SOLAR ELECTRIC MARKET TRANSFORMATION: A CASE STUDY FROM THE PACIFIC NORTHWEST

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ABSTRACT

The analysis presented in this paper summarizes a successful new Pacific Northwest PV program designed and administered by the Energy Trust of Oregon, Inc., which has incorporated program elements and processes not always seen in state or utility sponsored incentive programs.

The program design reflects research conducted by the authors and a renewable program development team in Oregon. The program development team chose a comprehensive market transformation approach. Program goals were set to overcome the perceived barriers to the PV market in Oregon. Implementation included partnering with solar professionals, local installers, utilities and state government to expand PV use, and target "early adopters."

1. BACKGROUND

The Solar Electric Program detailed in this paper for photovoltaic ("PV") applications, represents a compromise of timing, budgets, desires, and possibilities. The program focuses on market transformation, and because of this, it takes a phased approach to include feedback mechanisms to revise elements as needed.

1.1 Who is the Energy Trust of Oregon?

The Energy Trust of Oregon, Inc., is an independent nonprofit organization that invests in energy efficiency and renewable energy development. It began work in March 2002 with a mission to change how Oregonians produce and use energy.

Oregon customers of Pacific Power, Portland General Electric and NW Natural fund Energy Trust programs through their utility bills via a public purpose fund.

1.2 Program Development Process

1.2.1 Focus Groups

The development of this program began in July 2002 with scoping, framing, and engaging interested Oregonians and solar professionals. Energy Trust staff, with the assistance of personnel from the Oregon Department of Energy, examined the market barriers for solar in Oregon and previous efforts to build PV markets[1]. We also relied on studies sponsored by Energy Trust and others to identify lessons learned, design principles and key program elements.

Through fall and winter 2002, Energy Trust staff, industry representatives and solar contractors systematically and regularly engaged the interested public in reviewing program assumptions, drafting program elements, and revising program provisions. Staff led more than a dozen public meetings throughout the state to gain input and review. The final draft of the program reflects the important contributions gained from those meetings.

1.2.2 Market Analysis

At the time of the program launch in the spring of 2003, a report commissioned by Energy Trust revealed that the current market for PV in Oregon was composed largely of customized installations, including both off- and on-grid applications. From 1999 to 2002 the estimated number of both off- and on-grid installations averaged about 37 per year, with an

[1] *"PV Focus Group Report"* Christopher Dymond, Oregon Department of Energy, Peter West, Energy Trust of Oregon, 2002.

estimated 36 grid-connected systems totaling over 100 kW in Oregon.[2]

The baseline analysis of the Oregon market also found that:

- Technology was trending to more standard and easily integrated systems.
- System reliability was increasing for major components, improving system performance and warranties.
- System standards and certifications were needed to aid in customer assurance.
- New entrants were challenging the industry and offering new business models.
- PV installation companies tended to specialize in either commercial or residential applications.
- Experience in solar thermal appeared to be a precursor to doing PV.
- System costs were declining through competition, suggesting that incentives may need to be adjusted over time.
- Oregon tax credits needed to remain in place for at least another 5 years to have a sustained impact in the market.
- Current Oregon PV purchasers tended to be older, technically oriented people with graduate- level educations.
- The primary customer motivations for installing PV were environmental benefits, energy independence, and status.
- Net metering was critically important to the growth of PV.

This research helped provide a snapshot of the current market to serve as a reference for subsequent monitoring and evaluations.

1.3 Key Barriers to Market Transformation

The key barriers identified for developing a self-sustaining market for PV in Oregon were cost, knowledge, performance, and difficulties encountered in the delivery chain. Customers and industry professionals consistently identified the top problems as high up-front cost of systems, utility acceptance, the somewhat daunting technical nature of solar information, and confusion over quality assurance.

Table 1 on the following page summarizes the main market barriers and the actions that were identified to try to overcome them. This matrix was developed by Energy Trust staff and refined with input from key stakeholders in Oregon's solar industry.

As detailed in the elements to follow, this program proposed overcoming the barriers through a combination of reinforcing actions to:

- Lower the up-front costs of installed systems
- Promote high-performing systems
- Reinforce market trends toward standardization
- Create greater public awareness
- Simplify the information and make it easier to get
- Create consistent quality assurance and protections
- Support industry development and trained installers

1.4 Lessons Learned from other Renewable Energy Programs

Staff identified a list of the major lessons learned for developing, launching and running programs to support PV. It was compiled from three studies, one of which was commissioned by Energy Trust of Oregon.[3] The initial list was longer, but after review with the public it was shortened to address only the most applicable issues for Oregon.

1. The PV market is very hard to transform with many moving parts to address.
2. Program goals should drive program design.
3. System performance is an issue.
4. Utility cooperation is essential.
5. Quality assurance is critical for installers, equipment, and performance.
6. All players need to collaborate on marketing and education.
7. Customer's focus on kWh, the industry focuses on kW.
8. State experiences are unique and not wholly transferable.
9. Programs need to be flexible.
10. Long-term stable funding is critical.
11. Application processes should be quick and easy for the customer.
12. Incorporate incentives into an overall infrastructure development strategy.
13. Incentives should decrease over time.
14. Incentives should not exceed a fixed % of the system cost.

[2] *"Oregon Photovoltaic Market Characterization, Draft Report."* Prepared by Energy Market Innovations, March 14, 2003.

[3] *"Innovative Practices in Renewable Energy: A Review of Domestic and International Experiences"* Ryan Wiser, et.al., Clean Energy Group, 2002; *"State Financial Incentives for RE: case studies on program effectiveness"* Susan Gouchoe, et. al., North Carolina Solar Center, 2003; *"Customer Sited Photovoltaics: State Market Analysis"* Christi Herig, National Renewable Energy Laboratory, 2002.

TABLE 1: PV MARKET BARRIERS MATRIX

	Barriers				
Actions	**Cost**	**Knowledge**	**Performance**	**Delivery**	**Unrecognized Value**
	Buy-Down	Public Education	Output Guarantee	Equipment Warranties	Backup Power
	Low-Interest Loan	Customer Assistance	System Packages	Installation Guarantees	Ownership
	Bulk Purchase	Coordinated Marketing	Qualified Installers	Service	Environmental
	Production Incentives	Visibility	Applied Resource Assessment	Competition	Community Involvement
	Simplify Inspection	"Kick-the-Tires" Demos	Equipment Testing	Inspector Training	Building Integration
	Simplify Utility Interface	Customer information	Aesthetics - weigh against output	Knowledgeable Utilities	Trans & Distribution
	Leasing	Architect, builder information	Real-time Meter for Customer	Technical Assistance	Peak Shaving
	System Packages	Case studies		Easy to Buy	Health
	Tax Incentives			Good Salespeople	Social Status

2. PROGRAM GOALS & OBJECTIVES

2.1 Setting Goals

After significant public input and reviews by advisory councils, the Energy Trust board adopted program goals to double the number of grid-tied PV systems in Oregon within one year, which translates into 72 new systems. Goals also included ensuring high-quality installations and lowering delivered cost to the customer, as identified in section 1.3.

2.2 Design Principles

Given the barriers, lessons learned, and program goals, staff drafted the following design principles to guide program development and define key elements:

- Share risks and benefits among industry, state, Energy Trust, and customer.
- Leverage other resources, linking to existing efforts.
- Work with market forces, reinforcing positive trends.
- Create uniform specification standards.
- Sequence launch strategically.
- Become state-wide, reaching a diversity of geographic areas and market segments.
- Address quality assurance and potential issues in the delivery chain.
- Build in marketing, awareness, education, and technical assistance.
- Ensure that program elements and approaches reinforce each other.
- Focus on the next new customer.

2.3 Program Elements

Following the goals and design principles, the program was defined by 12 key elements, which were divided into two phases. The first phase of the program targeted:

1. Lowering front end costs
2. Establishing system design criteria
3. Defining installation standards
4. Offering installer training
5. Setting up performance monitoring
6. Inspecting installations
7. Marketing the program.

The second phase of the program proposes to:

1. Offer loan paths and financing options for customers
2. Target outreach to architects and design professionals
3. Offer a route for homeowner installations
4. Evolve to a performance based incentive
5. Conduct an independent evaluation.

2.4 Critical Success Factors

Staff identified the following critical success factors for the program during the first year:

- A high level of customer participation and satisfaction to strengthen the positive image of solar for customers and industry.
- Continued positive support of net-metering by utilities in order to broaden the market penetration for grid-tied PV.
- Effective marrying of Energy Trust requirements with those of the state to qualify for tax credits.
- An open and cooperative relationship with PV installers and vendors.
- Simplified end-to-end process of selecting and installing a PV system for the customer.

3. PROGRAM RESULTS

The design of the program and definition of all its elements took ten months. The equipment and installation standards and inspection requirements are defined on an ongoing basis by a technical committee that includes industry representatives.[4] This process has worked well to define acceptable quality, consistency and industry buy-in.

As the program is primarily contractor driven, consumers must use a contractor that has agreed to install to the program's standards and pass the separate inspection requirements. The incentives are then passed through the contractor to the consumer. If the system fails, it must be fixed at the installer's expense. These quality assurance features appear to effectively reassure consumers.

At the start of the program there were 16 eligible contractors. Staff conducted 10 trainings around the state to market the program to installers and electrical contractors. There are now 35 contractors enrolled in the program, 19 of which are new entrants to the solar industry

Concurrent with marketing to contractors and installers, staff also marketed to consumers and businesses. The program was promoted in more than two dozen different venues across the state. The most successful of these were seven public seminars that provided an introduction to solar and a chance to meet local installers.[5] Because of the technical nature of selecting solar and knowing how to choose a contractor has been a barrier for consumers in Oregon, these seminars were focused on making the solar choice simple and validating the program's contractors. The public attendance was strong and enthusiastic with more than 200 people attending.

The program also granted nine systems to seven different electrical training centers in Oregon. In exchange for the systems, the centers must teach a PV installation training course that provides continuing education credits.

In 2003, 74 systems were installed through the program, totaling 196 kW. Additionally, three demonstration projects were installed for another 140 kW. This included the Northwest's largest solar installation and an example of building-integrated PV.[6]

Initially, incentives were $2.50/Watt for residential installations and $1.75/Watt for commercial. Incentives are based on DC Watts installed and are in addition to any other credits available. When coupled with state and federal tax credits, the simple pay-back for commercial systems would be 10 years.

The incentives proved too low and were raised temporarily to $4.25/Watt for residential and $2.25/Watt for commercial. As the program gained momentum in the residential sector (over 90% of the systems have been residential) the incentive was decreased incrementally to the current level of $3.00/Watt.

During the first quarter of 2004, 31 systems were installed, totaling 90 kW. Another 94 systems totaling 350 kW have been committed. All told, the program has installations and commitments exceeding 775 kW in its first 11 months. The average residential system size has been 2.8 kW, and average installed costs (prior to incentives) are $6.25/Watt. Before the program the average installation in Oregon was less than 1 kW and cost more than $10/Watt.

The Energy Trust employs five independent inspectors, who are available to installers for questions and advice prior to installations. All systems are inspected and relatively few problems have appeared. The industry's inclusion in defining the standards and the subsequent trainings for installers created buy-in, support and clear understanding.

To promote high performing systems, the program limits the total amount of energy loss from shading, tilt and orientation to not more than 25%. Very few systems have pushed the limit. So far, the average loss from these factors for all installed systems has been 6%.

[4] All systems must also be eligible for state tax incentives.

[5] The idea was borrowed from Long Island Power Authority's successful solar program.

[6] In the four years prior to the Energy Trust's program about 100 kW of grid-tied systems were installed.

The program requires an owner's manual and a wiring diagram, which have proved reassuring to consumers and have aided inspections. A separate utility-grade meter is also required to record PV system output, allowing Energy Trust to analyze and report actual performance data.

The fastest growing regions of the state have had the most participation. These areas also have had the most prior experience with solar thermal. Participation in the Portland metropolitan area has lagged other parts of the state.

The rapid success of the program led staff to cut back on marketing. Early momentum was established. Field data indicated word of mouth was serving to drive new leads, particularly to the most active contractors.

3.1 Lessons Learned

The program experienced a very slow start. The consumers were unfamiliar with the Energy Trust, and the residential incentive was set too low. The combination of incentives and tax credits needs to reach at least 50% of up-front costs to initially move the market.

General awareness was important. However, simple seminars on "What is solar?" and "How it can be easy," turned out to be the most effective marketing. Including local installers and directing technical questions to them served quite well to identify and validate the contractors in the program.

Repeated press about the Energy Trust and participation in community events was needed. The Energy Trust was new, untested and consumers did not at first believe they really could get up to $10,000 to install solar systems.

When the program re-set residential incentives higher, a short-term bonus of $0.75/Watt was included. The 'sale' nature of the bonus was a powerful selling tool for contractors to force fence-sitters to act.

An e-mail pre-reservation system for funds coupled with a relatively short time limit (45-90 days) to install systems proved too difficult to manage. It created much more tracking then necessary and forced a tension to beat the clock that was unwarranted. The pre-reservation system was scrapped and the time limit extended to a year.

Initially, there was no limit to how much funds a contractor could reserve. Project attrition rates for some installers approached 80% and tied-up funds unnecessarily. It was occasionally difficult to give the industry an accurate read on remaining funds. Installers completing all aspects of a sale before reserving funds were sometimes disadvantaged.

The program now requires documentation of signed contracts to reserve funds. Any one contractor can not have more than eight uncompleted reservations at one time. So as not to penalize projects with long lead times, exceptions are available for new construction and projects requiring local design reviews. There is no limit on the total amount of funds a contractor can employ in a year.

The commercial sector has generally not been interested in PV. With the exception of those with a 'green' element to their product or marketing, most businesses appear distracted by the relatively poor economy.

Contractor training has been essential. It creates buy-in and understanding of the whys behind the program pieces. It is particularly important to walk thorough the equipment and installation requirements.

The track record indicates that inspecting every system may be overkill. A random inspection should suffice for experienced contractors, and the program expects to shift in that direction.

Finally, the low installed costs in Oregon have been a surprise. In fact, staff disbelieved the data at first. This led to holding on to the short-term bonus longer than was probably necessary. Finding the right level for an incentive is iterative and hardly science.

3.2 Summary

Consumers have responded well to the combination of efforts that provide quality assurance. While consumers seem to prefer a "Consumers Report' approach, they appear impressed with the system of standards and inspections.

Word of mouth is now driving the program in many parts of the state. Program participation has been slowest in the Portland metropolitan area, but activity is picking up and awareness is increasing.

The incentive was shifted both up and then down to react to demand and manage limited funds. Once momentum was established, the strong demand and the low installed costs caused staff to lower incentives over the course of the year. The challenge for the program in the future is to stabilize the incentive.

There is a myth that Oregon is not a solar-ready state. The successful launch of this program is dispelling that myth. Oregon is well on its way to one million Watts of new, grid-tied PV.