Benchmarking Oregon Solar Soft Costs 2014 Installer Survey Analysis

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Executive Summary

Energy Trust of Oregon aims to create a vigorous and sustainable market in Oregon for solar that can ultimately thrive without incentives.

To achieve a sustainable solar market at a national scale, the U.S. Department of Energy's SunShot Initiative determined that the installed cost of residential solar must be reduced to $1.50 per watt and the installed cost of commercial solar must be reduced to $1.25 per watt.

In 2013, the National Renewable Energy Laboratory, NREL, and Rocky Mountain Institute charted a path to achieve the SunShot solar cost goals in "Non-Hardware ("Soft") Cost-Reduction Roadmap for Residential and Small Commercial Photovoltaics, 2013-2020." This roadmap provides a framework for exploring and tracking solar installation costs in the U.S.

In 2014, Energy Trust set out to develop an effective cost-reduction strategy specifically for Oregon. In collaboration with the Green Energy Institute at Lewis & Clark Law School, Energy Trust developed a survey to compare Oregon's soft costs with nationwide figures. The survey was closely modelled after the surveys used to build the national roadmap.

The survey was sent to 133 companies registered as Energy Trust solar trade allies and 42 of those companies were actively installing solar during the survey period. In total 15 Oregon installers participated in the survey, representing 25 Oregon counties served by 15 utilities. During the survey period, which spanned the first half of 2014, these companies installed 4.2 megawatts of solar energy from 560 residential projects and 35 commercial projects. Based on the number and capacity of installations as well as the geographic range of projects installed, these installers are representative of Oregon's solar industry.

Energy Trust's survey collected data on labor hours required to complete specific design, permitting and installation tasks, along with data on expenditures for customer acquisition. The survey was divided into the same five categories as the national roadmap: hardware costs; installation labor; permitting, inspection, interconnection and incentives (PII+I); customer acquisition and other soft costs. Energy Trust incentives and the Oregon Department of Energy Residential Energy Tax Credit, RETC, were added to the permitting, inspection and interconnection category.

Based on survey analysis, Energy Trust reached two conclusions. First, Oregon residential solar projects in 2014 had lower total installation costs than the national roadmap targets due to low equipment costs[1], yet Oregon's total soft costs were higher than targeted. Second, Oregon commercial solar projects in 2014 had slightly higher installation costs than the national roadmap targets[2] due to higher soft costs (Table 1).

This analysis revealed that soft costs account for more than one-half of average installation cost for both residential and commercial installations in Oregon in 2014. This is despite Oregon's national leadership in soft cost reduction strategies such as adopting the first and only statewide solar building code, creating a prescriptive permitting path for residential solar, implementing strong net metering and interconnection policies, and conducting interconnection and incentive applications online.

[1] The cost of solar installations in Oregon has decreased by more than one-half since 2010, due primarily to reductions in solar equipment costs. Going forward, Energy Trust does not expect this steady rate of decline in hardware costs to continue.

[2] For a more detailed discussion on the U.S. DOE SunShot Initiative and NREL national roadmap, refer to APPENDIX A – National Renewable Energy Laboratory 2013 National Roadmap

Table 1: Comparison of Oregon Installer Survey Results for Residential and Commercial Installations to National Roadmap Targets for 2014

	Residential		Commercial	
	Oregon 2014 Survey	**Roadmap 2014 Target**	**Oregon 2014 Survey**	**Roadmap 2014 Target**
Customer Acquisition ($/W)	$0.32	$0.49	$0.19	$0.13
Installation Labor ($/W)	$0.48	$0.46	$0.33	$0.30
Permitting, Interconnection, Inspection & Incentives ($/W)	$0.16	$0.16	$0.07	$1.36
Other Soft Costs ($/W)	$1.42	$1.14	$1.31	
Total Soft Costs ($/W)	$2.38	$2.25	$1.90	$1.76
Hardware Costs ($/W)	$1.87	$2.24	$1.82	$1.88
Total System Costs ($/W)	**$4.25/watt**	**$4.49/watt**	**$3.72/watt**	**$3.64/watt**

To support a vigorous Oregon market for solar, more work is needed to reduce soft costs. The following recommendations are based on the results of this analysis and the related installer interviews:

Recommendation: Energy Trust should balance the benefits of working with regional stakeholders and individual installers to take advantage of cost reduction opportunities. Energy Trust is well positioned to work with state and regional stakeholders to reduce external soft costs for all solar installers, as well as to work with individual installers to understand their market barriers and business challenges.

Recommendation: Energy Trust should consider whether national roadmap targets are an appropriate goal for the Oregon solar market. This analysis compares surveyed data to the NREL national roadmap in the absence of any goals that are specific to Oregon.

Methodology

Energy Trust surveyed Oregon solar installers between July and September 2014 to benchmark the soft costs of Oregon solar installations completed in the first half of 2014. In collaboration with the Green Energy Institute at Lewis & Clark Law School, Energy Trust modeled its survey after NREL's 2010 and 2012 nationwide solar installer surveys (see APPENDIX B – Oregon Soft Cost Survey Instrument) to yield results that are readily comparable to national figures. NREL provided assistance with initial data analysis through its Solar Technical Assistance Team (STAT) Grant Program.

Energy Trust distributed the web-based survey to installers and followed up with telephone interviews to those who did not initially respond or whose response was incomplete. The average survey completion time was roughly one hour, which indicates that the survey required considerable engagement.

The survey collected data on the number of labor hours dedicated to different job tasks including permitting, interconnection, inspection and incentive paperwork processing for the average size system reported by each installer. Similarly, total installation labor hours and the percentage split

between different classes of installation work were also reported, including journey-level electrician, limited renewable energy technician (LRT)[3] and general laborer or apprentice. The survey questions were designed to elicit information from respondents with the understanding that installers do not organize their cost data for projects, or their businesses, in the same way.

Energy Trust used hourly labor rates previously reported by NREL in its analysis of the "2010 Photovoltaic Installer Survey" and also 2013 wage estimates for Oregon from the U.S. Bureau of Labor and Statistics. Installation labor wage rates reflect licensing requirements unique to Oregon and were fully burdened in line with NREL's methodology.[4] Table 2 shows the labor rates used to calculate labor costs.

For each installer, reported labor hours per project were converted to dollars per watt by dividing the number of projects by total kilowatts installed. The residential and commercial segment labor cost per watt was an average of these installer-specific values weighted by the total number of installations.

Table 2: Labor Class and Wage Assumptions Used to Calculate Labor Costs

Soft Cost Category	Occupation	Share of Labor Used (%)	Burdened Wage ($/hr)	Weighted Wage ($/hr)
Permit Preparation	Permit procurement	70%	$36.69	$31.55
	Admin. Staff	30%	$19.56	
Permit Submission	Permit procurement	30%	$36.69	$24.70
	Admin. Staff	70%	$19.56	
Inspection	Limited Renewable Energy Technician (LRT)	70%	$37.17	$31.89
	Admin. Staff	30%	$19.56	
Interconnection	Permit procurement	30%	$36.69	$24.70
	Admin. Staff	70%	$19.56	
Incentive Application Process	Limited Renewable Energy Technician (LRT)	30%	$37.17	$24.84
	Admin. Staff	70%	$19.56	
Installation Labor	Limited Renewable Energy Technician (LRT)	100%	$37.17	$37.17
	Electrician	100%	$54.11	$54.11
	Labor / Apprentice	100%	$32.84	$32.84

Energy Trust used a similar method to calculate the average cost of customer acquisition. The survey gathered data about semiannual expenditures for sales, advertising and marketing. As with the calculation of labor costs, total customer acquisition costs were divided by the total kilowatts installed by each contractor. Then, those values were weighted by the number of projects completed by each contractor to yield a figure in dollars per watt.

[3] Limited Renewable Energy Technicians (LRT) are licensed to install solar electric systems not exceeding 25kW in the state of Oregon.

[4] Fully burdened labor rate assumption includes a 23 percent increase over base, mean wage as reported by U.S. Bureau of Labor Statistics (based on NREL analysis of RS Means database).

The survey also asked what percentage of the average installed cost could be attributed to modules, inverter(s) and other hardware (racking, wire, conduit, etc.). When converted to actual dollars, these costs were revealed to be much higher than industry averages. Energy Trust collects manufacturer and model information for solar modules and inverters installed through incentive applications. Using this dataset of actual installed hardware, the purchase price for specific modules and inverters was obtained through online vendor sites.[5] Then these costs for modules and inverters were weighted by the capacity installed using each type from the Energy Trust database to obtain a more accurate hardware cost per watt for commercial and residential installations.

Solar Installation Data Collection and Results

Sample Market Representation

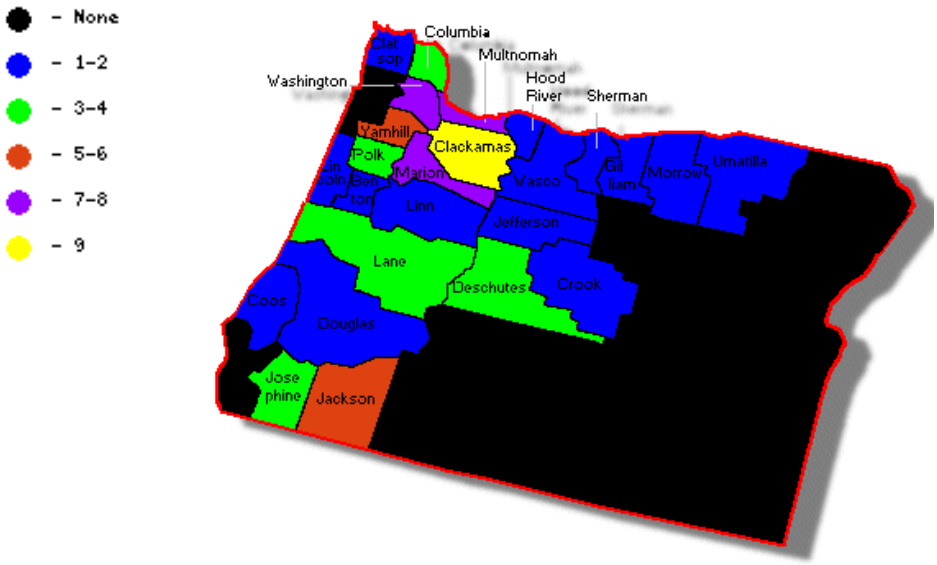
The survey was sent to 133 companies registered as Energy Trust solar trade allies and 42 of those companies were actively installing solar during the survey period. Energy Trust collected data from 15 installers about installations completed in the first half of 2014. During this period, the respondents reported collectively completing 560 residential installations (3,120 kW) and 35 commercial installations (1,051 kW). Installers spanned 25 Oregon counties and 15 utility territories. On average, respondents reportedly operated in five counties and had 15 employees.

Energy Trust compared the responses to a database of information collected from Energy Trust-funded incentive projects that were completed in the first half of 2014. To qualify for Energy Trust incentives, a solar project must be installed by an Energy Trust solar trade ally contractor[6] for an Oregon customer of Pacific Power or Portland General Electric; therefore not all solar installations in the state would qualify. During the survey period, 42 trade ally contractors were actively installing solar and completed 466 residential installations with a total capacity of 2,461 kW and 20 commercial installations with a total capacity of 541 kW. Since on average respondents reported that only 70 percent of their projects were eligible to receive an Energy Trust incentive, and the collected data represents 79% of residential and 51% of commercial installations reported in the Energy Trust database during the first half of 2014, it follows that the surveyed installers are representative of the general installer population in Oregon.

[5] Vendors referenced include: CivicSolar, Platt Electric, SolarWorld, and Wholesale Solar.

[6] Energy Trust maintains a list of solar trade ally contractors who install systems that meet program requirements and are eligible to offer solar electric cash incentives to their customers.

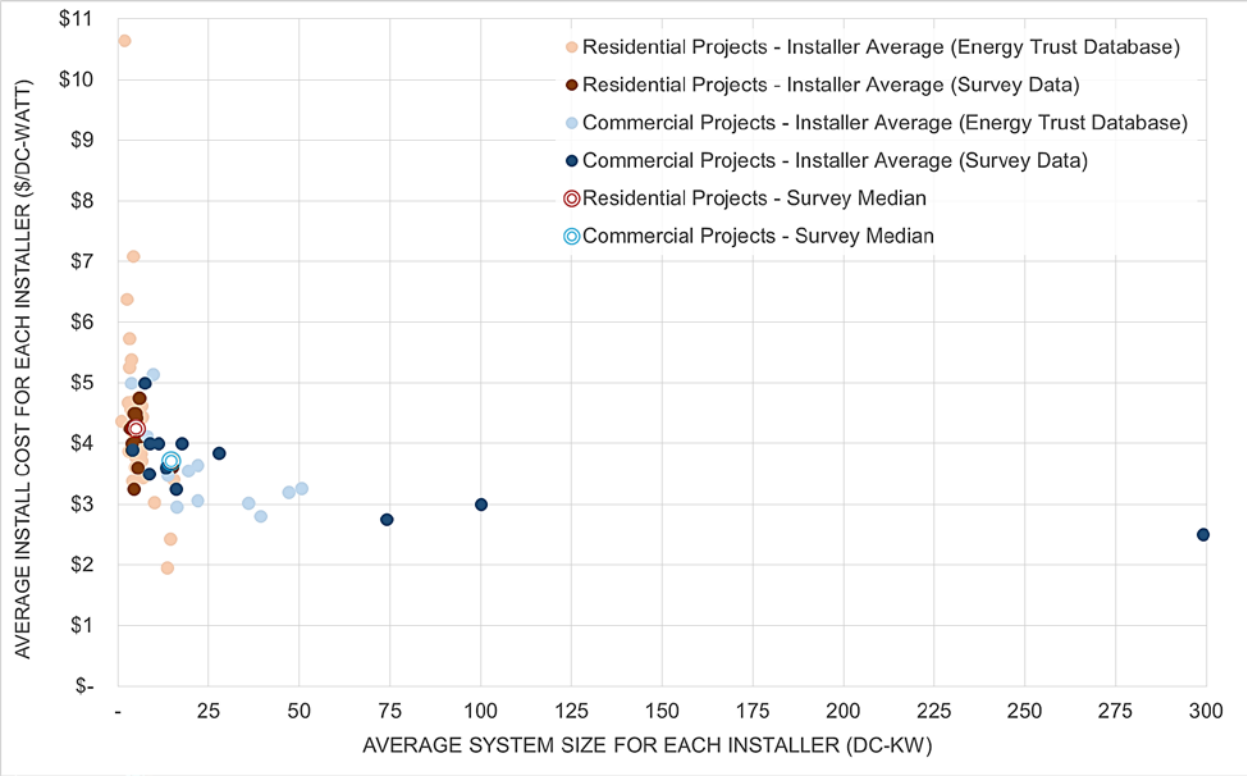
Figure 1: Survey Respondents by Oregon Counties (graphic courtesy of NREL)



Both residential and commercial responses represented a broad range of average system sizes. Median values for both segments were chosen as most accurately characterizing the dataset. The median residential system size was 5 kW with a median installation cost of $4.25 per watt. The median commercial system size was 16.8 kW with a median installation cost of $3.72 per watt. In the analysis, the survey results for each category are reported as an average cost per watt weighted by the total number of installations per respondent.

In Figure 2, the average system size and installation cost for Oregon solar installers as collected from the Energy Trust database is overlaid with the survey data to illustrate that collected data and the median values are representative for both residential and commercial customer segments. The survey data included responses from three commercial installers each reporting relatively few large projects which appear as the extreme outliers in Figure 2 below. It is reasonable that installers working with larger commercial customers would have few projects to report completing during the relatively short survey period compared to the longer lifecycle of large commercial projects. These data points follow the overall cost trend and reported values from these installers were included in the weighted averages.

Figure 2: Average Installation Costs and Average System Size Comparison for Individual Installers



Customer Acquisition

The survey asked respondents to report their total expenses related to customer acquisition for the first half of 2014 in two categories: advertising and marketing, and all other customer acquisition. The “all other” customer acquisition costs include lead generation activities, sales calls, site visits, travel time to and from a site, contract negotiation with system host or owner, system design, bid and financial pro forma preparation.

The process for residential customer acquisition typically begins with an initial phone call to establish eligibility for a project, followed by an in-person visit to the proposed site. Once an installer establishes that a site is suitable for installation, the installer designs the system (in-house or with outside engineers) and the sales team proposes the designed system to the customer. All these efforts, including site visits and project design, occur prior to having a contract in place. Consequently, each successful sale must also bear customer acquisition costs from sales work that did not result in a contract.

According to the survey, marketing and advertising expenses extended from $0 per watt up to $0.27 per watt for residential installations over the first half of 2014 with the weighted average equal to $0.03 per watt. One potential explanation for the low marketing and advertising costs reported by Oregon installers could be reliance on customer referrals or other low cost marketing channels.

The reported expenditures for “all other” customer acquisition activities on residential projects ranged from $118 to nearly $4,000 per installation. This wide variation can be attributed to differing interpretations of the costs associated with included activities (lead generation activities, sales calls, site visits, travel time, contract negotiation, system design, bid and pro forma preparation), which indicates the true costs of customer acquisition may not be fully appreciated by many installers. During survey follow-up interviews, it became apparent that each installer was accounting for

customer acquisition costs differently. For example, one installer questioned whether the sales team's commission should be included or not.

Table 3: Customer Acquisition Costs Reported for Residential and Commercial Projects

Customer Acquisition Cost Category	Residential Cost ($/W)	Commercial Cost ($/W)
Marketing & Advertising	$0.03	$0.07
Other Customer Acquisition	$0.29	$0.14
Total	**$0.32/watt**	**$0.19/watt**
National Roadmap 2014 Forecast	**$0.49/watt**	**$0.13/watt**

The survey yielded average total customer acquisition costs of $0.32 per watt for residential projects and $0.19 per watt for commercial projects (Table 3). The national forecast for residential customer acquisition costs was more than 50 percent higher than the Oregon surveyed values. As described previously, one possible explanation for Oregon's lower customer acquisition costs could be that installers conduct less marketing and advertising due to success with receiving new business from customer referrals. However, considering the broad range in reported costs between installers, another potentially likely explanation could be that installers are not accounting for all customer acquisition costs in their estimate.

Conversely, the national forecast for commercial customer acquisition costs was lower than the Oregon surveyed values. For commercial projects, customer acquisition expenses can be more challenging to ascertain. While both residential and commercial installers incur costs in generating leads and visiting work sites, commercial installers also report that strategic planning to reach previously untapped markets is a significant cost. This strategic planning may be reflected in the higher reported cost of marketing and advertising. The median commercial system size of 16.8 kW is relatively small, which limits the economies of scale typically seen in commercial projects nationally and could also account for some increase in the cost per watt for this category.

Installers were asked to report the number of bids prepared in the first half of 2014. Based on this information, the average residential sales close rate was 17 percent, or roughly six bids prepared for each completed project. For commercial installations, the sales close rate was closer to 30 percent. However, it should be noted the commercial close rate does not take into consideration the projects that require extensive resources but do not make it to the point of developing a proposal.

Permitting, Inspection, Interconnection and Incentives (PII+I)

The cost of carrying a project from contract to commissioning includes fees and labor associated with permitting, inspection, interconnection and incentive requirements (PII+I). Typical projects involve the following tasks:

- Preparing the permit package (including determining a jurisdiction's permitting requirements, traveling to a site, drawing system plans, performing structural calculations and preparing a permit application)
- Submitting the permit package (including travel time to and from the permitting office and wait time at the permitting office)
- Completing the permit inspection (including paperwork, travel time to and from the site, wait time for inspector and physical inspection)

- Preparing the interconnection package (including determining a utility's interconnection requirements, completing the application/agreement and submitting the application)
- Completing the physical interconnection (including travel time to and from the site, wait time for the utility technician and physical interconnection)
- Preparing an Energy Trust incentive package (including determining eligibility and completing and submitting the application)
- Completing Energy Trust verification (including travel time to and from the site, wait time for the verifier and physical inspection)
- Preparing the Oregon Department of Energy RETC package (including providing all documentation and completing and submitting the application)

To arrive at a total permitting, inspection, interconnection and incentives cost, Energy Trust assigned each of these task categories a cost in dollars per watt, based on labor rate assumptions (Table 4) and the weighted average of reported labor hours. Refer to Table 2 for the labor class and wage assumptions used in this calculation. Note that not all projects will apply for an Energy Trust incentive so this estimate of time is conservative. The residential permit fee was assumed to be a flat rate of $350 per installation, an average of known permitting costs at the time of the survey.[7] Since permit and interconnection fees can vary widely for commercial projects depending on system size and project valuation, no permit fees or interconnection costs were assumed for commercial projects in this analysis.

[7] Energy Trust of Oregon Renewable Energy Permitting Survey Results, August 2013

Table 4: Weighted Average of Permitting, Inspection, Interconnection and Incentives Costs Reported for Residential and Commercial Projects

Permitting, Inspection, Interconnection and Incentives Cost Category	Residential		Commercial	
	Hours	Cost ($/W)	Hours	Cost ($/W)
Preparing a permit package	3.2	$0.020	10.6	$0.028
Submitting the permit package	3.3	$0.016	4.8	$0.010
Completing the Permitting Inspection	2.4	$0.015	2.5	$0.005
Assumed permit fee ($350 Residential)	--	$0.070	--	--
Preparing the Interconnection Package	1.7	$0.011	1.7	$0.004
Completing the Physical Interconnection	1.3	$0.006	2.0	$0.006
Interconnection Fee	--	--	--	--
Preparing the Energy Trust Incentive Package	1.3	$0.006	3.2	$0.007
Completing the Energy Trust Verification	1.2	$0.008	2.5	$0.006
Preparing the Oregon Department of Energy RETC Package	1.5	$0.007	--	--
Total	**15.9 Hours**	**$0.16/watt**	**27.3 Hours**	**$0.07/watt**

National Roadmap 2014 Forecast		**$0.16/watt**	*See Other Soft Costs*

The survey found that roughly 16 labor hours are devoted to permitting, inspection, interconnection and incentives tasks for the average residential installation, whereas the average commercial project requires more than 27 hours. The largest difference in effort is in preparing and submitting the permitting package, which is consistent with the complexity of commercial installations and the additional permitting requirements. Again, because permit and interconnection fees vary widely for commercial projects, no costs were assumed for commercial projects in this analysis. The additional cost for permit fees and interconnection studies would be reflected in the other soft costs category for commercial projects.

Within each of the permitting, inspection, interconnection and incentives task categories, there was significant variation between installers in the reported times. This variation in illustrated in Figure 4: Commercial Reported Labor Hours for Tasks Associated with Permitting, Inspection, Interconnection and Incentives

Figure 3: Residential Reported Labor Hours for Tasks Associated with Permitting, Inspection, Interconnection and Incentives

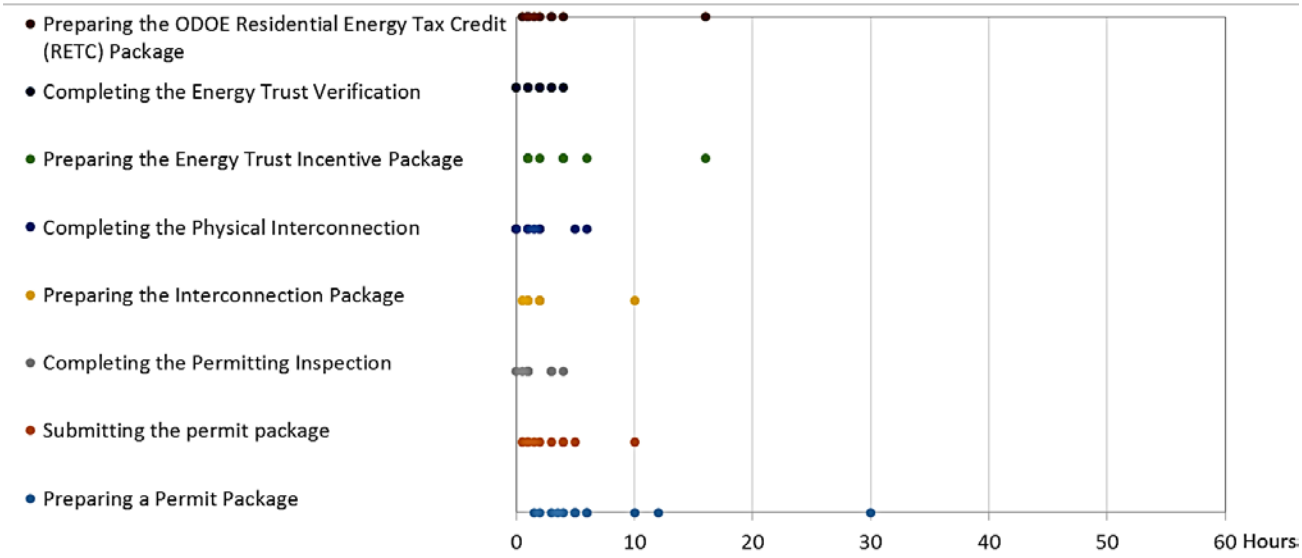
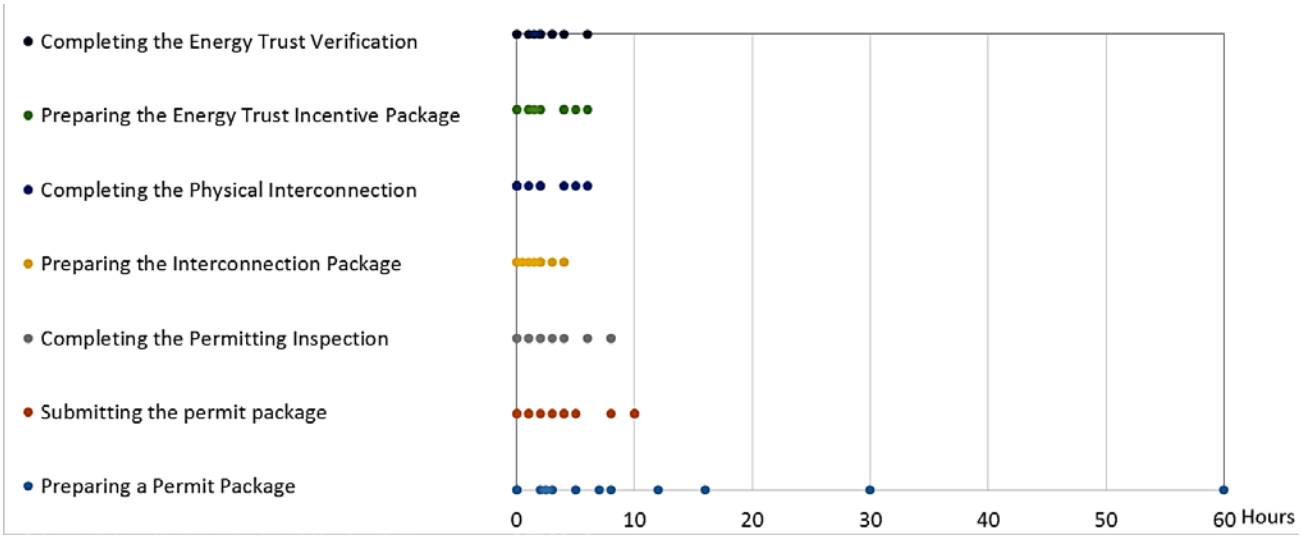


Figure 4: Commercial Reported Labor Hours for Tasks Associated with Permitting, Inspection, Interconnection and Incentives



It's notable that Oregon's permitting, inspection, interconnection and incentive costs are in line with the national forecast, given that solar installations funded by Energy Trust go through more rigorous review and verification than is performed in most other states. The standardized permitting requirements in the Oregon solar code and online incentive and interconnection application processes should be credited for this decrease in time spent.

The costs associated with the permitting, inspection, interconnection and incentives category are the lowest of any of the five soft cost categories, both in Oregon and nationally. However, this cost category only reflects time spent directly on permitting, inspection, interconnection and incentive tasks. Not included are the indirect costs associated with waiting for permit and interconnection approval, waiting for incentive review and approval, and waiting for a Permission to Operate letter

once installation is complete. Figures 5 and 6 illustrate the wide range in number of business days reported for each of these steps. While these values may not represent installer staff time, they can represent delays to beginning construction or achieving operation, which can impact installer cash flow, financing costs and scheduling.

Figure 5: For Residential Projects, Reported Number of Days before Receiving Installation Permit Approval, Interconnection Approval and Interconnection Permission to Operate Letter

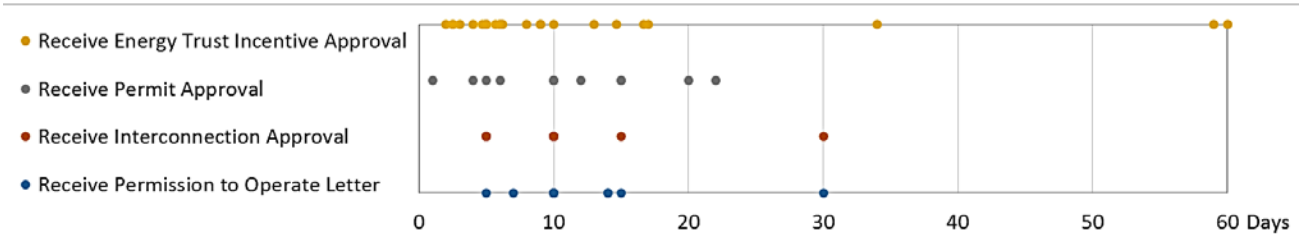
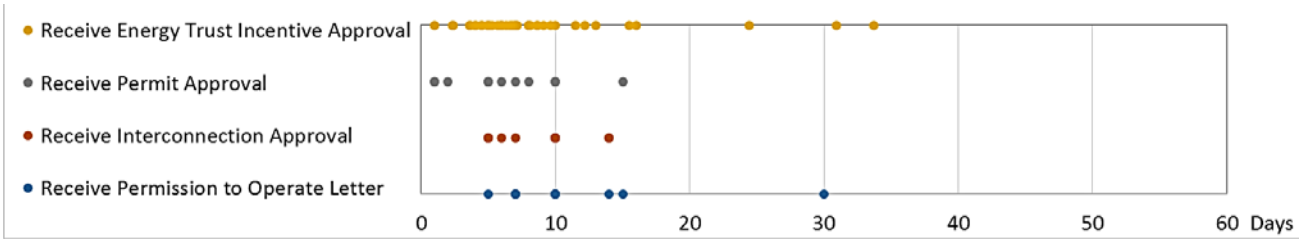


Figure 6: For Commercial Projects, Reported Number of Days before Receiving Installation Permit Approval, Interconnection Approval and Interconnection Permission to Operate Letter



Installations within Energy Trust territory must go through three separate review processes before proceeding, with Energy Trust, the utility and the local jurisdiction. Once a project is complete, projects must complete a minimum of three inspections before receiving a Permission to Operate letter from the utility that allows installers to turn on a system.

While the relatively low costs associated with the permitting, inspection, interconnection and incentives category may suggest there is less to gain from improvements, opportunities to streamline this cost category exist when the total number of days spent in the application, approval and inspection process are considered.

Installation Labor

The survey results indicate that installation labor for residential projects equates to a weighted average of 10.75 hours per kilowatts or $0.48 per watt. The reported labor hours for residential installations are split between 55 percent for an electrician, 15 percent for a limited renewable energy technician and 30 percent to a general laborer or apprentice workers.

For commercial projects, the survey responses show that installation labor equates to a weighted average of 8.4 hours per kW or $0.33 per Watt. On commercial projects, the labor split was reported as 25 percent for an electrician, 32 percent for a limited renewable energy technician and 43 percent for general laborers or apprentices.

Residential installation labor costs are 45 percent higher per watt, on average, compared to commercial installation labor costs. The commercial installation labor costs show some of the

anticipated economies of scale that are reflected in the national roadmap numbers, but commercial projects in Oregon have a smaller average system size, which minimizes the economies of scale.

The reported installation labor costs for both residential and commercial projects in Oregon (Table 5) are higher than for the same category in the national roadmap forecast for 2014. Two possible explanations for that difference could be that Oregon has higher labor rates due to stricter state licensing requirements and longer than average labor hours due to unique local installation standards.

Solar installation is a licensed trade in Oregon and electricians or limited renewable energy technicians are required to perform most of the work. As a result, labor rates in Oregon may be higher relative to other states where more of the work can be completed by unlicensed tradespeople.

Oregon is also unique in having a statewide solar building code with a prescriptive pathway for residential solar installations. This statewide code ensures that installers have standardized requirements for permitting and installation, which decrease permitting, inspection, interconnection and incentive costs, but could result in higher installation standards that require more labor time. In addition, Energy Trust enforces an even higher standard for installations that reflect industry best practices, which could also result in higher installation labor hours.

Table 5: Labor Costs for Residential and Commercial Installations

Installation Labor Category	Residential Cost ($/W)	Commercial Cost ($/W)
Electrician	$0.301	$0.107
Limited Renewable Energy Technician (LRT)	$0.073	$0.112
General Laborer / Apprentice	$0.105	$0.111
Total Cost ($/watt)	**$0.48/watt**	**$0.33/watt**
Total Labor (hours/kilowatt)	**10.75 hrs/kilowatt**	**8.4 hrs/kilowatt**
National Roadmap 2014 Target	**$0.46/watt**	**$0.30/watt**

Hardware Costs

The survey asked respondents to identify the cost of modules, inverter(s) and other hardware (racking, wire, conduit, etc.) by reporting each as a percentage of average installation cost. The reported costs ranged widely, as shown in Figures 7 and 8. The weighted average of these responses indicated that hardware costs total $2.69 per watt of the residential system cost and $2.62 per watt of the commercial system cost. These reported hardware costs are dramatically higher than costs apparent in the market at the time the survey data was collected.

Some explanations for the variations in hardware costs could include respondents reporting their hardware component costs after markup, instead of the actual component cost, or respondents not understanding the actual component cost as a percentage of the total system cost. The reported values for modules and inverters were replaced with averages of observed costs during the analysis to counteract the erroneous data. The “Other Hardware” costs for racking and electrical components were not altered and reflect reported values. Future surveys will frame the question about hardware cost differently in an effort to correct for this reporting error.

Figure 7: Reported Hardware Cost Distribution for Residential Projects

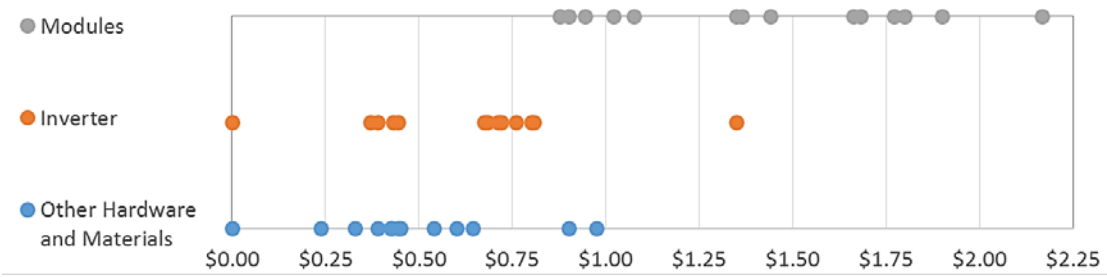
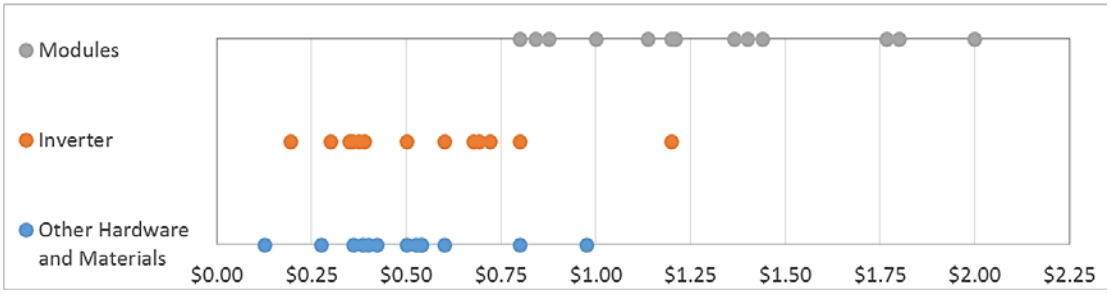


Figure 8: Reported Hardware Cost Distribution for Commercial Projects



As described in the Methodology section, the average cost per watt for modules and inverters was adjusted using data collected on actual installations from the Energy Trust database to obtain a more accurate hardware cost per watt for commercial and residential installations. The adjusted costs are shown in Table 6. These adjusted hardware costs can be considered conservative because installers typically have access to bulk pricing through ongoing vendor relationships. Using the weighted average of actual costs for modules and inverters installed in Oregon, as opposed to relying on the international module and inverter price indices, has the added benefit of accounting for the actual buying behavior of solar contractors in Oregon.

The adjusted hardware cost numbers in Oregon are lower than the national roadmap forecast, which can be attributed to hardware costs decreasing faster than anticipated.

Table 6: Reported Hardware Costs from Survey Compared to Weighted Average of Hardware Cost from Energy Trust Installed Project Database

	Residential		Commercial	
	Reported Cost ($/W)	**Adjusted Cost ($/W)**	***Reported Cost ($/W)***	**Adjusted Cost ($/W)**
Module	*$1.68*	**$1.10**	*$1.40*	**$0.99**
Inverter	*$0.67*	**$0.43**	*$0.68*	**$0.29**
Other	*$0.34*	**$0.34**	*$0.54*	**$0.54**
Total	*$2.69/watt*	**$1.87/watt**	*$2.62/watt*	**$1.82/watt**
National Roadmap 2014 Forecast		**$2.24/watt**		**$1.88/watt**

The “Other Hardware and Materials” category includes the cost of racking as well as structural and electrical components – commonly known as the balance of system. The Energy Trust project database does not contain information on these additional components of the solar installation and therefore “other” category was not adjusted from the reported values. The “Other Hardware and Materials” category for commercial projects was reported at $0.54 per watt compared to the average of $0.34 per watt for residential projects. It is uncommon to see higher per watt values for commercial installations because of the economies of scale present in larger projects. This increase could be caused by an increase in the structural and electrical complexity for commercial projects or it could be due to low data quality in this category.

Other Soft Costs

The “other” soft costs category is calculated from the survey responses and makes up the difference between the total median installed cost per watt and the sum of permitting, inspection, interconnection and incentives, customer acquisition, installation labor and adjusted hardware costs. From NREL’s analysis, the other soft costs category should include profit, overhead, supply chain costs and transaction costs. This category also captures any cost overruns, unplanned expenses, rework due to failed inspections or miscellaneous customer acquisition costs that do not fit into the other categories.

Based on the variation in survey responses and information gleaned from follow-up interviews, survey responses to the other soft costs category do not accurately reflect the intended components (profit, overhead, supply chain costs and transaction costs). The other soft costs category is the largest and least defined category, and a large portion of the costs reflected here may be more appropriately attributed by the installer to customer acquisition, permitting, inspection, interconnection and incentives or installation labor.

Study Limitations and Opportunities for Improvement

Opportunities for improving the survey fall into three categories survey deliver, survey design and timing of the effort. It is expected that making the following adjustments will increase data quality.

When delivering the survey it is important to consider that the soft cost categories do not translate exactly into expense categories that installers track at a project or business level, therefore providing clear definitions for these categories is critical to achieve accurate responses. Future surveys can accommodate for this by sending installers a worksheet in advance to assist in collecting the information and filling out the survey.

In designing the survey instrument using consistent and common units throughout will also aid in collecting accurate data. For example, the survey requested many responses in dollars per watt but requested hardware costs as a percentage of total costs. This discrepancy may be partially responsible for the divergence between survey responses and known average hardware costs. Module costs are often reported as a cost per watt, not a percentage, and inverter and racking could be easily translated into similar units.

Finally, future surveys would benefit from a broader sample size. Outreach efforts will be made to ensure detailed information is collected from a greater range of installers. Timing the next survey in early spring would allow the installers to use business data already collected for tax filing, minimizing respondent effort. Similarly using a whole year survey period - rather than one half of a year – would make it easier for the installer to provide data.

Conclusions and Future Work

This report provides insight into the makeup of the installed cost of solar in Oregon with the objective of tracking these costs over time and identifying local cost reduction opportunities. Results will inform Energy Trust Solar program policies and cost reduction efforts. Future cost reduction efforts may include comparing Oregon's policy landscape with policy landscapes of other leading markets, a roadmap highlighting opportunities for decreasing cost and strengthening the solar market in Oregon, and conducting periodic solar soft costs survey in Oregon to track progress in various cost categories.

The survey found that the average price of residential solar systems in Oregon in 2014 was $4.25 per watt, and the average price of commercial solar systems was $3.72 per watt[8]. More than 50 percent of the price for both sectors was attributable to soft costs.

Table 7: Comparison of Oregon Installer Survey Results for Residential and Commercial Installations to National Roadmap Targets for 2014 (reprinted)

	Residential		Commercial	
	Oregon 2014 Survey	**Roadmap 2014 Target**	**Oregon 2014 Survey**	**Roadmap 2014 Target**
Customer Acquisition ($/W)	$0.32	$0.49	$0.19	$0.13
Installation Labor ($/W)	$0.48	$0.46	$0.33	$0.30
Permitting, Interconnection, Inspection & Incentives ($/W)	$0.16	$0.16	$0.07	$1.36
Other Soft Costs ($/W)	$1.42	$1.14	$1.31	
Total Soft Costs ($/W)	$2.38	$2.25	$1.90	$1.76
Hardware Costs ($/W)	$1.87	$2.24	$1.82	$1.88
Total System Costs ($/W)	**$4.25/watt**	**$4.49/watt**	**$3.72/watt**	**$3.64/watt**

Total system costs for Oregon residential solar installations are significantly less than the national roadmap target, and that reduction is due to hard costs decreasing more quickly than anticipated.

For Oregon commercial solar installations, the total system cost is slightly higher than the national roadmap target due to higher soft costs.

This survey benchmarks Oregon installation costs to identify cost reduction strategies. However, the values provided either by the Oregon survey or national roadmap should be used with caution as an absolute target. Variations in cost between installers are substantial and could be due to reasons ranging from targeting different customer segments (residential or commercial), operation in different regions (rural or urban) or component offerings (low cost or high quality). These differences in cost are typical in a healthy market, and using an average value as an absolute goal is problematic without additional context.

As long as the market for solar continues to grow, the total cost of solar installations will decrease over time. However, in Oregon the soft costs are expected to fluctuate, including as a percentage of

[8] Initial data collected by Energy Trust on solar installation costs in the first half of 2015 suggest that Oregon will likely meet, or exceed, the 2015 national targets of $3.99 per watt for residential installations and $3.24 per watt for commercial installation.

total installation costs. Based on the survey responses, most solar installers do not categorize their expenses with the level of detail the survey demanded. Tracking costs more accurately is a positive outcome, even if survey results would indicate increased soft costs.

Certain solar soft costs are external to installation companies and impact all contractors, such as permit fees, inspection timelines and installation or application requirements. Each solar installer faces challenges unique to its region, market and business model, and these factors drive the individual costs that make up their price. An effective soft cost reduction strategy needs to address costs at the individual installer business level, in addition to local and statewide cost reduction opportunities.

Energy Trust is well positioned to work with state and regional stakeholders to reduce external soft costs for all solar installers, as well as to work with individual installers to address the market barriers and business challenges.

Energy Trust intends to survey Oregon solar installers at regular intervals to track fluctuations in soft costs over time and the next survey will be conducted in spring 2016. The lessons learned from this inaugural survey will inform future efforts.

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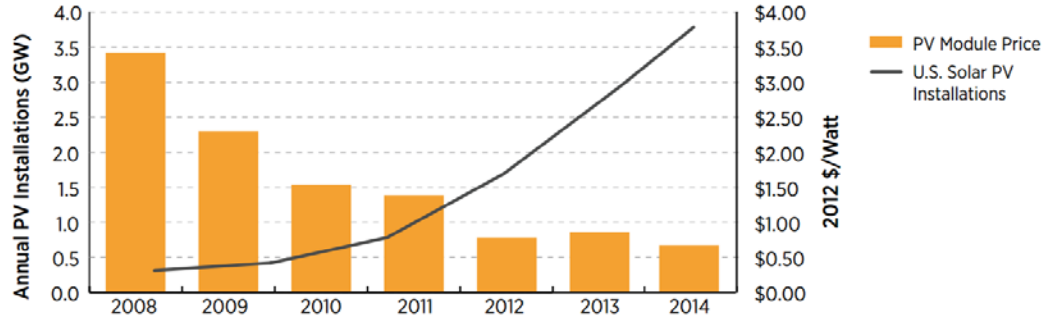
(Ardani et al., 2012)

APPENDIX A – National Renewable Energy Laboratory 2013 National Roadmap Summary

The U.S. DOE SunShot Initiative was launched in February 2011 with the goal of making solar electricity cost competitive before the end of the decade. The SunShot Vision Study (U.S. Department of Energy, 2012) published in 2012 showed that to reach the SunShot goals would require reducing total installed residential system cost to $1.50 per watt and total installed commercial cost to $1.25 per watt by the year 2020. At the time this goal represented a 75% decrease in the installed cost of solar. Historically decreases in PV module prices have been the driving factor in the continued decrease in cost of solar however in its analysis, National Renewable Energy Laboratory (NREL) showed that anticipated decreases in hardware costs would not be enough to meet this target and forecast that module prices would plateau.

Figure 9: Deployment and Module Price for U.S. PV 2008-2014 (DOE SunShot Fact Sheet 2015)



Note: The bars represent the falling price per watt of solar modules from 2008 ($3.42) to 2014 ($0.71). The line shows the rise in annual solar PV installations from 2008 (311 megawatts) to 2014 (6,201 megawatts).

As part of its 2013 report, “Non-Hardware (“Soft”) Cost-Reduction Roadmap for Residential and Small Commercial Solar Photovoltaics” (Ardani et al., 2013), NREL split the cost of solar installation in five key categories for the industry to focus its cost-reduction efforts: hardware costs; installation labor; permitting, inspection and interconnection (PII); customer acquisition and other soft costs.

For Energy Trust’s soft cost survey, costs associated with applying for Energy Trust incentives and the Oregon Department of Energy Residential Energy Tax Credit were included in the Permitting, Inspection and Interconnection category.

According to NREL’s analysis of their national installer survey, in 2012 solar soft costs made up more than one-half of the total system price for both residential and small commercial markets. NREL predicted that soft costs will make up roughly half of all residential and commercial project costs in 2014. In order to reach the SunShot price goals, NREL determined that soft costs for residential systems must decrease from $2.52 to $0.65 per watt between 2013 and 2020. Over the same period, commercial system soft costs must drop from $1.98 per watt to $0.44 per watt.

In Figures 9 and 10 the NREL National Installer Survey data is included alongside excerpted data from the 2013 National Solar Roadmap. The cost reduction opportunities identified by NREL in the national roadmap are ranked in one of four readiness factor categories and color coded as shown in Figure 12.

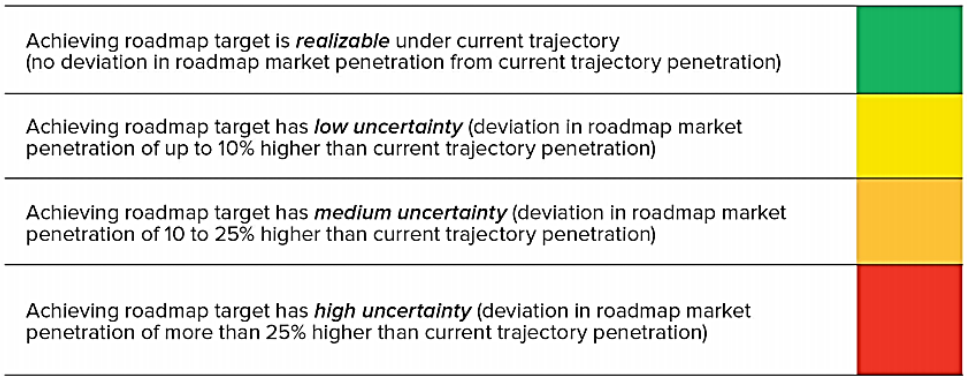
Figure 10: NREL 2013 Residential National Roadmap and Installer Survey Results[9]

Residential Cost Breakdown ($/W)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Customer Acquisition	$0.67	--	$0.48	$0.53	$0.49	$0.45	$0.41	$0.36	$0.28	$0.19	$0.12
Permitting, Inspection & Interconnection	$0.20	--	$0.19	$0.18	$0.16	$0.15	$0.13	$0.11	$0.10	$0.06	$0.04
Installation Labor	$0.59	--	$0.55	$0.51	$0.46	$0.42	$0.36	$0.30	$0.24	$0.19	$0.12
Other Soft Costs	$1.86	--	$2.10	$1.30	$1.14	$0.97	$0.82	$0.68	$0.56	$0.48	$0.37
Total Soft Costs	**$3.32**	**--**	**$3.32**	**$2.52**	**$2.25**	**$1.99**	**$1.72**	**$1.45**	**$1.18**	**$0.92**	**$0.65**
Hardware Costs	$3.28	--	$1.90	$2.47	$2.24	$2.00	$1.77	$1.55	$1.32	$1.08	$0.85
Total System Costs	**$6.60**	**--**	**$5.22**	**$4.99**	**$4.49**	**$3.99**	**$3.49**	**$3.00**	**$2.50**	**$2.00**	**$1.50**

Figure 11: NREL 2013 Commercial National Roadmap and Installer Survey Results[9]

Commercial Cost Breakdown ($/W)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Customer Acquisition	$0.19	--	$0.13	$0.15	$0.13	$0.10	$0.08	$0.08	$0.08	$0.05	$0.03
Installation Labor	$0.42	--	$0.39	$0.33	$0.30	$0.25	$0.20	$0.16	$0.12	$0.09	$0.07
Other Soft Costs	$2.03	--	$2.52	$1.53	$1.36	$1.22	$1.08	$0.90	$0.72	$0.53	$0.34
Total Soft Costs	**$2.64**	**--**	**$3.04**	**$2.01**	**$1.79**	**$1.57**	**$1.36**	**$1.14**	**$0.92**	**$0.67**	**$0.44**
Hardware Costs	$3.32	--	$1.93	$2.02	$1.85	$1.67	$1.48	$1.30	$1.13	$0.98	$0.81
Total System Costs	**$5.96**	--	**$4.97**	**$4.03**	**$3.64**	**$3.24**	**$2.84**	**$2.44**	**$2.05**	**$1.65**	**$1.25**

Figure 12: NREL 2013 National Roadmap Readiness Factor Legend (NREL National Roadmap)



[9] Cost category data provided for 2010 and 2011 is from NREL installer survey analysis.

APPENDIX B – Oregon Soft Cost Survey Instrument

Oregon Solar Soft Costs Survey

Introduction

According to numerous recent studies performed by the national labs and U.S. DOE, solar hardware costs are decreasing, while non-hardware "soft costs" continue to account for an increasing share of overall prices. Soft costs are associated with permitting, interconnection, incentives, financing, marketing and advertising, design, installation labor, bid preparation, inspections, overhead and delays. Nationally, soft costs now account for over 50 percent of installation costs. National studies are useful for guiding federal policy, but may not accurately represent the situation in any particular state. The objective of this survey is to benchmark the current soft costs associated with installing photovoltaic (PV) systems in Oregon.

This survey will help the Oregon solar industry by:
Clarifying what contributes to the cost of a solar installation in Oregon;
Quantifying the real costs of inefficiencies and identifying the entities with the power to address them;
Making a persuasive case for more affordable and consistent requirements for permitting, interconnection and incentives;
Highlighting opportunities to simplify and streamline the process of selling and installing solar; identifying how we can make solar a more profitable business in Oregon.

Questions ask about your installations and costs in Quarter 1 and Quarter 2 of 2014.

All answers will be kept confidential. The report of this survey's results will not identify any business by name and will not disclose raw data from any individual survey respondent. The report will present all information in aggregate and may offer a statistical analysis of results (showing, for example, what proportion of installers or what regions of the state face higher or lower costs). All results will be treated anonymously and will not reveal any respondent's trade secrets or confidential business information.

Q2 Your information:

Name:		Address:	
Job Title:		City:	
Company Name:		Zip Code:	
Phone:		Email:	

Q3 Including yourself, how many employees does your company have?

A3:

Q4 What counties has your company worked in during 2014? Select all that apply.

- ❑ All counties in Oregon
- ❑ Baker
- ❑ Benton
- ❑ Clackamas
- ❑ Clatsop
- ❑ Columbia
- ❑ Coos
- ❑ Crook
- ❑ Curry
- ❑ Deschutes
- ❑ Douglas
- ❑ Gilliam
- ❑ Grant
- ❑ Harney
- ❑ Hood River
- ❑ Jackson
- ❑ Jefferson
- ❑ Josephine
- ❑ Klamath
- ❑ Lake
- ❑ Lane
- ❑ Lincoln
- ❑ Linn
- ❑ Malheur
- ❑ Marion
- ❑ Morrow
- ❑ Multnomah
- ❑ Polk
- ❑ Sherman
- ❑ Tillamook
- ❑ Umatilla
- ❑ Union
- ❑ Wallowa
- ❑ Wasco
- ❑ Washington
- ❑ Wheeler
- ❑ Yamhill

PV Systems Installed in Oregon

Q6 For the following customer segments, provide the number of PV systems and the total DC nameplate capacity in kilowatts that your company installed in Q1-Q2 of 2014. Enter whole numbers only, no decimals. If you did not complete any installations in a customer segment, enter 0 for both # of systems and kW.

	# of systems in Q1-Q2 2014	kW in Q1-Q2 2014
Residential		
Commercial		
Other (utility scale and off-grid)		

Q7 What percentage of your company's Q1-Q2 2014 residential installations were leased systems? Enter as a whole number between 0 and 100; if you did not complete any residential installations in Q1-Q2 2014, enter 0.

A7:

Q8 What percentage of your company's Q1-Q2 2014 installations (residential and commercial) received an Energy Trust of Oregon incentive? Enter as a whole number between 0 and 100.

A8:

Q9 We calculate the following values based on your responses about your company's Qtr 1 and Qtr 2 2014 projects:

NOTE: *These values are calculated automatically in the online survey based on your previous input. The average system sizes for residential and commercial systems will be used as examples for future questions on system pricing and labor hours.*

Residential:
# of systems: Total Installed kW:

Average system size (# of Systems / Total Installed kW = Average Size kW):

Commercial:
# of systems: Total Installed kW:

Average system size (# of Systems / Total Installed kW = Average Size kW):

Other:
# of systems: Total Installed kW:

Average system size (# of Systems / Total Installed kW = Average Size kW):

Q10 Are these values correct? If not, click the Back button to go back and re-enter information. When you are satisfied with your answers, click the Next button to move on.

System Costs

Q12 What was the average end consumer price (in $/W, prior to any incentive) for systems that your company completed in Q1-Q2 2014? Enter as x.xx for $x.xx.

Residential average end consumer price:	
Commercial average end consumer price:	

Q13 Of the total average end consumer price above, what percentage before markup was attributable to each of the following cost categories? Enter as whole numbers between 0 and 100. Total must add to 100%.

	% of end consumer price, residential systems (1)	% of end consumer price, commercial systems (2)
Modules (1)		
Inverter (2)		
Other hardware and materials (racking, wiring, etc.) (3)		
Non-hardware soft costs, including 1) customer acquisition; 2) permitting, inspection and interconnection; 3) financing and contracting; 4) installation labor; and 5) profit and overhead (4)		

Installation Labor

Q16 For the total number of labor hours spent on installation, what was the percentage breakdown of limited renewable energy technician (LRT) vs. electrician vs. non-electrical labor hours per PV system in Q1-Q2 2014? Enter as whole numbers between 0 and 100. Total must add to 100%.

	Labor hours per average residential installation (avg. size calculated on page 3)	Labor hours per average commercial installation (avg. size calculated on page 3)
Limited Renewable Energy Technician (LRT) (1)		
Electrician (2)		
Non-electrician installer (3)		

Customer Acquisition

Q19 How many bids did your company prepare for systems with a planned, or actual, installation date in Q1-Q2 2014? (i.e., the number of individual bids that could have led to a contract, including bids for installations that did not go forward and bids made in 2013 for planned 2014 installations)

	Bids prepared (1)
Residential (1)	
Commercial (2)	

Q20 What was your company's total cost for customer acquisition activities in Q1-Q2 2014 (including sales calls, site visits, travel time to and from the site, contract negotiation with system host/owner, system design and bid/pro-forma preparation)? Enter whole numbers, with no "$" or decimals.

	Cost of customer acquisition activities in Q1-Q2 2014 (1)
Residential (1)	
Commercial (2)	

NOTE: *This is intended to represent costs associated with the sales process prior to contracting with the customer.*

Q21 What was your company's total marketing and advertising budget in Q1-Q2 2014? Please provide an estimate for residential and commercial sector, if internal accounting combines marketing and advertising budgets. Enter whole numbers, with no "$" or decimals.

	Marketing and advertising budget in Q1-Q2 2014 (1)
Residential (1)	
Commercial (2)	

Q23 We calculated the following values based on your responses about your company's Q1-Q2 2014 bids and customer acquisition costs:

NOTE: *These values are calculated automatically in the online survey and used as a sanity check.*

Q24
Residential bids per installation:

Residential customer acquisition cost per installation:

Residential marketing and advertising cost per installation:

Q25
Commercial bids per installation:

Commercial customer acquisition cost per installation:

Commercial marketing and advertising cost per installation:

Q26
Total bids per installation:

Total customer acquisition cost per installation:

Total marketing and advertising cost per installation:

Q55 Are these values correct? If not, click the Back button to go back and re-enter information. When you are satisfied with your answers, click the Next button to move on.

Permitting, Inspection and Interconnection

Q28 In which utility districts do you operate? Select all that apply.

- ❑ Pacific Power (1)
- ❑ Portland General Electric (PGE) (2)
- ❑ Central Electric Co-op (3)
- ❑ Eugene Water & Electric Board (EWEB) (4)
- ❑ Emerald People's Utility District (EPUD) (5)
- ❑ Ashland Municipal Electric Utility (6)
- ❑ Midstate Electric Co-op (7)
- ❑ Other (please list): (8) _____
- ❑ All of the above (9)

Q30 Of the PV installations you completed in Q1-Q2 2014, what percentage of permit applications were submitted electronically? Enter as a whole number between 0 and 100, no decimals or "%".

	Residential (1)	Commercial (2)
Permit applications submitted electronically (%) (1)		

Q31 On average, how many business days pass between submitting your permit application and receiving permit approval?

	Days to permit approval (1)
Residential (1)	
Commercial (2)	

Q32 Do you use SolarPermit.org to find permitting requirements for your jurisdiction?

- ❍ Yes (1)
- ❍ No (2)

Q29 Based on the average system size you reported, indicate the number of labor hours spent per residential PV installation in Q1-Q2 2014 on the following activities (include both full time employees and contract labor):

	Labor hours per average residential installation (size calculated on page 3) (1)	Labor hours per average commercial installation (size calculated on page 3) (2)
Preparing a permit package (including determining a jurisdiction's permitting requirements, travel time to site, drawing system plans, structural calculations, and permit application)		
Submitting the permit package (including travel time to and from the permitting office and wait time at the permitting office)		
Completing the permitting inspection (including paperwork, travel time to and from the site, wait time for inspector, and physical inspection)		
Preparing the interconnection package (including determining a utility's interconnection requirements, completing the application/agreement and submitting application)		
Completing the physical interconnection (including travel time to and from the site, wait time for the utility technician, and physical interconnection)		
Preparing the Energy Trust incentive package (including determining eligibility, completing and submitting the application)		
Completing the Energy Trust verification (including travel time to and from the site, wait time for the verifier and physical inspection)		
Preparing the ODOE Residential Energy Tax Credit (RETC) package (including providing all documentation, completing and submitting the application)		

Q33 What percentage of your company's Q1-Q2 2014 installations qualified for a Level 1 (simple) interconnection application? Enter whole numbers between 0 and 100, with no decimal or %.

	Residential (1)	Commercial (2)
Installations qualified for Level 1 interconnection (%) (1)		

Q34 On average, how many days pass between submitting an interconnection application for a system and receiving interconnection approval?

	Residential (1)	Commercial (2)
Days between interconnection application and approval (1)		

Q35 On average, how many days pass between requesting final interconnection from the utility for a system and receiving the Permission to Operate (PTO) letter?

	Residential (1)	Commercial (2)
Days between requesting final interconnection and PTO letter (1)		

Financing

Q37 Do you offer financing (loans, leases or energy service options) to your customers?

	Yes (1)	No (2)
Residential customer (1)	❍	❍
Commercial customers (2)	❍	❍

Q38 For the PV installations your company completed in Q1-Q2 2014, what percentage were paid for using: (Enter whole numbers between 0 and 100, with no decimal or %. Total must add to 100%.)

	% of residential installations (1)	% of commercial installations (2)
100% direct cash purchase (1)		
Financing from bank (2)		
Third-party lease agreement (4)		
Third-party power purchase agreement (5)		
Other (please specify) (3)		
Other (please specify) (6)		
Other (please specify) (7)		

Q40 Please provide any additional feedback that would be helpful in better understanding the soft costs associated with PV installation and the PV business process in Oregon:

A40:

Q41 What do you think is the greatest single opportunity to reduce soft costs in Oregon?

A41:

Q42 What do you think is the greatest single obstacle to reducing soft costs in Oregon?

A42:

Q56 We have focused on these cost categories: customer acquisition, permitting, interconnection and incentive paperwork. Do you have any suggestions for other cost categories that were overlooked?

A56: