OREGON PHOTOVOLTAIC MARKET CHARACTERIZATION

- Final Report -

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CONTENTS

1. OVERVIEW

This report summarizes research conducted for the Energy Trust of Oregon (ETO) to characterize the market for photovoltaic electric systems (PVs) in Oregon. The ETO has developed and launched a market transformation program for PVs and this research, conducted by Energy Market Innovations, Inc (EMI), is intended to provide a snapshot of the current PV market in Oregon and to provide guidance to the ETO in developing a baseline monitoring strategy that may be used to track future changes in the market. The report is also intended to provide information that will aid program planners and implementation staff in the their efforts to promote the use of this technology.

The research was conducted in two phases. In early 2003, research was conducted to characterize the "supply-side" of the market in terms of technology trends, installation activity, system sizes and costs, and barriers to growth. In the late spring of 2003, research was conducted to examine the "demand-side" of the equation, through interviews that were intended to capture and characterize the experiences and attitudinal characteristics of recent purchasers of grid-connected PV systems. This report summarizes the results of these two research efforts in order to:

- Provide a foundation of information upon which the program may be optimized and tracked into the future; and
- Identify where grid-connected PV lies along the path to broader customer acceptance by characterizing the attitudes and purchase decision processes of recent purchasers.

This report is organized into the following sections:

- Methodology
- PV system installation and cost trends
- Market Trends
- Consumer perspectives
- Summary and implications

2. METHODOLOGY

We describe below the methodology employed in conducting this research. Specifically, we describe the approach taken toward gathering data and information that was then analyzed to form a more thorough understanding of the supply-side (installers, manufacturers) and demand-side (consumers, recent purchasers) perspectives. Additionally, we provide an overview of the diffusion of innovations theory that serves as a framework for a portion of our consumer research.

2.1 Supply-side Characterization

The objective of the supply-side characterization was to paint as complete a picture as possible of the current market for PVs in Oregon. To address this objective, the research undertaken to support the supply-side characterization included the following tasks:

- **Broad literature review of market trends in California** – The bulk of recent PV market activity has taken place in California. As an initial step in assessing market trends, we reviewed almost 300 press releases and published articles from 2002 that were compiled and made available on the California Public Utilities Commission (CPUC), Office of Ratepayer Advocates (ORA), Self-generation Program website (http://ora.ca.gov/selfgen.htm).

- **Review and analysis of Oregon PV tax credit data** – Detailed historical data on PV tax credits approved in the state of Oregon were provided to the research team for detailed analysis.

- **Collection of information available regarding known grid-connected systems** – Information was collected from utility representatives and the Oregon Public Utility Commission (OPUC) regarding known grid-connected systems.

- **In-depth interviews with industry and market observers** – An in-depth interview guide was developed for this task and reviewed with ETO staff. A total of eight interviews were conducted.

- **In-depth interviews with PV manufacturers, distributors, and installers** – Using an in-depth interview guide approved by ETO staff, a total of 18 interviews were conducted (12 installers, 3 manufacturers, and 3 distributors), covering the majority of firms in the market.

2.2 Consumer Research

The primary objective of the consumer research was to understand more thoroughly the motivations, decision-making process, and experiences of consumers who had recently purchased and installed residential PV systems. We therefore conducted a series of in-depth telephone interviews with people who had installed grid-connected PV systems at their residences during the period 2000 through 2002 to explore several topics from the perspective of the PV consumer, including:

- Initial motivations and interest in PV
- Sources of information and search paths
- Key decision-making factors
- Barriers to purchase and installation
- Experiences with installation contractors
- Experiences and satisfaction with completed systems

Survey Development

In drafting the survey instrument for this work, we focused on the following topics:

- Confirmation of system data (e.g., year system was installed, description of equipment installed)
- Confirmation of contractor or self-install
- Personal interest in PV (e.g., how did their interest develop, when did it develop)
- Propensity to undertake other energy projects
- Sources of information relied upon and frequently used for PV and other home improvements
- Importance of information from an installation contractor
- Competing projects in which money could be diverted from PV
- Importance of various considerations in decision-making process (e.g., amount of electricity produced, PV vendor reliability, tax credit)
- Experiences throughout the installation process
- Overall satisfaction with installation and completed process
- Diffusion of information to others
- Attitudes towards innovations

Sample Development and Disposition

The source for the survey sample was the Oregon Residential Energy Tax Credit Database. From the database, we were able to identify names and addresses for people who had installed and received a tax credit during the period January 2000 through April 2003. Phone numbers were then researched in the paper tax credit files at the Oregon Office of Energy, and merged with the dataset.

The initial population included the recipients of 113 tax credits for residential photovoltaic systems in the three-year time frame. We attempted to call all of the contacts associated with

these installations, and conducted screening to eliminate those systems that were not grid connected[1]. Screening out the off-grid installations eliminated 53 people from the sample, as shown in Table 2-1 below, resulting in an eligible sample of 60 installations. Note that this figure may also be high since some portion of these remaining 60 that were not reached are likely to have had off-grid systems. Of these, we were unable to reach 34 people for various reasons, including phone number not working, no answer after 10 rings, or wrong number. Only three of the remaining 26 declined to participate in the survey, resulting in a very high response rate of 88 percent.

Table 2-1 – Sample Disposition

	No.
Original Population	113
Off-Grid Systems	53
Remaining Population	**60**
Bad Phone Number	19
Could Not Reach	15
Declined	3
Total Not Reached	**37**
COMPLETED SURVEYS	**23**

In-depth interviews were conducted with the 23 purchasers of grid-connected photovoltaic systems, or approximately 38 percent of the grid-connected purchasers targeted for this survey. These respondents to this survey were cooperative and very interested in sharing their experience of obtaining and owning a photovoltaic system. Many of the respondents were so interested in sharing their stories that the interviews (which were planned for approximately 20 minutes) typically lasted 35 to 45 minutes.

2.3 Diffusion of Innovations Framework

Product diffusion may be defined as the spread, among agents within an economic system, in the use (adoption) of a new product, technology, or otherwise productive asset. Economists and other social scientists have studied product diffusion in recent years as a means of understanding the forces of innovation within our economy and, in particular, the spread of innovative technologies. Market transformation, a term used in characterizing programs or public policy objectives to increase the rate of diffusion for a particular technology that is deemed beneficial to society (e.g., PV), is one of the primary objectives for the ETO Solar Electric program. As such,

[1] Note that, since the ETO program is promoting grid-connected systems, and because the decision-making circumstances are sufficiently different for non grid-connected systems, the decision was made to focus only on grid-connected systems.

understanding the factors that influence the diffusion, or spread, or PV technology will aid in refining the ETO Solar Electric program.

Diffusion of innovation theory holds that rates of adoption are determined, in part, by a predisposition among some consumers to purchase a new service or product. Some, for example, are more likely than others to purchase a technology while it is still relatively new. Product diffusion is first launched by consumers who are less risk averse than the general population and / or who are more willing and able to expend resources that will reduce that risk.[2] Over time, as awareness and perceived value of an innovation increases, more risk-averse segments of the population are likely to adopt a product. While supply side factors such as product improvements and price drops also influence adoption, messaging and delivery strategies that influence demand by responding to the core tendencies and behaviors of various adopter groups can also help to drive adoption.

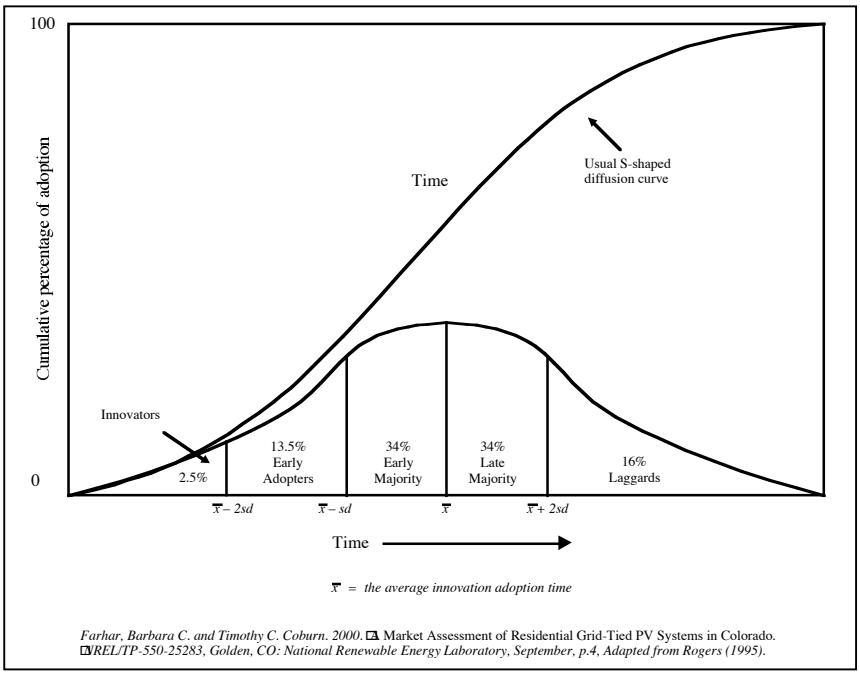
Using a categorization developed by Rogers, innovation can be shown to proceed sequentially across the five consumer categories of innovators, early adopters, early majority, late majority, and laggards. A summary of the characteristics of these groups is as follows:

- **Innovators** – Willing to take risk, have resources to pursue new ideas
- **Early Adopters** – Interested in new ideas, but more cautious and with fewer resources
- **Early Majority** – Interested, but want to see the idea has worked for others
- **Late Majority** – Will typically go along with what others are doing
- **Laggard**s – Tend to be the most risk averse and resource constrained

Figure 2-1, below, depicts the relationship among these groups within a product diffusion framework. Two important factors are at work within this curve. First, the cumulative adoption of a technology (as represented in this case by PV installations) increases over time. Second, the rate of change in the adoption (i.e., changes in the slope of the curve) also changes over time – starting out relatively slow, then accelerating, and finally tapering off at the end. Nested under the product diffusion S-curve is an estimate of the percentage of people, within the general population, who fall into the various categories. The bulk of the population, it has been suggested, falls within the early majority or late majority, with relatively few inclined to blaze new trails as innovators or early adopters. PV technology remains very early in the product diffusion cycle, and it is likely that the majority of recent adopters may be classified as innovators or early adopters.

[2] Farhar, Barbara C. and Timothy C. Coburn. 2000. *A Market Assessment of Residential Grid-Tied PV Systems in Colorado.* NREL/TP-550-25283, Golden, CO: National Renewable Energy Laboratory, September, pp 209.

Figure 2-1 – S-Curve Depicting Product Diffusion Cycle



Farhar, Barbara C. and Timothy C. Coburn. 2000. Market Assessment of Residential Grid-Tied PV Systems in Colorado. *NREL/TP-550-25283, Golden, CO: National Renewable Energy Laboratory, September, p.4, Adapted from Rogers (1995).*

From previous research, there are certain generalizations that we may make about consumers who fall within the various adopter groups. Innovators tend to control large resources, are knowledgeable about technology and, importantly, tolerate uncertainty. Early adopters, who follow the innovators, are well integrated into their communities and are people to whom others tend to turn for advice prior to adopting a new service or product. The early majority consumers are more deliberate than the first two groups, taking longer to adopt. The late adopters are skeptical of new ideas and cautious in their adoption. Finally, laggards are the last in the economic system to adopt an innovation, may be less integrated into social networks than other groups, and may be cautious for financial reasons.

This framework guided our approach to the survey of PV adopters. By developing an understanding of the characteristics of these adopters we can gain a better understanding of the location of the overall market for grid-connected PV systems on the product diffusion curve. Further, we can infer methods and the messaging needed to move the technology further along the curve. Thus, for the interviews with PV adopters undertaken in this study, we included a series of questions developed by Barbara Farhar at National Renewable Energy Laboratory (NREL), and added to by Jack Jenkins in a study for the state of Wisconsin[3] to identify adopter characteristics as they relate to potential purchasers of renewable energy systems.

[3] Jenkins, Jack. 2001. *Final Report: Homeowner's Attitudes Related to Using Renewable Energy in Northeast Wisconsin*. Prepared by Opinion Dynamics Corporation under contract to PA Consulting Group, Evaluation Administrator for State of Wisconsin Department of Administration, Division of Energy.

3. PV System Installation and Cost Trends

In this section, we summarize a variety of information that is intended to provide a comprehensive snapshot of the state of the Oregon PV industry prior to the introduction of the ETO Solar Electric program[4]. These include:

- Overview of Broad Industry Trends
- Annual Number of PV Installations in Oregon
- Total number of Grid-Connected PV Installations in Oregon
- Installed Capacity and Average PV System Sizes in Oregon
- Firmagraphic Characteristics of Oregon PV Installers
- Market Focus for Oregon PV Installers
- Average PV System Costs in Oregon

3.1 Overview of Trends

In attempting to gauge the level of PV market activity in Oregon, there are several reference points that have been used. These include:

- **Residential tax credit activity** – Information on residential energy tax credits approved in the state of Oregon. (1996-2003)

- **Business energy tax credit activity** – Information on business energy tax credits approved in the state of Oregon. (1996 – 2003)

- **System interconnect data** – Information on known grid-connected systems, as reported to the Oregon PUC by PacifiCorp and Portland General Electric, and information collected through interviews with representatives from the City of Ashland Solar PV program (a municipal utility with an active program promoting PV system installations).

From the above-referenced data, we were able to develop estimates of the following residential market baseline characteristics:

- Trends in numbers of installations
- Trends in installed system costs
- Trends in average system sizes
- Number of utility interconnected systems.

Table 3-1, below, provides an overview of the trends that may be derived from the residential tax credit database.

[4] The ETO launched its Solar Electric Program on May 2, 2003.

Table 3-1 – Summary Statistics, Oregon PV Residential Tax Credit Data

	1996	1997	1998	1999	2000	2001	2002
# of Installations (Total)	9	7	16	31	37	52	27
# of Installations (w/ Watt Data)	2	1	8	29	37	41	24
Total Watts Installed	2,384	600	5,310	24,695	37,745	30,760	15,322
Average System Size (watts)	1,192.00	600.00	663.75	851.55	1,020.14	750.24	638.42
Total Cost ($)	39,759	9,359	75,164	337,143	497,593	333,733	182,979
Total Credit ($)	2,400	1,200	9,108	38,149	52,050	53,028	29,764
Average Credit ($/watt)	1.01	2.00	2.61	2.03	1.83	2.18	2.42
Average Cost ($/watt)	16.78	15.60	15.21	14.20	13.41	10.90	12.71
Min Cost ($/watt)	15.44	15.60	5.05	4.52	5.46	0.00	3.70
Max Cost ($/watt)	18.12	15.60	29.14	26.13	26.50	20.00	62.50
Std Dev ($/watt)	1.89	N/A	9.58	6.32	5.40	4.78	11.72

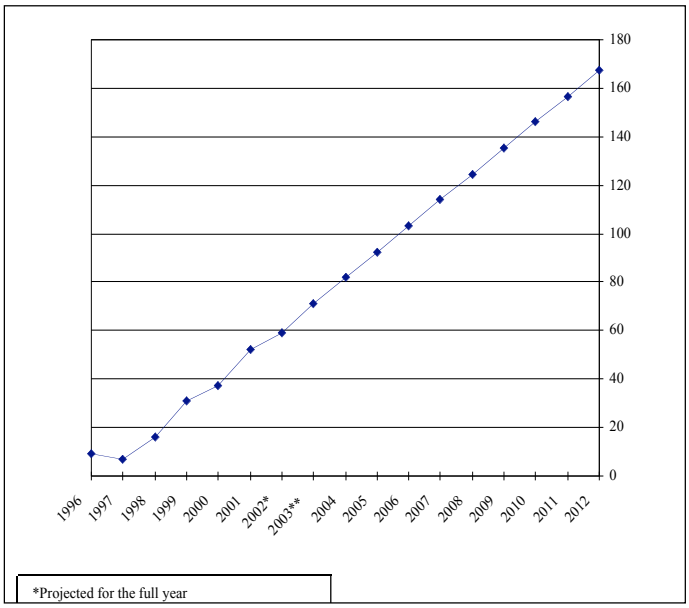
Starting in 1978, the state also offered a Business Energy Tax Credit (BETC). From the start of the BETC program through year-end 2002, 16 PV projects have been installed. Over 60 percent of these systems were installed in the past two years, including three in 2001 and seven in 2002. Far fewer systems have applied for this credit, and the data readily available in electronic format are less complete and thus less useful for examining trends.

3.2 Annual PV Installations

The Oregon PUC reports that tax credits were approved for 225 residential PV systems for the period 1984 through the end of 2001. An analysis of a subset of the residential tax credit data for years 1996 and beyond (determined to be most relevant to the current market) indicates that the total number of projects that qualified for the tax credit has increased steadily each year, at a rate of approximately 20-25 percent, and is projected to total approximately 60 systems in 2002[5]. This correlates with industry estimates provided by market observers we interviewed. Figure 3-1, below, illustrates recent trends and a 10-year straight-line projection of where this current trend might take the market.

[5] Note that, because the tax filings are due in April, there is typically a large number of applications that are submitted after the calendar year has ended.

Figure 3-1 – Actual and Projected PV Installations in Oregon (1996-2012, Base Case Scenario)

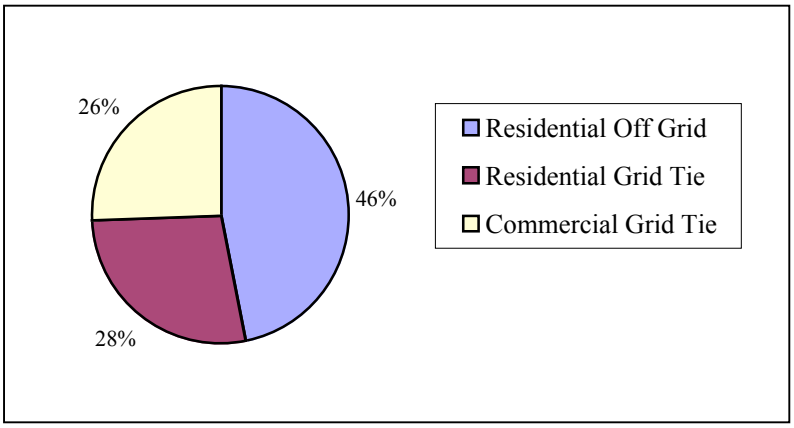


3.3 Grid-Connected PV Installations

The Oregon PV market includes both grid-connected and off-grid installations. Our best estimates indicate that there are at least 36 grid-connected systems in Oregon, totaling over 100 kW of capacity. This figure, based upon utility-provided records, may lag behind the actual number of systems that have been installed and will be eventually connected to grid. Additionally, although the number is thought by observers to be small, systems that may be installed on various municipal utility systems in Oregon (other than Ashland) are not included.

Industry observers report that there has been a recent increase in grid-connected systems, with approximately a 50/50 split at this point in time. Such a shift is difficult to verify from an empirical perspective since it is not known, from the tax-credit data, what percentage of these systems are actually grid connected. However, Figure 3-2 shows the estimated mix of grid tie and off grid systems for the past year, *as reported by the installers that were interviewed for this report.* Since the objective of the ETO program is to promote grid-connected systems, consideration should be given to working with the Oregon Energy Office to modify tax credit application forms to denote whether or not systems are expected to be grid-connected.

Figure 3-2 – Estimated Mix of Grid Tie and Off Grid Systems (2002)



Note: Based upon estimates provided by surveyed installers.

Interviews with staff at the Oregon PUC and utility representatives from PGE, PacifiCorp, and the City of Ashland yielded information on known utility-connected systems, as shown below in Table 3-2. Note that several of these installations are at public facilities and therefore do not show up in the statistics based upon tax data.

Table 3-2 – Oregon Net Metering Customers (1); Effective 6.30.2002

PacificCorp - Oregon (2)		Portland General Electric (3)		Ashland		Total
Generation Type	Rated kW	Generation Type (1)	Rated kW	Generation Type	Rated kW	
Solar	1.00	Solar	1.00	PV (muni)	5.00	
Solar	2.00	Solar	1.00	PV (muni)	5.00	
Solar	1.00	Solar	1.00	PV (muni)	15.00	
Solar *	1.00	Solar	1.20	PV (school)	0.64	
Solar *	1.00	Solar	1.25	PV (Univ.)	5.00	
Solar	8.00	Solar	1.40	PV (Res.)	3.20	
Solar	1.00	Solar	2.00	PV (Res.)	0.40	
Solar	5.50	Solar	2.05	PV (Res.)	0.40	
Solar *	1.00	Solar, Wind	2.40			
Solar	3.00	Solar	3.36			
Solar	2.50	Solar, Wind	3.79			
Solar	6.00	Solar	4.00			
Solar	4.00	Solar	8.40			
Solar *	1.50	Wind	25.00			
Solar	4.50					
Total # Solar PV Units:	15.00		13.00		8.00	36.00
Total Solar (kW):	43.00		29.75		34.64	107.39
Average Size (kW):	2.87		2.23		4.33	2.98

Notes:

(1) Source: Oregon PUC, provided by utilities in response to OPUC data request.

*(2) Actual capacity information for some customers is not available, marked with *. Per utility filing, staff confirm listed amount as a reasonable estimate for each of these customers.*

(3) Rate Schedule 203. Solar component assumed to be 50% of total solar / wind figure. Two additional units new or in-progress as of filing.

3.4 Installed Capacity and Average System Sizes

There are conflicting indications regarding trends in system sizes. Industry sources reported during in-depth interviews that systems presently being installed average two kW in size. Based upon the available tax credit data, average system size appears to have peaked most recently in the year 2000, at approximately one kW, and has declined since then to approximately 640 watts (see Table 3-1, above). Analysis of information on known grid-connected systems indicates a higher average as shown in Table 3-3.

Table 3-3 – Average Reported System Size in 2002 (kW)

Category	Average	No. Reporting Data
Residential Grid Tie	1.91	7
Residential Off-Grid	2.34	4
Commercial	21.00	4

Note: Based upon estimates provided surveyed installers and distributors.

One explanation for the difference in average sizes reported is that the data reported in Table 3-3 are based upon best estimates provided by installers and not upon actual system installation data. However, it also seems possible that the average size in the residential tax credit data is diluted by the fact that the Oregon Tax Credit, as structured, encourages installations in 500-watt increments. Thus, it is possible that several of the systems are actually located at the same address and are really part of a single system that was installed over the course of more than one year. This hypothesis was supported by information provided in interviews with consumers, several of who had installed their systems over multiple years.

3.5 Firmagraphic Data

Data collected on the twelve installation firms interviewed is summarized in Table 3-4. As shown, the typical installer is a very small business, averaging two and a half employees and installing an average of 8.4 systems per year. The people we talked with were generally very experienced in the industry and had, on average, been in business for over 14 years.

Table 3-4 – Installer Statistics

Category	Average	High	Low	Standard Deviation
Years in Business	14.7	30.0	2.0	8.86
No. of Employees	2.5	6.0	1.0	1.83
No. of Installs per Year	8.4	12.0	4.0	2.78

3.6 Installer Market Focus

During interviews, we asked installers to report the typical number of installations they might expect to complete in a year. This information is necessarily approximate; however, the results

are nevertheless indicative. As shown in Table 3-5, installers appear to focus predominantly on either the residential or the commercial market. Those working in the residential sector report few if any commercial installations. Similarly, those working predominantly in the commercial sector report that they will work in the residential sector, but really only do so as a favor since they report that they do not make a profit on these installations.

Table 3-5 – Market Share Concentration

Intallation Company	No. of Systems			Cumulative %
	Residential	Commercial	Total	
A	12	0	12	12%
B	12	0	12	24%
C	10	0	10	34%
D	10	0	10	44%
E	2	8	10	53%
F	2	8	10	63%
G	9	0	9	72%
H	0	8	8	80%
I	6	0	6	86%
J	5	0	5	91%
K	5	0	5	96%
L	2	2	4	100%
Totals	**75**	**26**	**101**	

3.7 Average System Costs

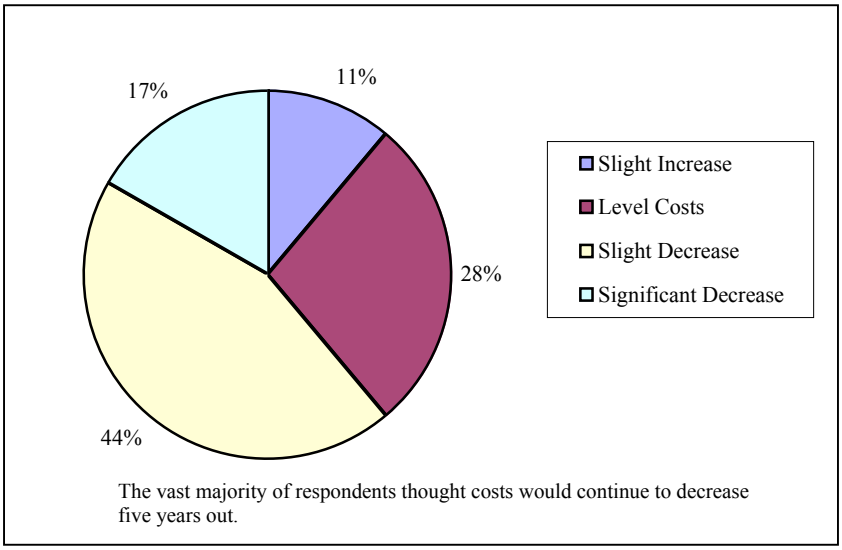
Average installed cost per watt has dropped over time and, at this point, appears to be in the range of $8-12 per watt. This figure was corroborated by industry reports indicating current installed costs in the range of $8-10 per watt, with an approximate breakdown as shown in Table 3-6. It should be noted that costs added to the "other" category differed by installer, but typically included miscellaneous hardware or sales related costs.

Table 3-6 – Reported break-out of Typical Installed System Costs

Category	Average	High	Low	Standard Deviation
Solar panels	55%	80%	40%	12%
Inverters	18%	25%	10%	6%
Installation	20%	40%	10%	9%
Other	7%	15%	0%	6%
Total Installed Cost ($/watt)	**$ 8.55**	**$ 14.00**	**$ 5.56**	**$ 2.21**

The majority of installers and market observers predict that costs will decrease slightly over the next five years, similar to what has happened in the industry over time. This is illustrated in Figure 3-3 below.

Figure 3-3 – Expectations of Trends in PV Costs during the Near-Term



4. MARKET TRENDS

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

- General market trends
- Technology perspectives in Oregon
- Market perspectives in Oregon
- Policy perspectives in Oregon
- Program design perspectives in Oregon

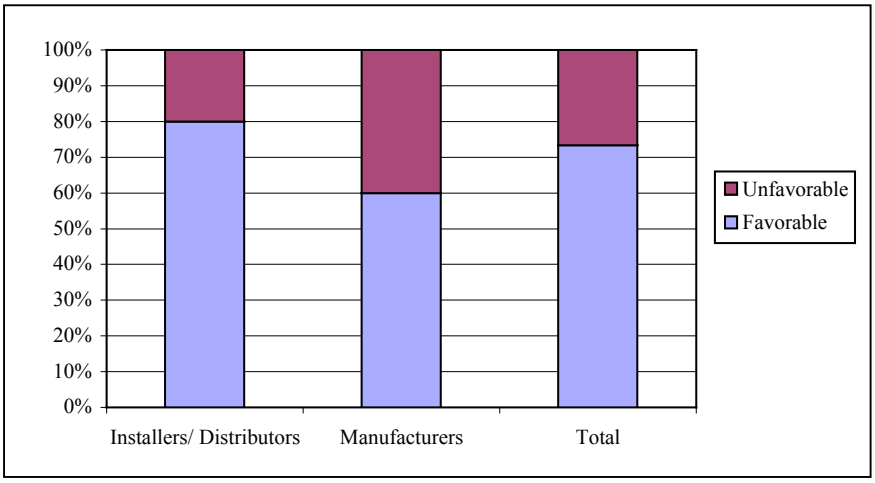
4.1 General Market Trends

Within general market trends, we summarize findings related to perceptions on the Oregon marketplace, specific companies, trends in PV technology, trends in new business models, and new applications for PV technology.

Perceptions Related to Oregon Marketplace

The majority of firms interviewed were generally excited about developments related to PV within Oregon. To quantify these responses, we categorized their responses as either "favorable" or "unfavorable," as shown in Figure 4-1 below.

Figure 4-1 – Reported Favorability of Oregon Marketplace for Grid-Tie PV



PV Companies

- **Entry of Sharp has spurred competition** – Sharp electronics, reportedly the world's largest producer of PV systems, issued a press release announcing that it will enter the U.S. market[6]. Sharp has been cited as attempting to buy market share and thereby contributing substantially to recent price drops in system components.

- **PowerLight** – PowerLight has a joint venture agreement with Siemens to use panels fabricated specifically for use by PowerLight. PowerLight has emerged as an aggressive firm, focusing largely on commercial applications as opposed to residential. Sales tripled to $23 million in 2002.

- **Evergreen Solar** – This firm is small (with approximately five million in annual sales), but may be worth watching closely as it is actively seeking to broaden its geographic sales mix in the residential and commercial grid-connected markets in New York and New Jersey. The firm has developed proprietary String Ribbon technology for manufacturing solar cells. The firm claims that this technology "strengthens [its] position as a leading technical innovator in solar industry."

Trends in PV Technology

- **Trend toward longer PV Module Warranties** – Twenty and 25-year warranties are now standard for PV modules. Astropower is offering a 20-year warranty on all of its equipment, thereby eliminating this barrier among both purchasers and installers.

- **Emergence of Rooftop integrated systems for residential markets** – Astropower announced in November 2002, a new line of roof integrated systems that will initially be marketed to the company's existing roster of partner homebuilders. The system directly replaces conventional roof tiles.

- **Trend toward system integration** – Sharp recognizes the need for easily integrated systems and will have a full product line. Similarly, Astropower is securing UL listings and is offering its products in Home Depot stores. Trends in this area are likely to diminish the current importance of the custom system design skills that are so prevalent in the Oregon PV industry.

- **Emergence of Freestanding flat roof system** – Schott Applied Power introduced SunRoof FS, a proprietary flat-roof system that requires no roof penetrations and no ballast. This was cited as a huge step forward for the flat roof, commercial-scale PV market.

[6] Note that subsequent information indicates that Sharp achieved a 12 percent market share during this first year.

- **Economics of Thin Film** – In November 2002, BP Solar announced that it was backing away from thin film technology, cutting its work force to concentrate entirely on crystalline silicon cells, which account for 85 percent of its production. The development of thin-film remains a promising technology and a high priority of the U.S. Department of Energy (DOE) Solar Program and NREL activities.

Trends in business models

- **Retail availability** – Astropower has an agreement with Home Depot to offer its SunChoice solar electric home power systems in 61 stores "to put solar power in the hands of mainstream consumer." This program worked very well in California and has been expanded to stores in the East Coast. Locations include San Diego, Los Angeles, Long Island, New Jersey, and Delaware.

- **Partnerships with production builders** – Astropower has been very aggressive in working with production homebuilders to incorporate PV into their new homes. They are targeting the market for homeowners (now 20 percent) who are reportedly willing to pay up to $10,000 more for a "green" home. The California tax credits and rebates put this within reach. Benefits to the builder include ability to differentiate their homes from others and price them at a premium.

- **Entry of electrical and HVAC contractors** – With the advent of standardized integration approaches, and extended warranties, it appears likely that electrical and HVAC contractors will enter the market as a means of establishing new business areas and distinguishing themselves in the area of energy efficiency (e.g., EconoAir, Anaheim, California).

- **New entrants** – Sun Power and Geothermal Energy, a firm located in San Rafael, California appears to be new and growing quickly. This indicates that new entrants may be expected in Oregon once the incentives are attractive enough to stimulate industry growth. Moreover, these new entrants may be expected to explore and develop new business models that build upon the changing technologies and structure within the marketplace.

- **Innovative financing as cornerstone of new business**
  - California Green Light, Inc., has put together a financing program in which homeowners will immediately be cash positive. Services include (1) assess economics for customer (utility incentives, energy use, etc.), and (2) help homeowner secure a home equity loan at low rate without fees or points or other access charges.
  - BP Solar is reportedly working to provide customer financing and/or leaseback arrangements.

Emergence of new applications for PVs

- **Solar Street Lighting** – National Solar Technologies of New York has developed a cost effective PV powered streetlight. Benefits of this technology include avoided costs associated with not having to dig up concrete or roadways to run electrical wiring, as well as the ongoing operating costs.

- **Agricultural applications** – WorldWater Corp is supplying solar-powered irrigation pumps to the California agriculture market. The system can be used as stand-alone or grid-connected.

4.2 Technology Perspectives in Oregon

In addition to providing insight into price and warranties, information gathered on technology perspectives in Oregon revealed technology preferences for both PVs and inverters.

Technology Preferences and Trends in Oregon: PV Modules

- All manufacturers of PV modules currently provide warranties of 20-25 years.
- A few of the installers noted that PV panels are now being viewed as commodity products. Prices have come down considerably and this trend is expected to continue.
- There is a preference in the market for Sharp panels, based upon both aggressive pricing and the fact that the systems are relatively well integrated (plug-in modules).
- There are reports of Sharp dumping product into the U.S. market in an effort to gain market share (now estimated at 12 percent).
- Manufacturers report that they expect continued price drops. Sharp, in particular, is citing potentially significant decreases in cost during the past year.
- Some installers express a definite preference for buying American-made products (e.g., Astropower).
- More than one person mentioned a desire to avoid oil-company linked suppliers as they feel that this supports what they referred to as "big oil."

Technology Preferences and Trends in Oregon: Inverters

- **Inverters are cited as the weak link** – Inverters are viewed, by many in the industry, as the weak link in the current market. This weakness is, in turn, opening the segment up to competition and innovation:
    - Sharp has announced that it will soon introduce its own line of inverters.
    - Outback, previously focused on off-grid technology, is coming out with a grid-tied inverter.

- **Inverters for grid-connected systems** – There is a general preference for Sunny Boy inverters in grid-connected applications.

- Some installers dislike Sunny Boy because their product is not scalable (i.e., one cannot add modules later on, which is important in Oregon because of tax structure).
- Sunny Boy claims an 85 percent market share for inverters.

- **Inverters for off-grid systems** – There is a general preference for Outback inverters for off-grid applications.

- **Challenges for Xantrex** – Xantrex had some quality control problems recently that has left a sour taste with many in the industry, but the company is actively working to make amends with the industry (free replacement of bad units and installation cost allowance).

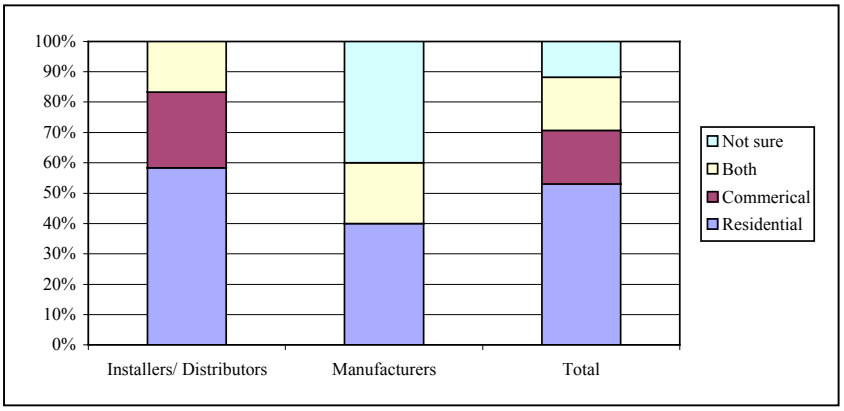
4.3 Market Perspectives in Oregon

Perspectives on the PV markets in Oregon include information on market focus among installers, PV system costs and trends, market barriers, marketing strategies, and marketing messages.

Potential market focus among installers in Oregon

- **Commercial or residential focus?** – Installers in Oregon hold varying opinions regarding whether commercial markets or residential markets hold greater potential. Those that are supportive of the commercial markets highlight better economics due to tax incentives, while the supporters of residential growth mentioned that it was a vast and virtually untapped market (referring to grid-tie systems). A slight majority of those interviewed do see more potential in the residential sector as shown in Figure 4-2 below.

Figure 4-2 – Market Segment with the Most Potential



- **Grid-connected vs. off-grid systems** – Many Oregon-based installers typically prefer grid-tie systems, if given the option. Reasons for preferring grid-tie projects include:
  - Relatively simple to design
  - Easier to install
  - No involvement with batteries
  - Less travel

- **Off-grid systems** – The off-grid market in Oregon is viewed by most installers as a well-developed niche with a relatively straightforward set of economic benefits.
    - There are established rules of thumb that dictate, "if you live X miles from the grid, it is cost effective to install PV."
    - Installers who state a preference for off-grid appear to derive the largest share of their business in this segment.

Market Barriers

- **Low electricity rates in the Northwest** – From a financial perspective, historically low electricity rates in Oregon are viewed as a barrier to widespread adoption.

- **Lags in inverter technology development** – Inverters are viewed as the number one technical challenge even though there has been much improvement in inverter technology. One installer speculated that inverters still only have 4.7 years for meantime failure (i.e., 50 percent will need to be repaired within five years). This is a vast improvement as another installer commented that he remembered a time when inverters would only last 30 hours before failure.

- **Industry approach toward power ratings** – The use of DC power ratings in the industry, rather than AC power ratings, is viewed as being misleading to consumers and an impediment to grid-tied installations. AC output will reflect a 30 percent loss relative to DC output ratings.

Marketing Messages

- **Perceived negative economics of grid-connected PVs** – PV installers repeatedly referenced the "fact" that PVs are not economic for grid-tie applications.

- **Oregon PV purchaser characteristics** – According to Oregon system installers, buyers of grid-connected systems tend to have the following characteristics:
    - Buyers tend to be older and technically oriented (e.g., 47 year-old engineer)
    - Have a graduate education

- **Primary consumer purchase motivations** – It was generally noted that the economic benefits of PV are not yet favorable enough to be a significant motivating factor for grid-connected systems. Motivations for purchase that were cited by installers include:
    - Environmental benefits
    - Energy independence
    - Status symbol

- **PV demonstration sites are important for marketing** – Several installers noted that visible demonstrations are important to promoting PV to the consumer.

  - "There is no real storefront for the PV industry (e.g., in all of Portland there is one company advertising PV to the public). The lack of visibility hurts [the] industry."

- **Myths or market misperceptions** – The following "myths" were mentioned during the interviews with Oregon installers:
  - PV will be very affordable "one of these days."
  - People can meet all of their electric needs with PV
  - Oregon does not have enough sunshine for PV

- **Marketing messages** – Messages and themes that were suggested for promoting PV include:
  - Produce green power at home, as well as purchase green from your utility.
  - Eco-guilt – The US is a large consumer of energy and PVs help to reduce consumption.
  - PV is a reliable technology.
  - Multiple benefits – Economic, environment, security.

- **Ways to market:**
  - Classes and/or seminars
  - Trade shows
  - Utility bill stuffers

- **Utility involvement** – Several installers recommended utility involvement in promoting PV, as they have the customer relationship and control of the grid interconnection process.

4.4 Policy Perspectives in Oregon

Information derived from industry interviews on perspectives related to net metering and interconnection, as well as tax credits, is summarized below.

Net Metering and Interconnection Issues

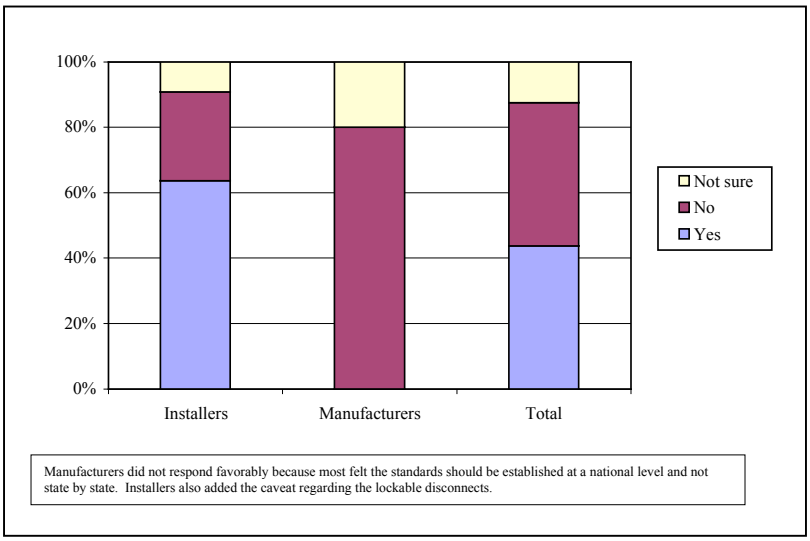
- **Net metering is critically important** – According to the majority of interviewees that commented on net metering, net metering is viewed as essential to the growth of the industry primarily because it improves the economics of PV.

- **Oregon net metering laws need improvement** – One interviewee commented that Oregon law should allow people to carry forward a credit for the value of their power. The current law zeros out the kWh balance each month, which does not give the consumer full advantage of months in which there is more power produced from PV.

- **Lockable disconnect requirements** – Interconnect standards require lockable disconnects that the industry views as unnecessary since the inverters do not work if grid is down and hence, do not pose any danger.
    - "Utilities need to realize that inverters won't work without a signal from the grid; therefore, extra rules or pieces of equipment are not necessary."

- **Need for consistent interconnection standards** – Interviewees, especially manufacturers, reported that interconnection standards did not meet needs (as shown in Figure 4-3) and many felt standards should be set at a national level and not vary by state. Specific standards mentioned included IEEE 9-29-2000 and NECS Chapter 690.

Figure 4-3 - Do Interconnection Standards Meet Needs?

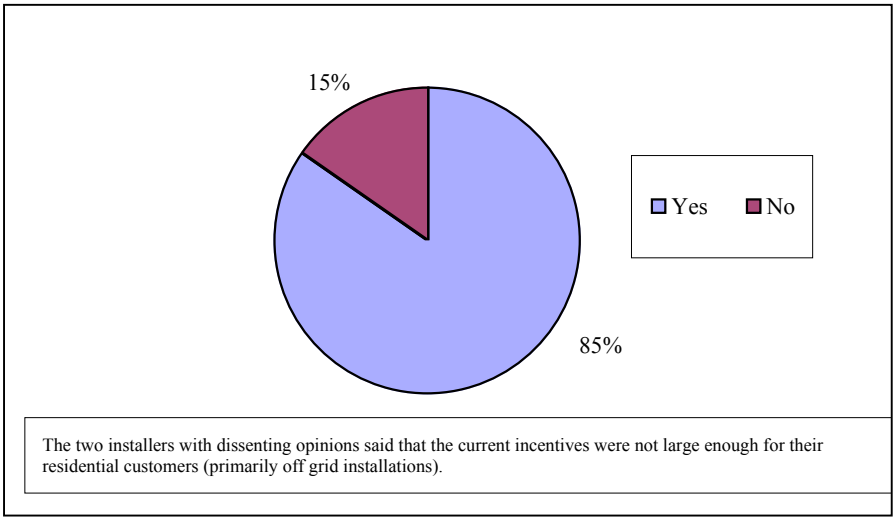


- **State of knowledge among Oregon electric coops needs improvement** – There is a perception that smaller utility co-ops may not fully understand current PV technology and therefore they are somewhat obstructionist in their willingness to facilitate interconnects.

Oregon Tax Credits

- **Importance of tax credits** – Figure 4-4 below shows that the majority of installers thought tax credits were important to the industry. However, there were conflicting opinions as to how important the Oregon residential tax credits are:
    - "Tax credits are essential, but too much will have installers addicted to them."
    - "Our research indicates that the combination of tax incentives and rebates that cover 30 percent of the system cost stimulate the most demand for PV."
    - "Tax credits are not that important. My clients never ask about them."

Figure 4-4 – Importance of Tax Credits to Industry (n=12)



Note: Based upon information provided by surveyed installers.

- **Tax credits to level the playing field** – Among those who favor tax credits, these credits are viewed as being essential to the development of the industry. There was repeated reference to "creating a level playing field among all energy sources."

- **Future role of tax credits** – There was general consensus that tax credits would need to remain in place for at least another five years to have a sustained impact in the market.

- **Commercial tax credits** – Tax credits for commercial installations were cited as being more favorable than residential installations at this time. In Oregon, purchasers qualify for the business energy tax credit (BETC), as well as federal tax credits, and accelerated depreciation treatment.

- **Bias in Oregon tax credit** – The structure of the Oregon tax credit appears to encourage consumers to limit installations to 500 watts and to stage their system installation over multiple years.

4.5 Program Design

Various perspectives on program design were offered by many of those interviewed. Since the ETO has conducted extensive outreach with the industry in developing its initial program design, we suspect that most of these perspectives have been heard previously. Nevertheless, we offer these perspectives for consideration as warranted.

- **Grandfathering for industry veterans** – There is a general feeling that experienced installers should be grandfathered in terms of the certification requirement.

- **Promote <u>all</u> solar technologies** – Several of those interviewed stressed that they believed the ETO should promote all technologies (e.g., small-scale wind and hydro, solar hot water), not simply PV.

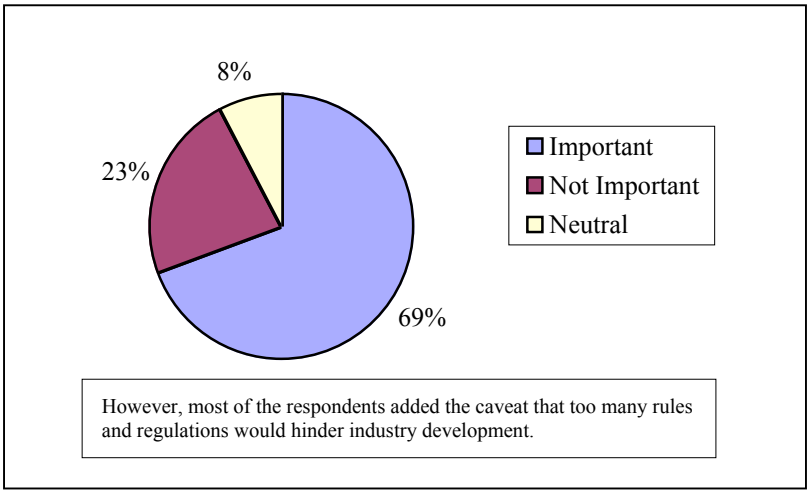
- **Include <u>all</u> of Oregon** – There were repeated references for the need to promote PVs in all areas of Oregon, and not limit program efforts to Portland and Eugene.

- **Keep it simple** – Installers expressed a desire for simplicity in program design. Not surprisingly, there were a few vocal installers who are not supportive of standards and certification.

- **Continuity** – It was stressed that there is a need in the marketplace for consistency in whatever the final program is, and not to start and stop. Continuity is important.

- **Balanced standards and certification** – The majority of installers and manufacturers see the need for standards and certification; however, most of the interviewees added the caveat that too many rules and regulations will stifle the marketplace. Within the ETO's marketing plan, there should be marketing to the industry itself stressing the benefits of standards – specifically the importance of these efforts in building the trust of consumers. Figure 4-5 summarizes the responses to whether standards and certification are important.

Figure 4-5 – Importance of Standards & Certification (n=12)



- **Promote efficiency with PV** – More than one installer emphasized the importance of achieving all available efficiency first, before installing PV. Although especially important in off-grid applications, it is also felt that this makes sense in grid-connected systems.

- **Explore performance-based incentives** – One person advocated for a performance-based incentive system, rather than a rebate system (note that this may be more appropriate as a subsequent approach to market development).

- **Conduct on-going outreach with manufacturers** – Manufacturers did not appear to be as well informed of developments in Oregon as might be expected. Perceptions included that (1) Oregon is not doing much, and (2) Oregon is more focused on wind than anything else. This suggests that additional outreach with manufacturers may be beneficial. One recommendation would be to see what they might be able to offer in the way of leverage and support to train the installer network in business practices. BP Solar seems especially out of touch with what is happening in Oregon.

5. CONSUMER PERSPECTIVES

This Section presents a summary of findings from the survey of PV adopters, organized into the following topics:

- Overview of adopter characteristics
- Adopter attitudes toward innovation
- Adopter decision-making process
- System installation and operating experiences
- Role of adopters in disseminating PV information

5.1 Overview of PV Adopter Characteristics

During the course of these interviews, we spoke with 23 individuals who had installed residential PV systems. The average system size was approximately700 watts, but included systems as large as 2.6 kW and as small as 300 watts. Investments in these systems ranged from a high of $30,000 to a low of just over $2,000.

Initial Interest in PV

The majority of these purchasers had heard about and explored PV for a substantial period of time before installing a system at their residence. Fully 70 percent of respondents indicated a long-term interest in PV, having been interested in PV for five or more years before installing the recent system (see Table 5-1, below). Several mentioned an interest going back over a decade, influenced by such factors as the energy crisis during the Carter administration and increasing global environmental concerns, including warming. One of the respondents with a more recent interest in grid-connected PVs had his interest triggered by concern over Y2K.

Table 5-1 – First Interest in PV

	No.	Percent
1-2 Years Prior to Install	2	8.7%
3-5 Years Prior to Install	4	17.4%
5 or More Years Prior to Install	16	69.6%
Other	1	4.3%
Total	**23**	**100.0%**

New Systems vs. System Expansions

A majority (82 percent) of the systems discussed were new installations and, as Table 5-2 indicates, the remaining were all expansions of already existing systems.

Table 5-2 – Expansion of Existing Systems

	No.	Percent
No	19	82.6%
Yes	4	17.4%
Total	**23**	**100.0%**

Contractor-installed vs. Self-installed

Table 5-3, below, shows that 65 percent of respondents had the systems installed by a contractor. Self-installers either had previous experience installing systems, or had technical backgrounds. Those who did install systems had electrical experience, received assistance from friends or acquaintances with technical backgrounds, or worked directly with the manufacturer for advice. Forty percent used the contractor as their main source of information prior to installing their system.

Table 5-3 – Contractor vs. Self-Installed

	No.	Percent
Contractor	15	65.2%
Self	8	34.8%
Total	**23**	**100.0%**

5.2 Adopter Decision-Making Process

In this section, we present survey findings for a wide array of topics related to consumer's PV decision-making.

Factors First Stimulating Interest in PV Project

When asked what first interested them in the current PV project, about half (11) of the respondents provided more than one reason while the remaining 12 provided a single reason, as Table 5-4 shows. Helping the environment was most frequently stated as first attracting their interest (15) followed by promoting the technology (6). Responses falling in the "other" category that received multiple mentions included:: reduced dependence on the electrical grid (4); desire to make a political statement regarding the present federal administration (4); tax credit (2); interest in solar as a hobby project (2); and coordination with a remodel (2). Single responses included: availability of attractive panels; a decline in PV system cost; availability of net metering; and first time home ownership.

Table 5-4 – Factors Stimulating Interest in Project

Common Responses	No.
To help protect the environment	15
To promote the technology	6
Political statement	4
Energy Independence	2
Energy reliability	2
Hobby project	2
Remodel	2
Attractive panels available	1
Availability of net metering	1
Decline in PV system cost	1
First-time home ownership	1
Tax credit	1
To promote my business	1
To save money	1
Total	**40**

Predisposition Toward Energy-related Projects

Among these respondents, there is a predisposition toward renewable energy that appears to be based, in part, on previous experience with solar hot water and other energy-related installations. As shown in Table 5-5, 87 percent of respondents noted that they have pursued other energy projects in the past. Of these 20 who had pursued other projects, 14 (70 percent) indicated that they had pursued solar projects other than photovoltaics. These included respondents who had solar water heat (11), solar water heat and a passive solar home (2) or a passive solar home with no solar water heating (1). Additionally, four of the 23 respondents (17 percent) indicated that this installation was an addition to an existing PV system.

Table 5-5 – Other Energy Projects

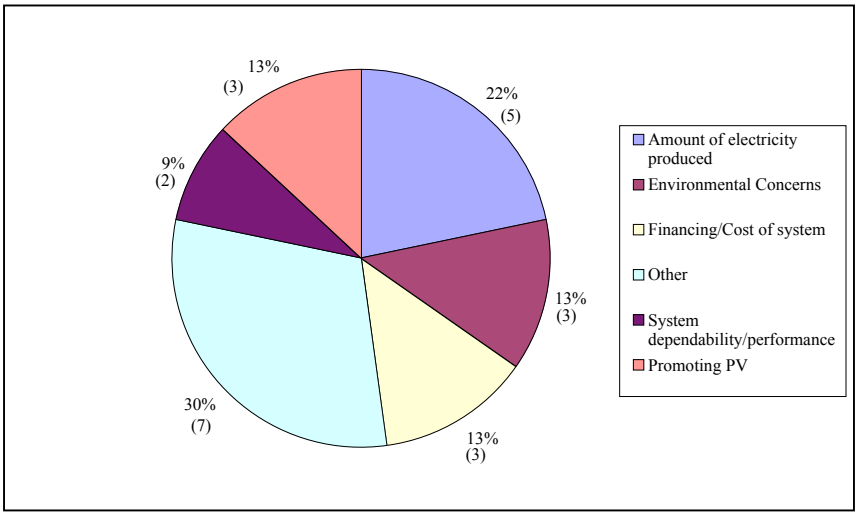
	No.	Percent
No	3	13.0%
Yes	20	87.0%
Total	**23**	**100.0%**

Three respondents had weatherized their home; note that while relatively few did weatherize, several noted that their homes are currently energy efficient, while others indicated that they were planning to add insulation to their homes. Also, the majority of these adopters has either added to, or is planning to add to, the existing PV system. For over one-third (35 percent) of the respondents, this grid-connected PV was an addition to a current system, or has been added to since receiving the tax credit. Three respondents specifically indicated that they intend to apply for future tax credits to continue adding to their system. Additionally, five indicated that they have already taken steps to prepare for additions to their system, including installing additional roof racks and installing an inverter that will handle increased output from added panels.

Important Decision-making Considerations

Each respondent was asked to identify the single most important issue that they considered in making their decision. As indicated in Figure 5-1, the "amount of energy produced" was considered the most important decision-making consideration by the largest number of respondents (5 or 22 percent) even though environmental issues were cited as the most important reason for first being interested in the project. Of the remaining respondents, "financing/cost of the system," "environmental concerns" and "promoting PVs" were each the top considerations of three respondents (13 percent for each of the three categories), and the system dependability and performance was the top consideration of two respondents (nine percent). The seven considerations (30 percent) included in the "other" category, were each selected by a single respondent. These included: "all considerations are important;" "codes and covenants;" "dependability and reputability of the vendor;" "energy Independence;" "protection against power outages;" "environmental responsibility;" and "having a good PV demonstration project."

Figure 5-1 – Most Important Consideration in Installing PV System



Role of Oregon Residential Tax Credits

Table 5-6 shows that while 100 percent of the interview sample was comprised of people who had received tax credits for residential photovoltaic systems, 65 percent stated that they would

have proceeded with the installation even without a tax credit. Moreover, the fact that the majority of these systems were installed by homeowners for whom cost was not the primary driver indicates that these purchasers were primarily innovators. Additionally, however, five volunteered that they have either applied for, or intend to apply for, multiple tax credits to expand their grid-connected systems. This indicates that the tax credit does play an important role for some portion and, in fact, influences the size and phasing of the actual installations.

Table 5-6 – Importance of Tax Credit in Decision to Purchase PV

	No.	Percent
No	7	30.4%
Yes	15	65.2%
N/A	1	4.3%
Total	**23**	**100.0%**

Time Sensitive Issues

Two-thirds of respondents considered the decision on their project to be time-sensitive in nature, as illustrated by Table 5-7, with four mentioning that the project needed to fit in with new construction or remodeling, four citing financial considerations and three citing the ability to apply for tax credits in a given year. Other reasons given for timing of the installation included a need to complete the project before travel, potential interference with working in the garden, a desire to protest national energy policy, and an eagerness to complete the project.

Table 5-7 – Time-sensitivity of PV Decision

	No.	Percent
No	8	34.8%
Yes	15	65.2%
Total	**23**	**100.0%**

Potential Barriers

Of the several factors that would have prohibited respondents from undertaking the PV project, the predominant factor was higher cost, referenced by 11 of the 23 respondents. The majority paid for the system with money that they had in savings; the remainder had taken out loans covering the installation, either as part of the cost of new construction or renovation, or as a loan to specifically fund the installation.

Two respondents each cited not having a tax credit, any rebates/incentives, and unreliable technologies as potential barriers to the project. The following factors were each mentioned by single respondents as barriers that might have prevented them from completing the project: extra utility charge; visual impact; insufficient solar access; no feasible placement; need for battery backup; and grid interconnection being unavailable.

Previous Consideration of PV Systems

Table 5-8 shows that 30 percent of respondents reported that they had considered a system in the past (prior to the project for which they received a tax credit) but had abandoned the idea. Seven of these eight respondents mentioned cost as the reason for not previously pursuing the system, but each had reached a point at which they could afford a PV system. The eighth stated that lack of interest on the part of a spouse prevented him from pursuing a previous PV project.

Table 5-8 – Previously Considered, but Abandoned PV Installation

	No.	Percent
No	14	60.9%
Yes	8	34.8%
N/A	1	4.3%
Total	**23**	**100.0%**

Sources of Information

Sixty-one percent of respondents used multiple sources of information in their installation decision. Slightly over half of the respondents had referred to publications in researching installation, as shown in Table 5-9. The most frequently mentioned publications were Home Power Magazine (7), the Real Goods Catalog (5), and Mother Earth News (2). Nearly 40 percent searched the Internet for information, as many as mentioned that they sought information from installation contractors or consultants. It should be noted that, for this question, respondents were not prompted by response category and that, when prompted, 18 respondents indicated that contractors were a source of information. While six of the nine web users were not specific regarding the sites they visited, the three others mentioned the following websites: Oregon Office of Energy (with two mentions); Mr. Solar; the NREL; Sandia National Laboratory; King Solar; the Oregon Solar Energy Association; Real Goods; and How it Works. Three respondents obtained information from home shows and/or home tours, while two had taken classes in solar energy before deciding to install the PV system.

Table 5-9 – Sources of Information Used in Decision to Install PV

	No.
Manufacturer	1
Installation Contractor	9
Oregon Energy Office	3
Magazines or Journals	12
Other	1
Internet	9
Home show.energy show	3
Classes	2
Total*	**40**

** Multiple responses allowed*

Assessment of Information Provided by Contractors

As Table 5-10 shows, 17 of 18 respondents receiving information from a contractor rated the information they received as at least a four on a five-point scale, where five indicates "very high quality." The one respondent who responded negatively based the response on experience with an initial contractor; the respondent ended up hiring a second contractor who received high marks. Five respondents did not receive information from an installer.

Table 5-10 – Quality of Contractor Information

	No.	Percent
1*	1	4.2%
2	1	4.2%
4	4	16.7%
5*	13	54.2%
N/A	5	20.8%
Total	**24**	**100.0%**

Interestingly, respondents noted varying types of decision-related information that had been provided to them by their contractors. Nine (47 percent) reported that the contractor had provided detailed product information, seven (37 percent) reported installation cost, four (21 percent) mentioned payback analysis, two (11 percent) mentioned net metering impact, and four (21 percent) mentioned other information. None mentioned a sun chart. These discussions with respondents also indicated that there was not a consistent "package" of information that these customers received to help them in their decision-making process.

Competing Priorities for PV Investments

As shown in Table 5-11, 13 respondents had other projects that competed with their installation decision. Options that competed with installing a PV system were most often another home improvement project or a decision to pursue another option for living in a more sustainable manner. For example, one person said that the PV purchase competed with installing new windows and insulation. Another person added that they were considering purchasing a hybrid vehicle, but purchased a PV system instead.

Table 5-11 – Competing Projects

	No.	Percent
Other Home Energy Projects	2	8.7%
Home Renovation	5	21.7%
Other	5	21.7%
Multiple Projects	1	4.3%
None	10	43.5%
Total	**23**	**100.0%**

Importance of Issues to Decision-making

Respondents were asked to rate the importance of 10 issues potentially affecting their decision to proceed with the installation. Ratings were done on a five-point scale, where one connotes "not at all important" and five connotes "very important." As Table 5-12 shows, the top three issues identified were "manufacturer reliability" with a mean score of 4.3, followed by "electricity produced" at 4.2 and "PV vendor reliability" at 4.1. The three issues of least importance were "maintenance expense" with an average score of 2.3, "space needed" with a score of 2.2 and "what friends and neighbors might say" at 2.1.

In addition to responding to the specified categories, five respondents named "promoting PV" as an important issue, with an average score of 4.6. Five respondents also mentioned "financing of the system," with an average score of 4.5. "Environmental concerns" was added as a major issue by three respondents and the score on this issue averaged 4.3.

Table 5-12 – Importance of Issues to Decision-Making

	Average Score
Other: Promoting PV (5 responses)	4.6
Other: Financing/cost of system (5 responses)	4.5
PV manufacturer reliability	4.3
Other: Environmental concerns (3 responses)	4.3
Electricity produced	4.2
PV vendor reliability	4.1
Warranties	3.9
Ease of installation	3.0
Need for repairs	3.0
Codes or covenants	2.6
Maintenance expense	2.3
Space needed	2.2
Friends and neighbors	2.1

5.3 System Installation and Operating Experiences

Respondents were asked a variety of questions regarding their experiences with the installations and subsequent operation of the system.

Site Preparation and Permitting

Few issues were reportedly encountered in the permitting process for PV installations. Five respondents specifically credited their installation contractors for this, noting that they often addressed any such issues as they arose. Two respondents felt that permit costs were excessive. Site preparation was required in almost half of the instances, as shown in Table 5-13. For roof-mounted systems this was mainly focused on reinforcing the roof or re-roofing. The most extensive preparations were typically required for the installation of pole-mounted systems. This preparation included trenching for wire and excavation for poles.

Table 5-13 – Preparation Required for PV Installation

	No.	Percent
No	12	52.2%
Yes	10	43.5%
N/A	1	4.3%
Total	**23**	**100.0%**

As shown in Table 5-14, 74 percent of respondents experienced no problem with licensing or permitting for their systems. Of those who had problems, three mentioned difficulty working with the utility on net billing, and two indicated difficulty obtaining an inter-tie agreement with the utility, with one of these respondents reporting that his installer made a presentation to the utility board to explain the net metering law and utility compliance. Two others felt the electrical permit fee for their installation was excessive. Some respondents also noted that their contractors took care of licensing and permitting, and therefore they were not in a position to comment on any specific licensing or permitting issues.

Table 5-14 – Licensing or Permitting Barriers Encountered

	No.	Percent
No	17	73.9%
Yes	6	26.1%
Total	**23**	**100.0%**

Tax Credit Application Process

As Table 5-15 indicates, four respondents had difficulties with the tax credit application process, each having a different difficulty. The difficulties that were cited included: not knowing to submit a contractor certification; slow response by contractor in providing necessary information; an ongoing delay in receiving the tax credit; and a time consuming and cumbersome tax form.

Table 5-15 – Tax Credit Barriers Encountered

	No.	Percent
No	19	82.6%
Yes	4	17.4%
Total	**23**	**100.0%**

Installation-related Issues

Approximately 35 percent of the respondents reported encountering some sort of issue between the time of deciding to proceed and the installation, as shown by Table 5-16. The issues reported, at one apiece, were:

- Failed inverter
- Utility was not helpful in providing information for calculating savings
- Initial contractor performed poor quality work
- Locating the system properly
- Inspectors were not familiar with the technology, so extra time was needed for the inspection
- Delay in receiving approved inverter
- Difficulty in figuring startup process for inverter
- Difficulty getting financing

Table 5-16 – Other Issues Encountered Between Decision and Installation

	No.	Percent
No	14	60.9%
Yes	8	34.8%
N/A	1	4.3%
Total	**23**	**100.0%**

Scope and Cost of Installation

Tables 5-17 and 5-18 show that 35 percent of respondents reported that their projects took longer to complete and cost more than expected.

Table 5-17 – Length and Effort Project: Expectations vs. Actual

	No.	Percent
Less	1	4.3%
Same	13	56.5%
More	8	34.8%
N/A	1	4.3%
Total	**23**	**100.0%**

Table 5-18 – Project Cost: Expectation vs. Actual

	No.	Percent
Less	1	4.3%
Same	14	60.9%
More	7	30.4%
N/A	1	4.3%
Total	**23**	**100.0%**

Satisfaction and Overall Expectations

Respondents were asked to specify how they felt their systems performed, and whether they would have done anything differently. More than 70 percent responded that, overall, the project either met or exceeded their expectations. These results are summarized in Table 5-19 below. The most common reasons, either favorable or unfavorable, related to system performance or the power output. The three respondents commenting on how the system exceeded their expectations indicated that the system put out more energy than expected, while all seven respondents commenting on how the system met their expectations indicated that it was producing power as expected. Two of the three with systems operating below their expectations indicated that the system was producing less power than expected, while the third said that the system has yet to be connected to the grid.

Table 5-19 – Overall Project Expectations: Expected vs. Actual

	No.	Percent
Below	3	13.0%
Meet	12	52.2%
Exceed	6	26.1%
Don't know	2	8.7%
Total	**23**	**100.0%**

Using a five-point scale, where one indicates “very dissatisfied” and five indicates “very satisfied”, 78 percent rated their overall satisfaction with the completed project as a four or a five, with approximately 70 percent saying they were “very satisfied.” (See Table 5-20, below) These results complement the findings related to overall project expectations. As with the satisfaction with system performance, overall satisfaction was strongly related to the amount of power being produced by the system.

Table 5-20 – Satisfaction with Completed Project

	No.	Percent
1	1	4.3%
3	2	8.7%
4	2	8.7%
5	16	69.6%
N/A	2	8.7%
Total	**23**	**100.0%**

Lessons Learned

As Table 5-21 below shows, 52 percent stated that they would undertake some aspect of their project in a different manner if given the opportunity, and cited one or more specific items, including the following:

- Do something differently with the inverter, including buying a different type or brand (5)
- Build a bigger system (2)
- Change the order of a construction process, such as when to insulate (2)
- Change equipment configuration. This includes installing an automatic switch for the battery and grid (1), changing voltage to reduce line loss (1), and putting in a battery backup (1).

Table 5-21 – Project Changes if Doing Project Again

	No.	Percent
No	10	43.5%
Yes	12	52.2%
Don't Know	1	4.3%
Total	**23**	**100.0%**

All respondents offered words of advice. These responses varied, but may be grouped as follows:

- **Do your homework** – Many respondents brought up how important it was to do thorough research and shop around before selecting a system and an installer.

- **Plan on making a significant investment** – Respondents would want to let people know not to skimp on quality and not to expect fast paybacks on their systems.

- **Talk to a qualified contractor** – Get references and make sure you are comfortable with the contractor you choose. Even respondents who had installed systems themselves often consulted with a contractor to make sure things were done properly.

Importantly, the Solar Electric program implemented by the ETO includes elements that address each of these above areas. Technical assistance is provided as requested; financial incentives are provided to offset the cost of the investment; and steps are taken to assist consumers in differentiating among various contractors.

5.4 Role of Adopters in Disseminating PV Information

One typical characteristic of innovators and early adopters is that they often serve as sources of information for the new technology product in which they have invested. We therefore asked questions of respondents to determine if in fact this was the case with these adopters.

Interest of Friends and Acquaintances

All but one respondent said that their friends have expressed an interest in their system, as show by Table 5-22, below. The most common questions asked were "how much power does the system produce?" and "what does it cost?" Most of the respondents also added that while their friends had expressed interest, very few of them have actually purchased a system. The one person responding negatively said that his friends are too busy out buying fast cars and SUVs.

Table 5-22 – Friends and Acquaintances Shown Interest in PV

	No.	Percent
No	1	4.3%
Yes	22	95.7%
Total	**23**	**100.0%**

Recommend PV to Others

One hundred percent of respondents indicated that they would recommend a grid-connected PV system to others. The most frequently cited reason for recommending the system to others, mentioned by nine respondents, focused on helping protect the environment by using clean energy. Another eight recommended it as a way to help avoid an energy shortage or energy crisis. Three would recommend it because they feel it is affordable; another three consider it an alternative to spending money on large, extravagant purchases that are not environmentally beneficial. Other reasons for recommending it to others included: personal energy independence (three); promoting the solar industry (two); and simplicity and effectiveness (one). Respondents were permitted to provide multiple responses to this question.

While all said they would recommend the system to others, seventeen limited the type of person they would recommend it to. Eleven said they would recommend it to people who were financially able to afford it, four would recommend it to people concerned about protecting the

environment, and four would recommend it to those concerned about an energy shortage. Three respondents would recommend the system to do-it-yourselfers, while one would recommend it to people interested in reducing energy cost.

PV Adopters as Evangelists

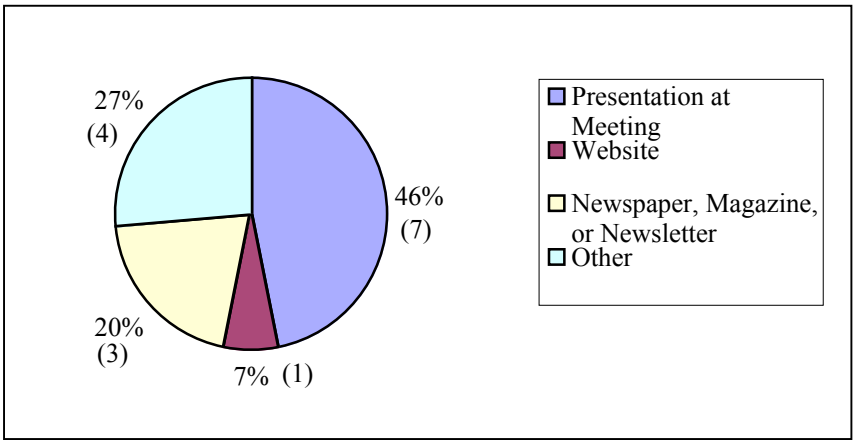
Several of our findings indicate that these respondents became "evangelists" for the PV technology after their systems were installed.

- **Twelve of the respondents have promoted PV systems beyond their group of friends and family (Table 5-23 and Figure 5-2, below) –** The three most common methods for promoting PV are through Internet discussion groups, local newspapers or magazines, and allowing people to visit their homes as part of a solar tour.

Table 5-23 – Communicated PV to a Wider Audience

	No.	Percent
No	11	47.8%
Yes	12	52.2%
Total	**23**	**100.0%**

Figure 5-2 – Method of Communicating to a Wider Audience



- **All of the respondents would recommend this type of project to others –** Their reasons for recommending a system varied, but the common themes included environmental concerns (including fossil fuel depletion), energy independence, and wanting to stimulate development of solar industry (a couple of people mentioned that this would stimulate demand and then lower costs for people to install systems).

- **Many adopters want friends and neighbors to notice their PV system. –** These people were not concerned with whether their neighbors did not like a system in their neighborhood, but were more concerned with positively promoting the technology and,

therefore, having their friends and neighbors respond favorably towards installing their own system.

5.5 Adopter Attitudes Toward Innovation

One of the key objectives of this research was to explore the attitudes of recent PV purchasers in order to understand where they fall within a diffusion framework. Understanding these attitudes, as well as important motivating factors, provides insights that may support given marketing messages and tactics. We provide below a summary of the overall framework for this analysis, as well as the results we obtained, and important marketing implications.

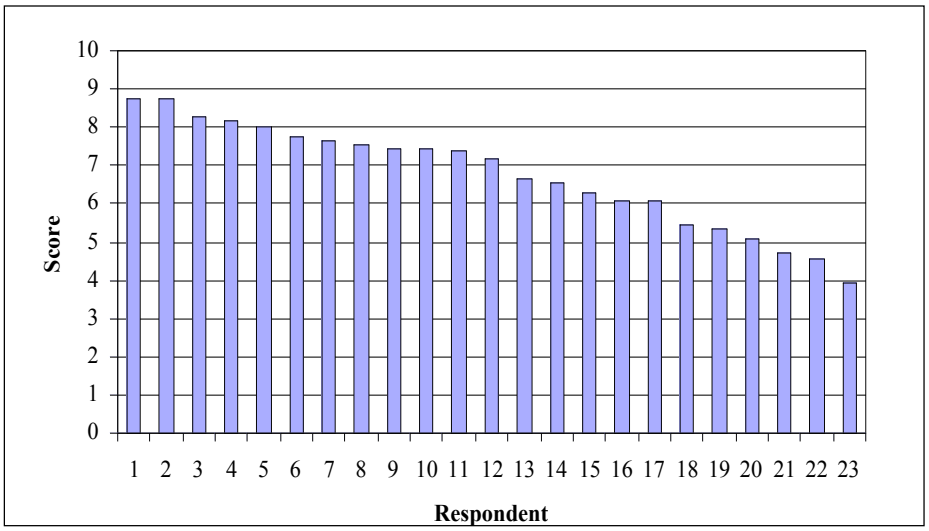
Attitudes Toward Innovation

In order to investigate the attitudes of recent PV adopters toward innovation, and to understand where these consumers lie on a product diffusion curve, a series of questions was used to identify technology adoption characteristics of respondents. These questions, as discussed in Section 2.3, are drawn from a survey of Wisconsin residents (Jenkins, 2001) and can be used to understand where adopter falls within the product adopter categories. Five of these questions were also used in the earlier Colorado study also previously discussed[7]. Responses to these survey questions, combined with information on actual consumer behavior for grid-connected PV, indicate that the grid-connected installers surveyed fall in either the innovator or early adopter categories for solar photovoltaics.

For each respondent, we calculated an average innovation score based on their responses to eleven questions, the results of which are shown in Figure 5-3. Respondents were asked to score, on a linear scale of 1-10, the degree to which they agreed with each statement. A high score to a given question is an indicator that the respondent is predisposed towards innovation while a low score is an indicator of not being predisposed. To counter bias related to the positive scaling of each question, three "dummy" questions with negative scaling were placed in different spots in the survey sequence. The results of our analysis of these questions suggest that there is a mix of both technology innovators and early adopters among these PV purchasers.

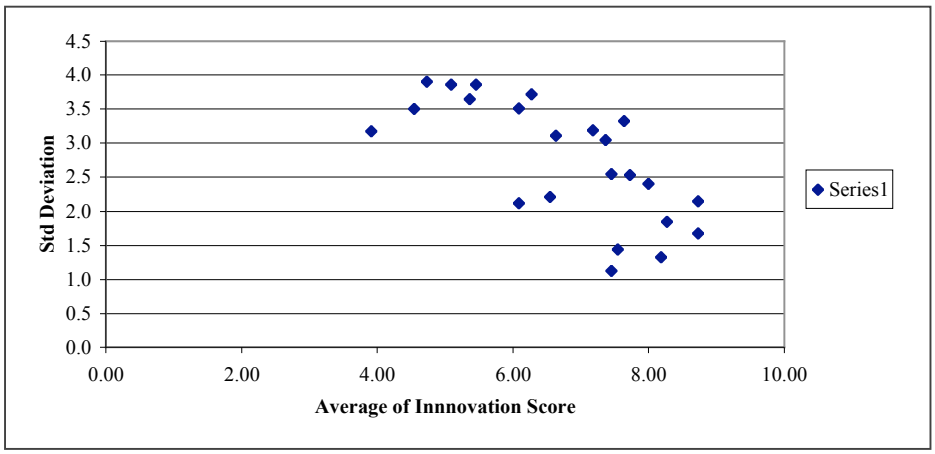
[7] *Appendix B: Adopters of Innovations, Focus on Energy Pilot Study, Final Report: Homeowners' Attitudes Related to Using Renewable Energy in Northeast Wisconsin*. August 14, 2001. Summarized from Everett Rogers, *Diffusion of Innovation*: *Chapter 7 Innovativeness and Adopter Categories*. 1995. pp. 252-280.

Figure 5-3 - Distribution of PV Purchaser Innovation Scores



Interestingly, a scatter plot of the average innovation scores and the variance around these scores (as measured by the standard deviation of each individual's scores) reveals another dimension to these adopters. Specifically, as shown in Figure 5-4, those adopters who generally score lower in terms of their inclination toward innovation are also likely to have a greater variance around their scores. That is, these individuals agreed very strongly with some statements but disagreed strongly with other statements.

Figure 5-4 – Variance in PV Adopter Innovation Scores



An analysis of responses for each question (i.e., with which questions respondents agreed most strongly) is provided in the following section.

Analysis of Individual Questions

To complement the analysis of individual scores, we examined the data to quantify the average scores and variance *across each question* (as opposed to each of the individuals). This analysis, the results of which are shown in Table 5-24, show that some questions were scored more highly

than others. In addition, we examined the variance in responses to these questions, across all of the individual respondents, in order to understand where there was likely to be convergence, or agreement, among the statements they were asked to score.

Further examination of these individuals' responses also helps to explain the variance observed among some of the respondents. This analysis shows that three questions, in particular, were primarily contributing to the above-noted high variance among respondents for whom the average score of innovation was lower. Each of these questions centered on technology-related innovation issues as opposed to other areas of innovation. The fact that respondents scored lower on these questions (Q8.4, 8.6, and 8.10) indicates that, although many of these PV purchasers may consider themselves to be innovators in many ways, they are not necessarily *technology* innovators. Rather, they may more aptly be classified as *environmental* innovators or *lifestyle* innovators. Our analysis suggests that, since the majority of new purchasers will continue to be a mix of innovators and early adopters from the early part of the adoption curve (see Figure 2-1), messages appealing to these types of innovators, as opposed to strictly technology innovators, will be most successful in attracting the next wave of program participants.

Table 5-24 - Relative Applicability of Attitudinal Themes To PV Adopters

Applicability	Attitudinal Theme	Average Score	Std. Deviation	Std Dev. As % of Average Score
Attitudinal themes that resonate consistently well.	*8.5 "I am willing to accept modifications to my lifestyle if it helps the environment."*	9.2	1.3	14%
	8.7 "I buy environmentally-friendly products, even if they cost somewhat more."	8.8	1.3	15%
	8.1 "I like to experiment with new ways of doing things."	8.3	1.7	21%
Attitudinal themes that resonate with some but not all.	*8.9 "I like to be as independent as possible so I don't have to rely on others to meet my needs."*	7.5	2.7	36%
	8.2 "I am seen as a leader in my work life, social life, or volunteer activities."	7.4	2.2	30%
	8.11 "I like to keep up with and know about new technology even if I can't afford to buy it right now."	6.7	3.0	45%
	8.3 "I track trends in society to make sure I am prepared."	6.7	2.8	42%
	8.8 "I know a lot about new technologies, compared with most people."	6.3	2.9	45%
Attitudinal themes that do not resonate well.	*8.6 "I read technology magazines or journals."*	5.4	3.7	69%
	8.4 "People seek out my advice before they make a decision about a technology."	4.8	3.0	62%
	8.10 "I like to be the first of my friends and people I work with to get a new technology."	2.9	2.4	82%

Potential Marketing Implications

As also shown in Table 5-24, above, the individual questions fall neatly into three groups: those that scored high consistently and with low variance; those that scored moderately well, but with increased variance; and, those that scored low and had a very high variance. The statements with high mean scores – those that resonate well – suggest that marketing messages capitalizing on these themes, i.e., environmental concern and a desire to try new things, could be effective. Additionally, these consumers view themselves as leaders. Targeting messages to these leaders

based, using themes that consistently express their views, could be effective with other innovators and early adopters.

6. SUMMARY AND IMPLICATIONS

We provide, below, a summary of key findings and implications resulting from this research. These include:

- Summary of PV market Developments
- Key policy considerations
- Program tracking and evaluation considerations
- Additional support for consumers
- Program marketing and promotional efforts

6.1 Summary of PV Market Developments

Several salient market trends were identified:

- **Recent PV purchasers are, as a whole, very satisfied with their decisions, and with their installation experiences** – This indicates that the current industry has built a positive reputation in the market, thereby providing a solid basis for future industry development.

- **System costs are declining through competition** – System costs are currently at $8-10 per installed watt of capacity. Installed system costs are declining, with competition among manufacturers, and this trend is expected to continue.

- **Inverter technology is improving** – Inverter technology, historically the weak link in PV system design, is improving. Weaknesses in this area have led to innovation and increased competition to supply reliable products to the market.

- **Rapid changes in the composition and structure of the Oregon PV market are likely** – There is a tremendous amount of innovation occurring outside of Oregon that will inevitably have an impact upon the characteristics of the market in Oregon. These include the availability of PVs through consumer retail channels, entry of electrical and HVAC contractors, development of standardized modular systems, and PV roof tiles for new construction.

6.2 Key Policy Considerations

Key policy considerations and recommendations identified during this research include:

- **Continue efforts to revise Oregon residential PV tax credit structure** – Discussions with PV installers, as well as an analysis of tax credit data and surveys with consumers who have recently purchased PV systems, indicate that the Oregon tax credit structure currently distorts the development of a market by constraining system size to 500 watts.

- **Facilitate review of experiences with Oregon net metering laws** – Discussions with installers suggest that Oregon's net metering provisions appear to not work as well as they could. The PV program evaluation may need to address this issue within its scope. Moreover, there may be a role for the ETO to play in facilitating a review of this law.

- **Continue program policy of standards and certification** – While there is some reluctance among the current industry to have stringent standards and certification requirements, the majority of market actors/observers interviewed recognize that this is likely to be in the long-term interest of both the consumers and the development of the market. Nonetheless, there was a strong interest among all parties to "keep it simple."

- **Maintain flexibility to adjust financial incentives** – Given the uncertainties that are likely to persist in the market with respect to systems costs and customer interest, it may be wise for the ETO to develop a flexible financial incentive structure. For example, a base incentive level, augmented with a generous limited-time availability bonus or bounty, might be employed to increase near-term participation. Such a bonus or bounty could always be renewed if necessary, or rescinded if the market grows rapidly and does not warrant the extra incentive.

- **Consider distinguishing between residential and commercial program strategies** – At present, PV installation companies appear to specialize in either residential or commercial applications. Moreover, installers expressed opinions suggesting that the markets in which they currently work have the greatest long term potential. This suggests that the markets are sufficiently different from one another to warrant distinct strategies on the part of the ETO. For example, marketing efforts (e.g., case studies, outreach, demonstration projects) may need to be sufficiently differentiated between the two markets.

- **Continue to monitor and track market developments in other states** – Developments in other states appear to be fueling technology improvements and innovations in market applications. The impacts of these developments are likely to spill over into the Oregon markets as well. As such, the ETO will benefit from understanding these trends and potential implications for the ETO efforts to develop PV markets in Oregon.

6.3 Program Tracking and Evaluation

As the Solar Electric program moves forward, there are a number of areas in which on-going tracking and evaluation will help to refine the design of the program and, in the long term, support the development of the market. These include:

- **Continue using Diffusion of Innovation Framework** – The diffusion model used in this study appears to provide a useful framework for continued analysis of market transformation for this program. The data collected in this study serve as a baseline for recent PV purchasers, all of whom appear to fall into the *innovator* and *early-adopter* categories. Unfortunately, given the limited scope of this study, it was not possible to

explore fully the applicability of this model. However, now that a reference point has been established with recent PV purchasers, similar data should be collected from future program participants for comparison with earlier purchasers in order to identify changing trends in the characteristics of these purchasers and to see if there is a shift toward early adopters and / or the early majority.

- **Consider undertaking efforts to refine existing baseline data** – The information outlined in this report provides a solid picture of the current PV market in Oregon. The Oregon PV tax credit database provides a comprehensive source of baseline information, an initial analysis of which is included in this report. As discussed with the ETO, there are opportunities to refine the overall quality and comprehensiveness of these existing baseline estimates by reviewing the actual tax credit applications and (1) verifying out of range data, and (2) augmenting the existing dataset with information that is likely to be included on the paper applications.

- **Work with the OEO to differentiate between grid-connected and off-grid systems for tax credits** – Since the objective of the ETO program is to promote grid-connected systems, consideration should be given to working with the Oregon Energy Office to modify tax credit application forms to denote whether or not systems are expected to be grid-connected.

- **Ensure on-going data collection to support program evaluation** – Careful review of program application forms should be undertaken to ensure that the ETO is collecting key information needed for tracking progress in transforming the market. ALSO ADD from p.10, 6.3, 2nd bullet - adding info on grid-connected or not to tax credit forms to allow tracking

- **As part of ongoing program evaluation, the ETO should track industry cost and effort over-runs** – Approximately 30 percent of respondents indicated that their projects took more effort or ended up costing more than they initially expected. While these innovators remain satisfied despite the incremental costs and effort, movement toward the broader market may be less tolerant of such issues. As such, the ETO may want to track these issues through its evaluation process and report these results to the industry on an annual basis.

Since the objective of the ETO program is to promote grid-connected systems, consideration should be given to working with the Oregon Energy Office to modify tax credit application forms to denote whether or not systems are expected to be grid-connected.

6.4 Additional Support for Consumers

In order to enable consumers to be as successful as possible in their search for information on PV technologies, the following additional support may be beneficial:

- **Consumers may benefit from a checklist of information that should be provided by, or expected from, contractors** – Based upon information provided regarding the types

of information supplied to consumers by contractors during the decision-making process, it appears that there may be a lack of consistency in the types of information consumers are provided. In order to ensure that consumers are receiving more consistent and comprehensive information to help in their decision-making, it would be beneficial to provide consumers with a simple checklist of items that they should expect to receive from contractors. These items would include:

- Installation cost proposal
- Rebate information
- Product information
- Warranty information
- Sun chart
- Payback analysis
- Net metering information and contacts

- **There may be a need for the ETO to ensure consistency of information provided to consumers by installers** – One of the key findings arising from this research is the importance of information provided by installation contractors during the decision-making process. This underscores the importance of ensuring that these contractors have up-to-date and consistent information, to the extent possible, to give customers. In addition to the certification training that the ETO has undertaken, steps that may be pursued by the ETO to ensure that contractors have access to state-of-the art information. This information could be disseminated, for example, through (1) quarterly information seminars for contractors, with presentations by manufacturers and other industry intermediaries, (2) regular newsletters and /or e-mail briefings, (3) coordinating workshops with the Oregon solar Industries Association (OSEIA), or (4) in-person visits from ETO staff.

6.5 Marketing and Promotion Recommendations

A key outcome of this research is the recommendation of marketing and promotional strategies that the ETO may wish to pursue. These include:

- **Support and promote highly visible PV demonstrations** – Most observers and market participants agree that one of the barriers to market development is lack of familiarity and visibility. The development and promotion of visible installations is desired so that they may be used for marketing purposes by the industry.

- **Improve communications with PV manufacturers** – As noted earlier, manufacturers appear to not be well-informed regarding developments in the Oregon market. It also appears that the majority of outreach on the part of ETO has been with installers rather than manufacturers. Manufacturers may play a key role, however, in supporting the dealer and installer networks in the state. As such, bringing these players into the process could aid substantially in transforming the market

- **Marketing efforts for the program, and for the industry as a whole, should be based on one or more of the attitudinal themes that are shown to resonate well with recent**

PV consumers – Although it is outside the scope of this study to assess whether or not the market has tapped the majority of innovators and early adopters, it seems likely that at least the early program participation is still going to include a mix of innovators and early adopters. In order to reach these groups, this study has shown several attitudinal themes that are common across recent PV consumers. These include:

- "I am willing to accept modifications to my lifestyle if it helps the environment."
- "I buy environmentally-friendly products, even if they cost somewhat more."
- "I like to experiment with new ways of doing things."

- **Consider cross-marketing the Solar Electric and Residential New Construction programs** – The consumer research identified new construction as a time when PV purchasers decided to install their systems. If consumers are made aware of the Solar Electric program and its financial and technical assistance opportunities at the same time they are made aware of energy efficiency opportunities, this may help to increase adoption in this market. The ETO could also consider increases in incentives for installations that address multiple improvements (e.g., efficiency and PV).

- **The ETO should consider efforts to build program awareness among general contractors and builders throughout the state** – The results of this survey note the fact that the decision to install PV systems is often tied to decisions related to other home improvements. For example, replacing a roof presents a timely opportunity to install mounting and wiring to be used in a PV system. Building general awareness among the contracting community about the availability of the program may serve to ensure that these opportunities are captured more frequently than might otherwise be expected. The ETO could also consider incentives for builders who provide referrals that result in PV installations at the same time as other improvements.

- **Cross-link the most frequented websites with the ETO website** – Recent purchasers identified several websites that they frequented during their information search. These include: Oregon Office of Energy, Mr. Solar, the National Renewable Energy Laboratory, Sandia National Laboratory, King Solar, the Oregon Solar Energy Association, Real Goods, and How it Works. Linking the ETO with these websites will help to ensure that potential adopters are aware of financial incentives and other program support available through the Solar Electric program.

- **Promote the availability of the program in frequently referenced publications** – The publications most often cited include: Home Power Magazine, the Real Goods Catalog, and Mother Earth News.

- **Work closely with national retailers who have shown an interest in marketing PV systems** – If the efforts on the part of Home Depot are successful in California and elsewhere, this is likely to provide a retail model that may be replicated in Oregon.

- **Support word-of-mouth marketing by providing support to recent purchasers in their efforts to promote PV** – Recent purchasers have the potential to serve as evangelists for the ETO program. Among these recent purchasers, the industry has a

significant opportunity to facilitate word-of-mouth promotion of PV technology in general and the ETO program specifically. All have communicated with friends about their systems and, of these, 50 percent report that they have communicated to wider audiences through presentations and meetings. There are several steps the ETO may wish to take to capitalize upon and enable this momentum:

- Building upon the recent example set by BMW in its effort to promote the Mini-Cooper, the ETO could build a PV owners network. Quarterly newsletters, technology updates, an email listserv or electronic bulletin board, promotional items, etc. could all be utilized to (1) facilitate on-going communication among PV system owners, and (2) enable these owners to spread the word about PVs and about the availability of ETO programs.

- Develop a PV owner's communication package that would contain general technology and program information that could be shared with interested parties. Such a package could be sent out at the same time as the consumer's rebate check.

APPENDIX A: CONSUMER SURVEY INSTRUMENT

PV Adopters
In-depth Interview Guide
(Rev. 6/17/03)

Recruitment
My name is _____. I am with Energy Market Innovations, a research and consulting firm in Seattle. We are conducting research on behalf of the Energy Trust of Oregon to assess experiences with grid-connected Residential PV systems. Our records indicate that you had a photovoltaic installed at your (home/business) in (year). Is this a grid-connected PV system?

If NO, read:
For this survey we are only interviewing owners of grid-connected Residential PV systems. I don't have any additional questions for you. Thank you for your time.

If YES, read:
I am interested in talking with you briefly to learn about the experiences you had in selecting and installing a PV system.

Is this a good time to talk, or would you prefer to schedule a time that I could call you back? The interview does take about 15 minutes, and we're very interested in having your input.

Yes
No, not interested
Callback time: _____

Section 1: System Description / Confirmation

1.1 Our records show that in (year) you installed a (describe what was installed.) Is this correct?

1. Yes
0. No (note correct information): _____

1.2 Was this an expansion of an already-existing system, or have you added to the system since the initial installation of the system?

1. Yes
0. No (continue)

<u>If YES, read</u>: In the following questions, I'd like to focus only on the portion of the system that you received a tax credit for in (year of tax credit).

1.3 Before we begin, how would you describe the system that you installed?

*(**Prompt**: What is the size of the system, manufacturer of panels, type of inverter?)*

[Text]

1.4 Did a contractor install the system for you, or did you install it yourself?

1. Contractor installed
2. Self-installed

Section 2: Interest

I am interested in understanding how you initially became interested in PVs…

2.1 How did you first become interested in photovoltaics in general?

[Text]

2.2 About when did you first become interested in PV? Was it:

1. The year that you decided to install a PV system at your house.
2. One to two years before you decided to install a PV system at your house.
3. Three to five years before you decided to install a PV system at your house.
4. Five or more years before you decided to install a PV system at your house.
5. Other (please specify) _____

2.3 What sparked your interest in PV systems?

(Prompt: Was it something you read or heard, something somebody told you?)

[Text]

2.4 Had you considered installing a PV system previously, but abandoned the idea?

1. Yes
0. No

If YES, read:

2.4A Why did you abandon this idea when you earlier considered installing a PV system?

[Text]

2.5 What first interested you in this current project?

1. To help protect the environment
2. To promote the technology
3. To promote my business
4. To save money
5. Other reasons _____

2.6 Have you pursued other energy projects?

1. Yes
0. No

If YES, read:

2.6B: What other energy project or projects have you completed?

[Text]

Section 3: Information Search

I am interested in understanding the types of information you sought out once you decided that you were interested in pursuing this project…

3.1 What sources of information did you consult (take all that apply)?

Do not read

1. manufacturer
2. installation contractor
3. Oregon Energy Office
4. Energy Trust
5. Magazines or Journals (please specify): _____
6. Other (please specify): _____
0. None

3.2 Of the sources that you mentioned above, what turned out to be the *most valuable source (s)* of information that you consulted?

1. manufacturer
2. installation contractor
3. Oregon Energy Office

4. Energy Trust
5. Magazines or Journals (please specify): _____)
6. Other (please specify): _____
0. None

If they did NOT mention contractors in 3.2,

3.3 Did you obtain information from potential installation contractors and, if so, what types of information? (Take all that apply)

Do not read

1. installation cost proposal
2. detailed product information
3. sun chart
4. payback analysis
5. impact of net metering
6. Other (please specify) _____

3.4 On a scale of 1-5, where 1 means 'very poor quality' and 5 means 'very good quality', how would you rate the quality of information received from contractors in terms of completeness and ease of understanding?

1 2 3 4 5

If 3 OR LESS, read:

3.5 Why do you give it that rating?

3.6 Did you have any issues or concerns with the information provided by contractors?

1. Yes
0. No

If yes, please specify: _____

3.7 What publications do you subscribe to, or purchase, that provide you with information on renewable energy systems such as PV?

[Text]

3.8 What publications do you subscribe to, or purchase, that provide you with more general information on home improvement issues?

[Text]

Section 4: Decision Evaluation

Once you had obtained more information, I'm curious to learn how you went about making your final decision…

4.1 When it came time to make a decision, what other projects or activities was this project was competing with?

Do not read

1. Other home energy projects
2. Home maintenance
3. Home renovation
4. Business-related projects
5. Other (please specify) _____

4.2 I am going to read a list of possible considerations you might have had when you were thinking about adding this PV to your home. For each consideration on the list, please indicate on a 1 to 5 scale, with '1' as "Not at all important" and '5' as "Very Important" how important a concern it was for you.

	Score
1. Amount of electricity produced	_____
2. Amount of space needed at my home for a PV system	_____
3. Codes or covenants that might prohibit it	_____
4. Dependability and reputability of PV manufacturer	_____
5. Dependability and reputability of PV vendor	_____
6. Ease of installation	_____
7. Expense of maintaining the PV system	_____
8. Need for repairs, maintenance	_____
9. What friends and neighbors might say	_____

4.3 What other considerations did you have, and how important were these considerations?

1. Please specify:_____
2. Please specify:_____

4.3A Using the same scale of 1-5, how important were these other considerations?

1. First other consideration:_____
2. Second other consideration:_____

4.4 Out of the above-mentioned items, what was the most important consideration in your decision to have this PV system installed?

1. Amount of electricity produced
2. Amount of space needed at my home for a PV system
3. Codes or covenants that might prohibit it
4. Dependability and reputability of PV manufacturer
5. Dependability and reputability of PV vendor
6. Ease of installation
7. Expense of maintaining the PV system
8. Need for repairs, maintenance
9. What friends and neighbors might say
10. Other (1)
11. Other (2)

4.5 What, if anything, would have prohibited you from undertaking this project?

[Text]

4.6 Would you have installed PV without a tax credit?'

1. Yes
0. No
2. Don't know

4.7 Was this a time-sensitive decision? (i.e., did it need to fit into a larger construction schedule?)

1. Yes
0. No
2. Don't know

If YES, please describe: _____

Section 5: Installation Experience

5.1 Did you need to do anything to physically prepare the building for the installation?

1. Yes
0. No
2. Don't know

If YES, please describe: _____

5.2 Did you encounter any issues or barriers when obtaining licenses and permits for your project?

1. Yes
0. No
2. Don't know

If YES, please describe: _____

5.3 Did you encounter any issues or barriers when in applying for approval of a tax credit??

1. Yes
0. No
2. Don't know

If YES, please describe: _____

5.4 Were there any other issues encountered between the time you made the decision to make this investment and the installation of the system? If yes, what were these issues?

1. Yes
0. No
2. Don't know

If YES, please describe: _____

5.5 Overall, did the project take about less time and effort than you expected, more than expected, or about what you expected?

1. Less than I expected.
2. About what I expected.
3. More than I expected.

5.6 Overall, did the project cost less than you expected more than expected, or about what you expected?

1. Less than I expected.
2. About what I expected.
3. More than I expected.

5.7 On a scale from 1 to 5, with 1 being 'very dissatisfied' and 5 being 'very satisfied', how satisfied were you with the installation process?

1 2 3 4 5

5.8 Why do you give it that number?

[Text]

Section 6: Satisfaction with Completed Project

6.1 Overall, did the project meet, exceed or fall below your expectations?

1. Fell below expectations
2. Met expectations
3. Exceeded expectations

6.2 In what ways did this PV installation (meet, exceed, or fall below) your expectations?

[Text]

6.3 On a scale from 1 to 5, with 1 being 'very dissatisfied' and 5 being 'very satisfied', how satisfied were you with the completed project?

1 2 3 4 5

6.4 Why do you give it that number?

[Text]

6.5 If you had the project to do over, would you do anything differently?

1. Yes

0. No
2. Don't know

If YES, please describe: _____

6.6 Is there anything you wished you would have known before starting the project?

[Text]

Section 7: Diffusion to Others

7.1 Have friends or acquaintances shown an interest in your PV installation?

1. Yes
0. No
2. Don't know

If YES, please describe: _____

7.2 What questions have people most often asked you about this system?

[Text]

7.3 Besides your friends and acquaintances, have you communicated with a wider audience about your PV system?

1. Yes
0. No
2. Don't know

7.4 How did you communicate with the wider audience?

1. Presentation at a meeting
2. Web site
3. E-mail
4. Newspaper, magazine or newsletter
5. Other

7.5 Who was your communication aimed at?

1. Architects
2. Contractors
3. Government Officials
4. Home builders
5. Homeowners
6. Other

7.6 Would you recommend this type of project to others?

1. Yes
0. No
2. Don't know

For all answers, Please explain: _____

7.7 Are there certain types of people you would recommend this type of project to?

1. Yes
0. No
2. Don't know

If YES, please describe: _____

7.8 For what reasons would you recommend that someone NOT undertake such a project?

7.9 What words of advice would you offer to others considering such a project?

Section 8: Behavior Type

[Note: "A" questions are dummy questions in this sequence.]

I have a final set of general questions to help us better understand people who install or consider installing PV systems:

How much do you agree or disagree with each of the following statements:

8.1 "I like to experiment with new ways of doing things."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.2 "I am seen as a leader in my work life, social life, or volunteer activities."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.3 "I track trends in society to make sure I am prepared."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.3A "New automotive technology is too complicated for the average car owner."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.4 "People seek out my advice before they make a decision about a technology."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.5 "I am willing to accept modifications to my lifestyle if it helps the environment."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.6 "I read technology magazines or journals."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.7 "I buy environmentally-friendly products, even if they cost somewhat more."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.7A "In my home, many of the appliances are unnecessarily complicated"

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.8 "I know a lot about new technologies, compared with most people."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.9 "I like to be as independent as possible so I don't have to rely on others to meet my needs."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.9A "I will generally sacrifice safety for innovation when necessary."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.10 "I like to be the first of my friends and people I work with to get a new technology."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

8.11 "I like to keep up with and know about new technology even if I can't afford to buy it right now."

☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7 ☐8 ☐9 ☐10

Completely Disagree — Completely Agree

That was my last question. Do you have any final comments you want to make?

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