be . . .

1 Less than $50,000
2 $50,000 - $75,000
3 $75,000 - $100,000
4 $100,000 - $150,000
5 Over $150,000
6 DK/NA

18. Which of these categories best describes your age? Is it . . .

□ Less than 25
□ 25 – 34

- □ 35 – 44
- □ 45 – 54
- □ 55 – 59
- □ 60 – 64
- □ Over 64
- □ DK/NA

19 Which of the following best describes the highest level of education that you have completed?

1 Some high school or less
2 High school graduate
3 Some college
4 College graduate
5 Post graduate degree
6 Trade or technical school
7 DK/NA

**Thank you very much for your help.**

20. Interviewer: Note the person's gender.

38. Male
39. Female

# Appendix E: Business Interview Guide

## Solar Thermal Water Heating Market Assessment
### Business Interview Guide

Case Number: _____

Business Name: _____

Contact Name: _____

System Type: _____

City & County: _____

Telephone: _____

Contractor: _____

Introduce myself and background information on Energy Trust of Oregon (ETO):

- Tell them my name and representing ETO, with assistance from **the Oregon Office of Energy.**
- We are assisting ETO in learning more about the current market for solar water heating systems in Oregon and are interested in your experiences as a purchaser and owner of a solar water heating system. This information will help us to improve the effectiveness of ETO's programs.
- If they ask about ETO:
    - The Trust invests in energy efficiency and renewable energy on behalf of private utility customers in Oregon;
    - The Trust has programs that serve businesses and homes.

Ask to speak to the person most familiar with the purchase, installation, and operation of the solar water heating system.

Ask if they still have an operating solar water heating system *[If no, ask what prompted them to take out their system (or why it is not operating) and end the interview.]*

Start the interview or schedule a convenient callback time (interview should take approximately 20-30 minutes)

Note date and time of scheduled interview: _____

Note date and time of actual interview: _____

## A. Background on Solar Installation

*First, I would like to ask you a couple of questions about your solar water heating system.*

1. In what type of business is your solar hot water system installed? *[In some cases this may be obvious and just confirm the information we have. In other cases it is not at all clear. If clarification is needed, ask follow up questions about the nature of the business.]* If multi-family, how many units in the property where the system is installed? How many units are served by the solar thermal system?

2. For what purposes do you use your system's hot water? *[For example, is it used for a pool, laundry, general domestic hot water, etc.?]*

3. How many panels are there in your solar system? *[This is an indicator of system size.]*

## B. Decision Making

*The next set of questions address your decision to install a solar water heating system.*

4. How and where did you first learn about solar water heating systems? What first caught your attention *[interested you]* about them? Do you recall about what year you first learned about these systems?

5. *[Encourage the person being interviewed to share the story of their decision to install a solar water heating system.]* I'd like you to think back from the time you first got interested in a solar hot water system for your business to the time you purchased one. Could you tell me, step by step as you recall it, how you came *[decided]* to install one at your business? *[Alternative: Tell me how the idea to install a solar water heating system at your business came up and why you decided to purchase a system?]* Probe: Try to get at all reasons, both business and personal, for installing the system. Try to differentiate which reasons were business and which were personal.

*[Depending on the response to Q5 use Q6-Q10 as prompts]*

6. How did you learn more about solar water heating systems? What information sources did you use?

7. Had you had previous experiences with solar water heating systems? Had you known other owners of solar water heating systems? If yes to either: did this influence your decision to purchase a system?

8. Did you consider different types of solar hot water systems? If yes, which did you consider? What type of system did you select *[active, passive, pool, other]*? Why did you select this type of system? *[Note that all the business systems are active, except for one passive system.]*

9. What finally motivated you to purchase a solar water heating system? What were the business reasons for making this decision?

10. How important were the following factors in your purchase decision? *[Important, Somewhat Important, Not Important]*
    - *tax credit*
    - *payback*
    - *energy savings*
    - *greenhouse gas reductions*
    - *other environmental benefits*
    - *system reliability*
    - *contractor credentials*
    - *other factors I did not mention? Specify:* _____

11. Were there any obstacles or barriers to your purchase decision? *[Probe for difficulty of finding contractors, price, and complexity of the potential installation.]*

12. Do you recall how much your system cost? Amount: _____

## C. Satisfaction with Solar Water Heating Contractors and Systems

*The next set of questions concern your experience with the installation and performance of your solar water heating system.*

13. *[Encourage the person being interviewed to share the story of their installation experience.]* Please tell me about the installation of your solar hot water heating system from the purchase of the system to its operation in your business.

*[Depending on the response to Q13 use Q14 – Q17 as prompts]*

14. Was installation part of a remodel or new construction?

15. Did you use a contractor to install your system? Why or why not? How was the contractor selected? Did you consider multiple bids?

16. How did installation go? *[prompt about: any issues with the roof – life of existing roof, structural supports; time for installation from initial order; any installation problems; any interruptions to the business]*

17. *[If not self-installed]* How satisfied were you with your installation contractor (both during and after installation)?

18. *[Encourage the person being interviewed to talk about the performance and operation of their solar hot water heating system.]* How satisfied are you with your solar water heating system? Is it exceeding your expectations in any way? Is it falling short of your expectations in any way?

*[Depending on the answer to Q18 use Q19 – Q23 as prompts]*

19. Is your solar water heating system delivering the expected energy savings? If not, what do you think might explain this?

20. Is your solar water heating system producing the expected *[adequate]* amount of hot water?

21. Are you receiving any other business benefits from your solar water heating system?

22. Does your solar water heating system need periodic or regular maintenance? Do you do this work yourself or find a contractor to do it? Have you been able to find someone to do this work? Please describe this regular maintenance and its cost.

23. Has your solar water heating system needed any repairs (have there been any equipment failures)? Did you make the repairs yourself or find a contractor to do them?? Were you able to find someone to do this work? Please describe the repairs and their costs.

24. Have you ever recommended solar water heating to other businesses? If not, would you? If no, why not? *[If yes to either]*
    - What would you tell other businesses who are thinking about installing a solar water heating system?
    - If multi-family property: Do you have other properties? IF SO: How likely would you be to install solar thermal at any of these other property?

25. Do you plan to continue using your solar water heating system in the future?

## D. Business Market Questions

*We'd like you to help us learn more about the types of businesses that might be interested in buying solar water heating systems.*

26. Is there anything about your *[type of]* business that you think makes it a more likely candidate for a solar water heating system *[or makes a solar water heating system an especially good fit.]*?

27. What types of businesses do you think are good candidates for solar water heating systems? *[What are the characteristics of good candidates? How can good candidates be identified?]*

28. Have you taken any other actions to reduce energy use at your business *[such as purchasing more energy efficient appliances or lights or putting in more insulation or better windows]*? What have you done? Did you receive any assistance/incentives to complete these improvements? If yes, in what year were these improvements completed? Who provided incentives? How important were the incentives in making these other improvements – very, somewhat, not at all?

29. Has your business taken other actions that help improve the environment *[such as using more green or environmentally friendly products]*? What have you done?

30. Are you or your business active in any environmental organizations? In what ways?

31. What business reasons would you use to encourage other businesses to consider purchasing a solar water heating system?

32. What suggestions do you have for the Energy Trust about developing programs that would encourage businesses to purchase solar water heating systems?

*To complete our interview, we would like to ask you several questions about your business that will be used to analyze the results of our survey.*

33. Approximately how many years has your business operated?

34. How many people does your business employ?

35. What are your annual business revenues?

36. That completes our interview. Are there any other experiences with your solar water heating system that we haven't talked about that you believe should be noted?

*Thank them for their input!*