

A Study on the Residential Market Valuation of EPS and Solar PV in the Greater Portland and Bend, Oregon Markets

Prepared by:



Presented to:



With research assistance and support from:



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Executive Summary

A very large number of new homes and a significant number of existing homes (5,300 to date) that are performance tested in Oregon receive an Energy Performance Score (EPS). The metric is thus an integral part of the single-family energy efficient construction marketplace, which also includes residences with solar photovoltaic (PV) systems and green certified homes.

The goal of the study is to determine the contributory value (if any) of EPS and solar PV in residential single-family-house sales in the Portland, Oregon¹ area. Because EPS is the primary metric with which new home energy performance is measured, it is closely tied to green certification of new homes. Thus, an analysis of EPS requires consideration of green certified homes. Results of the analysis applied in this study conclude the following findings, among others:

- That there is an increased market value associated with residential PV systems in the study area.
- That there is a statistically significant price premium for certified over non-certified homes in the study area, and these certified homes generally include EPS.
- That EPS is significantly underrepresented in the RMLS, the primary regional real estate database from which the majority of all real estate market data is sourced.

The valuation results provide additional support to previous local and regional valuation studies and lead to the recommendation that Energy Trust continue to focus on the promulgation of EPS in the local and regional market, EPS' accurate and consistent listing on RMLS, and additional marketing of EPS to buyers of homes, whether new construction or retrofit. It will be through these efforts that the market value of energy efficiency in the region will be clarified.

¹ The Bend market was part of the original research plan, but early examination of the results suggested that Bend had completely different market dynamics over the study period than Portland. Numbers of sales were low at times, and fluctuations in price over time were extreme. For these reasons, Bend was treated separately.

MEMO



Date: August 14, 2015
To: Board of Directors
From: Phil Degens, Evaluation Manager
Sarah Castor, Evaluation Sr. Project Manager
Lizzie Rubado, Senior Project Manager Commercial Solar
Marshall Johnson, Senior Program Manager, Residential
Subject: Staff Response to the Solar and EPS Valuation Study

The study examined the contributory value of EPS and installed solar systems on home price. This study mirrored the findings and results of past Energy Trust studies on the impacts of solar on home valuation. This was the first time that Energy Trust examined the impact of EPS on home value.

Homes that have solar systems installed tend to turn over infrequently, resulting in a small study sample. Additionally, EPS values are underrepresented on RMLS, the primary source for real estate value data used in this study. The small samples cause estimated impacts to have a fairly large error band. The study did conclude that there is a premium for a home with a solar system compared to a home without a system and that the premium appeared to be more than the out of pocket cost to the homeowner for the system. This finding is consistent with our previous study and a national study of the impact of solar on home values. Green certified homes, which can include homes with an EPS, also were shown to have a statistically significant price premium, although there is no apparent premium for EPS itself at this time.

Energy Trust plans on repeating the analysis of solar's effect on residential valuation in a few years, expecting that the passing of time will lead to greater turnover in homes with installed solar systems, a larger number of homes from which to sample, and more robust results. Also, the increase in third party ownership will add an additional area of research.

EPS appears to still be in the early phases of market adoption. It is also only one aspect of energy efficiency home certification as it is often used in tandem with other certifications such as ENERGY STAR and Earth Advantage. As it comes into greater use for both new construction and existing homes, and is captured in RMLS data sets, Energy Trust will revisit this area of research. As with solar, we plan to wait a few more years before researching the impacts again.

Background

There remains a market perception that initial capital investments for increased energy efficiency or green certification will not be recaptured when the home is sold. As long as these perceptions persist among key market actors such as homebuilders, lenders and consumers, there will remain a reluctance to invest in these systems, and the residential market will continue to be a significant contributor to U.S. greenhouse gas emissions. Ultimately, the value the market places on energy-efficient or green residential construction either encourages or hinders further incorporation of those features into homes.

In 2009, Watkins & Associates, in partnership with Earth Advantage and SEEC LLC as part of a regional Green Building Value Initiative (GBVI), issued a study assessing the market impacts of third-party certification on residential properties in two key markets in Washington and Oregon. Conducted in collaboration with a broad array of stakeholder groups, the 2009 study represented a first step in examining the market performance of highly energy efficient homes. This initial study also informed other valuation research efforts around the country, including subsequent national² and localized³ studies that have garnered national attention. This first attempt to quantify the market value of third-party certification led to increased interest and activity around this issue central to the proliferation of energy efficient construction in the US.

Watkins & Associates also engaged with Energy Trust of Oregon in 2009 - 2012 on a valuation study of residential solar systems throughout Oregon, which shed light on the particular valuation issues involved in these properties as well as the market value of residential PV systems to buyers that purchased properties with solar already installed.

In the interim, Energy Trust released the Energy Performance Score (EPS) to the market. Based on past valuation experiences around high performance homes, and in light of recent market developments, Watkins & Associates, with research support from Earth Advantage, proposed that similar market-based valuation techniques be applied to solar PV installations and sold residential properties with EPS between January 2009 and January 2014 to determine if there is any market value to these features.

Though work has been done concerning the market value for PV and third-party certification, the work outlined above provides only a small amount of information over a particular period of time. Further, no valuation research had yet been conducted on the EPS label, which is newer to the market than other certifications such as Earth Advantage and ENERGY STAR. For these reasons, an inquiry into the market value for EPS and residential PV was believed to be of high value to all participants in the real estate market, from energy efficiency programs to buyers and sellers of real estate.

² *Market Impacts of ENERGY STAR® Qualification for New Homes*: William Pflieger, Chuck Perry, Nicholas Hurst, Jeff Tiller; Appalachian State University

³ *The Capitalization of Green Labels in the California Residential Housing Market*: Matthew Kahn and Nils Kok

Study Overview and Methodology

The goal of the study is to determine the contributory value (if any) of several different environmental features in residential single-family-house sales in the Portland, Oregon⁴ area. These features are:

- Solar photovoltaic installation
- Energy Star certification (including EPS)
- Earth Advantage certification (including EPS)
- All certifications combined (including EPS)
- All certifications combined (without EPS)
- Presence or absence of EPS, among certified homes⁵

Valuation Model and Hypothesis

To determine the contributory value of a given environmental feature (for example, Energy Star certification), Taylor Watkins and Martin Brown have developed the following methodology, which uses an appraisal-style calculation that compares market data on sold properties that *have* the feature (the “subjects”) to similar sold properties that *lack* the feature (the “comparables”). The market data were obtained, and the parameters for correcting prices of the comparables (as described in the next section) were defined, by Taylor Watkins of Watkins and Associates.

In general, the valuation model is:

$$V_e = S - C$$

where

V_e = Contributory value of environmental feature

S = Sold price of subject property

C = Sold price of comparable property (incorporating details and corrections described below)

The formal hypothesis is that the mean V_e , across all the subjects in the study, and expressed either in dollars or as a percentage of the comparable’s price, will be significantly more than zero.

⁴ The Bend market was part of the original research plan, but early examination of the results suggested that Bend had completely different market dynamics over the study period than Portland. Numbers of sales were low at times, and fluctuations in price over time were extreme. For these reasons, Bend was treated separately.

⁵ One original goal for the research was to determine the market value of various EPS numerical values, apart from and independent of certifications – for example, would lower EPS values translate into higher prices? However, a look at actual listings showed that few if any listings mentioned EPS, even for properties that had EPS. Since EPS was apparently not part of the property sales conversation, it seemed unlikely that fine distinctions in EPS would translate into price differences. Accordingly, we do not perform a fine analysis on EPS. However, we do look for an effect of EPS by comparing certified homes that do and do not feature EPS.

Methodological Details

Because using a single comparable property might be deceptive, in this study, as well as much residential appraisal work, each subject property has at least 3 comparables. Accordingly the valuation equation actually compares the price of each subject property to the *mean* price of those comparables.

$$V_e = S - \bar{C}$$

It is not always possible to find comparable properties that are exactly similar to a given subject property. Comparables may diverge from subject in several ways commonly acknowledged to affect purchase prices, notably, square footage, bathroom count, and time of sale. To narrow the range of differences between a subject property and its comparables, the comparables must meet the following criteria:

- sold with a closing date no more than 6 months prior to the closing date of the subject property
- located within the same neighborhood or sub-neighborhood, defined by appraiser market knowledge.
- constructed in a similar style based on photographs and staff determination
- constructed to the same degree of quality (e.g., design and materials)
- in the same age range (built within 3 years prior and 3 years after the subject home)
- approximately the same size (within a range from 15% smaller to 15% larger in square feet)
- built with no distinguishing green features, certifications, or EPS score

Additionally, the collected comparables should bracket the gross living area (GLA (which is the amount of total above-grade, and below-grade in some cases, residential space)) and age of the subject property, which means that some comparables should have less GLA than the subject, and some should have more GLA; some comparables should be newer, and some should be older than the subject. In some cases, full bracketing was not possible, but in these cases if a comparable is within 50 square feet of GLA of the subject or is the same age as the subject, then it was considered bracketed for the purposes of this study.

To make each comparable a more precise “control” for the subject property, we altered the sales price of the comparable according to the following rules:

- Square footage differences between the subject and comparable were valued at \$40 per square foot. For example if the comparable had 100 fewer square feet than the subject, \$4000 was added to the comparable’s price.
- Bathroom count differences between the subject and the comparable were valued at \$4000 per half-bath and \$8000 per full bath. For example, if the comparable had three full baths and the subject two full baths, \$8000 was subtracted from the comparable’s price.
- Bedroom count differences were valued at \$8,000 per room, but only for one bedroom differences in homes that had a minimum of three bedrooms (so no two bedroom homes were compared to three bedroom homes or higher). Three bedroom homes were only compared to three or four bedroom homes, and four bedrooms homes were only compared to four or five bedroom homes.

Date-of-sale corrections required a more complex calculation, the methodology involved in this was developed by Martin Brown. Though the sales dates of subjects and their comparables were rarely more than a few months apart, the study period spanned some notable swings in the Portland real-estate market. It was necessary for us to create a price-time trend to use as a standard reference.

Because conditions seemed to differ among the MLS Areas in our data, we created one trend line for each MLS area, with the following method.

From rmlsweb.com, we obtained the monthly median sales prices of all single-family-home sales in each Portland MLS Area, from August 2008 to July 2014. Because prices varied considerably among MLS Areas, and we were interested in making areas comparable, we converted the absolute median values (in dollars) to relative values (proportions) by dividing each monthly median into the July 2014 monthly median for that MLS Area. The monthly median value was assigned a specific date (the 15th of the month). Combining these two conventions, the sales price index for July 15, 2014, will always be exactly 1.0.

When this data was graphed, it was clear that trend lines needed to express several phenomena. There was a general bowl-shaped trend, with higher values in 2008 and 2014, and a dip in 2011-2012. There were also weak but noticeable trends with season. Price indexes were higher in summers than in winters, with July differing from February by about 0.06 on the index scale.

These trends seemed too irregular, and too unique to each MLS area, to be expressed with a single preconceived functional form (for example, a polynomial, or sine wave). Accordingly, we chose to draw trend lines for each MLS area using localized regression (LOESS), a statistical technique that makes no assumptions about the inherent shape of the data.

The resulting trends appear as follows (MLS areas are distinguished by different color lines):

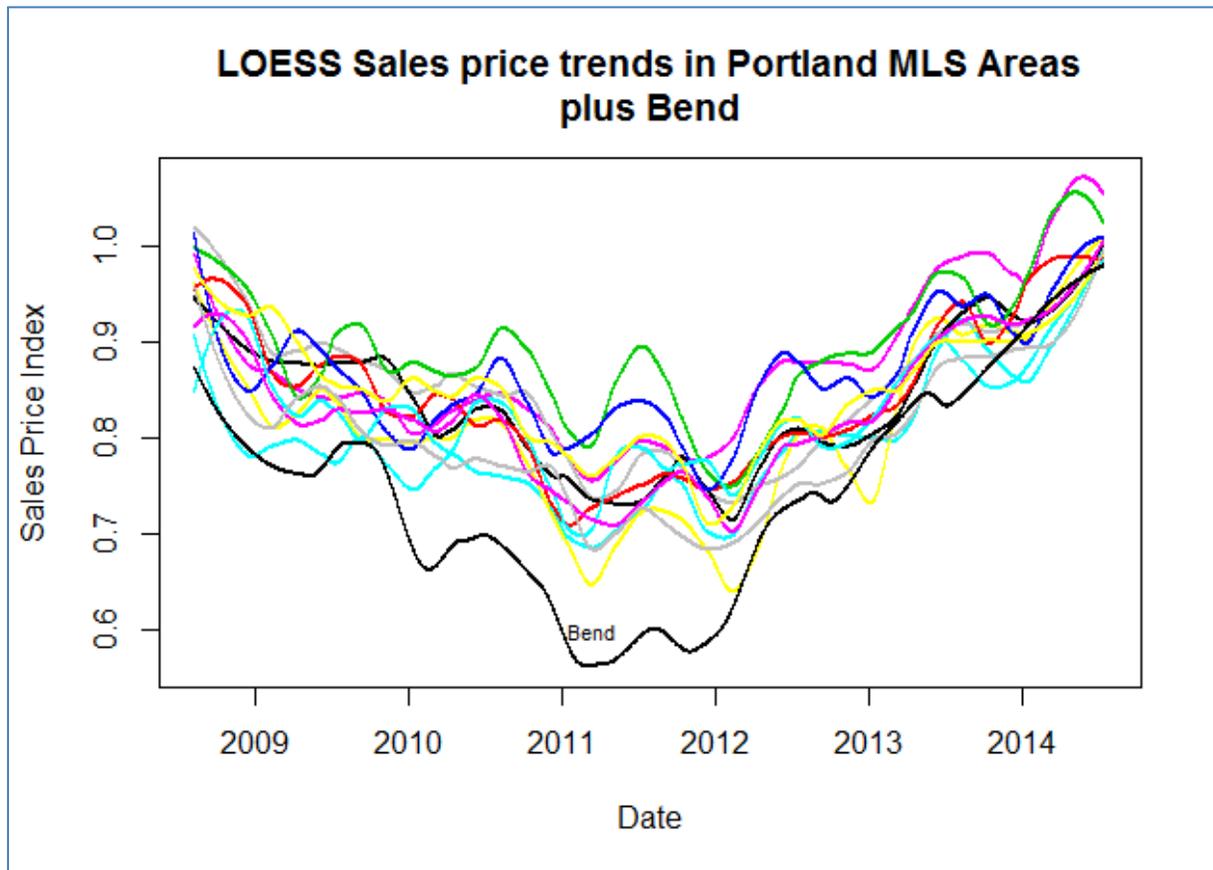


Figure 1: LOESS graph. All MLS areas.

These lines give each date in each MLS area a specific index value. The date-of-sale correction is applied to each comparable by utilizing the relevant index values for the date of sale of the subject, and the date of sale of the comparable. The correction is:

$$\left(\frac{\text{index value on subject sale date}}{\text{index value on comparable sale date}} \times \text{sales price of comparable} \right) - \text{sales price of comparable}$$

For example, if the index on the subject sale date is 0.9, and the index on the comparable sale date is 1.0, and the sales price of the comparable is \$100,000, then \$10,000 will be subtracted from the comparable's price.

Development of the Subject Property Datasets

This methodology was to be applied to groups of properties that were located by Energy Trust through their own databases that were merged with other known databases. In order to isolate the value of a solar PV system or a label such as EPS, properties with one of these features needs to have sold after obtaining the feature. The sale gives a point in time where a property's "value" (its sold price) is known. Using this point as a reference, the comparable valuation techniques described above can be applied to the property as of that time to determine the contributory value of the item being isolated.

Energy Trust developed two lists, or datasets, of possible subject properties – one with solar PV and one with EPS. In order to create the lists, Energy Trust had to merge together three other datasets. The solar PV dataset, after merging Metro Scan with Strata and Site ID resulted in 70 possible subject properties with solar PV. The EPS dataset was developed after merging Metro Scan with Strata and Site ID, and resulted in 716 possible EPS subject properties⁶.

The PV Dataset

The PV dataset included over 70 properties provided to the team by Energy Trust. This list was generated by Energy Trust cross-checking properties with known PV systems against transfers of the properties after the PV system was installed. This gives a point in time where a property's "value" (its sold price) is known. Using this point as a reference, the comparable valuation techniques described earlier can be applied to the property as of that time to determine the contributory value of the item being isolated; in this case the PV.

After vetting the PV list, however, very few properties remained as candidates for inclusion in the study. There were five primary reasons for not including a property:

1 – not an open-market sale. To meet the definition of "market value" several conditions need to be met, including reasonable exposure time to the broader real estate market, and the transaction being arms-length, with the parties not knowing one another before the transaction.

⁶ Please see Appendix A for a detailed explanation of the development of the solar PV and EPS datasets.

2 - incorrect data information. This came in several forms, but usually indicated the transfer was not an open-market sale or that the actual date of sale fell outside of our study period. An open-market sale requires that it be offered to the public for sale, that both buyer and seller be knowledgeable, typically motivated, and not related to one another, and other more minor requirements. Many transfers of properties are the result of other activities, such as foreclosures, sales within families, transfers to trusts for estate planning, sales of the land only with no improvements, and for other reasons. Many of the transfers in the Energy Trust list were not open-market sales for one of these reasons, which were verified through public records and MLS searches.

3 - no comparables available in the MLS system for the subject property. This was the case if the property was unique for any number of reasons, including square footage, location (waterfront, view property), design and style.

4 - no solar listed in MLS. If the listing for the property did not include any solar feature, then it was assumed that the market was not given the opportunity to react to the feature, so it could not be clearly isolated in the valuation.

5 - multiple green features (*i.e., certification + solar*). It was not possible to isolate the PV system by itself.

There were 14 PV properties included in the final analysis.

Solar PV Properties in the Portland, Oregon Area

The sample size for this analysis is small, with 14 subject properties with solar photovoltaic arrays. Given that, it appears that these installations are *probably* associated with a small premium in price, but at this point we cannot claim there is a statistically significant difference. A larger sample size would probably clear up the relationship.

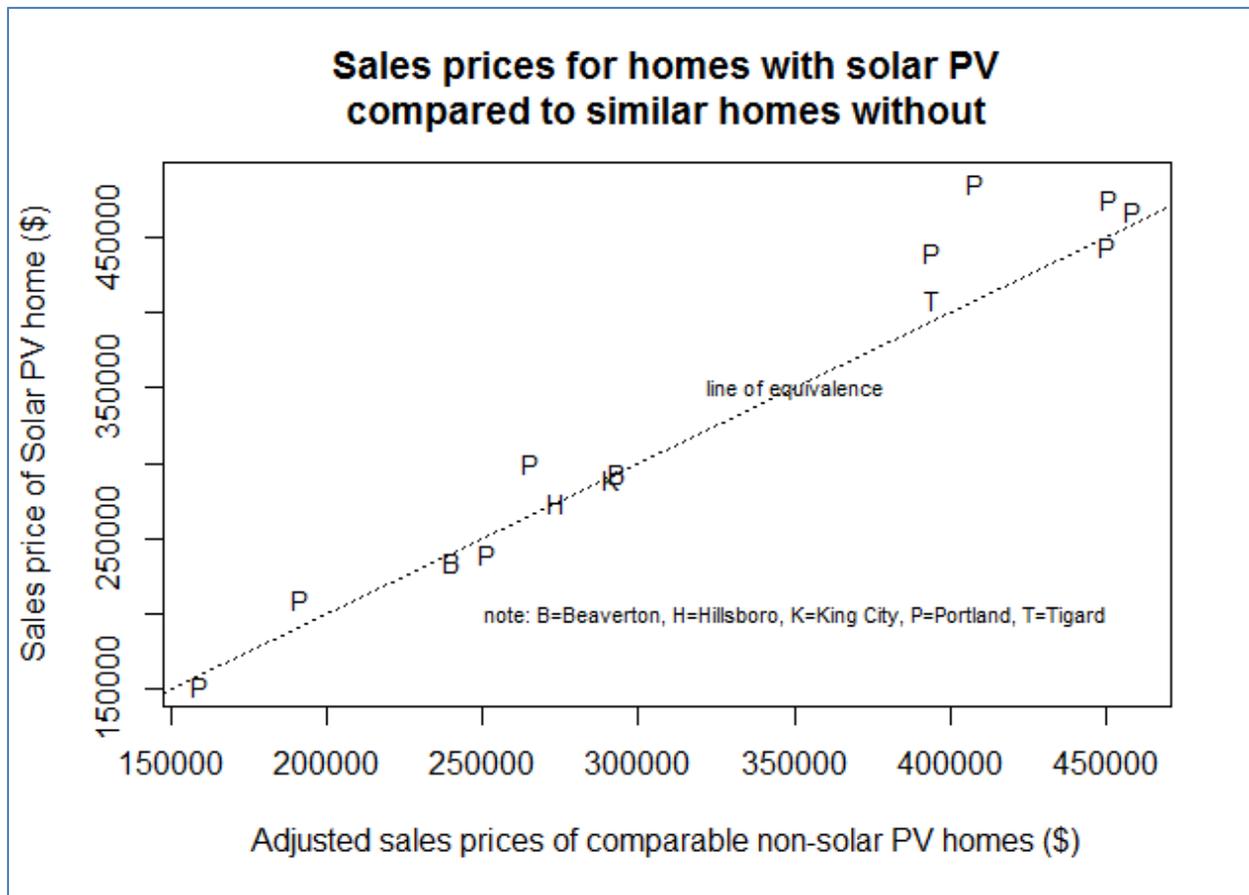


Figure 2: PV Adjusted sales prices.

It is fairly convincing that the majority of points are above the line of equivalence. The mean premium is \$13,694, or 3.6% of sale price.

These results have borderline significance by statistical *conventions* – which tend to be rather conservative. It depends on exactly what test is considered. All the different possible tests are detailed below, with those we feel are most valid to the current data set highlighted in yellow. The most conservative versions are highlighted in blue.

Definitions of tests:

- Parametric tests assume the distribution of the variable in question is normal – a common but accepted suggestion, but something we question for this data set.
- One tailed tests assume a direction. In the one tailed tests, we are asking, are the solar PV properties greater in sales price than similar non-PV properties? It ignores the possibility that they might have lower prices on average.

Table 1. Statistical Tests and Probabilities

| Variable | Test | P-value |
|--------------------------|--------------------------|---------|
| Absolute difference (\$) | Parametric | 0.06 |
| Absolute difference (\$) | nonparametric | 0.10 |
| Absolute difference (\$) | Parametric one-tailed | 0.03 |
| Absolute difference (\$) | Nonparametric one-tailed | 0.05 |
| Relative difference (%) | Parametric | 0.08 |
| Relative difference (%) | nonparametric | 0.17 |
| Relative difference (%) | Parametric one-tailed | 0.04 |
| Relative difference (%) | Nonparametric one-tailed | 0.09 |

The most likely reason that the results show borderline statistical significance is sample size.

This result has important implications because the installed costs of the PV systems are likely lower than this value result. This can be partially explained by sample size and the fact that when more properties were added to the study (from 9 – 14), the premium moved downward. This trend may continue with more properties added to the sample. There are also real estate transaction-related factors that cannot be accounted for in any valuation model, and it is possible that there are other variables at play in this value conclusion that have not been considered. Still, there is a positive value indication for solar PV in the Greater Portland, Oregon area.

Cost Versus Value

The results in an opinion of market value can be compared to the owners' costs out-of-pocket for the systems, as in the table below.

Table 2. Costs of Subject Property PV Systems

| Installation Date | System size (kW) | Installed Cost | Energy Trust Incentive | Federal Tax Credit | State Tax Credit | Net Cost |
|--------------------------|-------------------------|-----------------------|-------------------------------|---------------------------|-------------------------|-----------------|
| 1/22/2013 | 4.08 | \$26,240.00 | \$3,060.00 | \$6,954.00 | \$6,000.00 | \$10,226.00 |
| 7/28/2011 | 3.00 | \$17,550.00 | \$5,250.00 | \$3,690.00 | \$6,000.00 | \$2,610.00 |
| 9/16/2010 | 2.15 | \$12,792.50 | \$3,762.50 | \$2,709.00 | \$6,000.00 | \$321.00 |
| 7/14/2011 | 2.00 | \$13,499.14 | \$3,500.00 | \$2,999.74 | \$6,000.00 | \$999.40 |
| 7/15/2009 | 2.45 | \$19,355.00 | \$5,513.00 | \$4,152.60 | \$6,000.00 | \$3,689.40 |
| 11/10/2011 | 3.00 | \$16,500.00 | \$5,250.00 | \$3,375.00 | \$6,000.00 | \$1,875.00 |
| 9/29/2011 | 3.68 | \$29,366.00 | \$6,440.00 | \$6,877.80 | \$6,000.00 | \$10,048.20 |
| 11/24/2010 | 2.94 | \$17,493.00 | \$4,410.00 | \$3,924.90 | \$6,000.00 | \$3,158.10 |
| 9/29/2009 | 3.01 | \$22,836.00 | \$6,772.50 | \$4,819.05 | \$6,000.00 | \$5,244.45 |
| 11/3/2011 | 2.07 | \$16,519.00 | \$3,105.00 | \$4,024.20 | \$6,000.00 | \$3,389.80 |
| 1/6/2011 | 2.87 | \$16,933.00 | \$5,033.50 | \$3,569.85 | \$6,000.00 | \$2,329.65 |
| 9/30/2010 | 2.30 | \$14,953.00 | \$4,025.00 | \$3,278.40 | \$6,000.00 | \$1,649.60 |
| 8/19/2010 | 2.40 | \$14,160.00 | \$4,200.00 | \$2,988.00 | \$6,000.00 | \$972.00 |
| 12/29/2003 | 3.00 | \$26,000.00 | \$12,750.00 | \$3,975.00 | \$6,000.00 | \$3,275.00 |

What is apparent in the table above is that the net cost is lower than the average value result in this study for these PV systems. There are several possible reasons for this. One is that the average cost for

the components of PV systems has dropped while incentives have remained relatively stable. While lower overall costs certainly plays a role, PV systems have become more accepted in the market, which may also be tied to a general increase in marketing and buyer awareness of green building practices. As buyer awareness around energy efficient and green building increases, it seems natural that most of the elements of green building, from energy efficiency to indoor air quality, will be reflected in the market.

Another reason may be linked to the transaction costs of having a PV system installed. The purchaser of an owned system must not only have a significant amount of funds to purchase the system, but also obtain bids, contract with an installer, fill out tax credit paperwork in many cases, and apply the tax credits over four years (in the case of Oregon state tax credits). It is a far simpler process to simply purchase a property that already has solar PV installed.

Finally, the value result for this PV analysis, while not closely linked to net cost, is similar to other recent valuation of residential solar results in the state and region. As this author reported in 2012, in the Energy Trust commissioned report, *Market-Based Investigation of Residential Solar Installation Values in Oregon*, solar PV installations in different location in the state had a range of average sales price from \$9,861 - \$12,817 using the methodology in that report⁷. Though the methodology differs somewhat from that applied in this current study, the results are similar, which lends weight to the results of each study.

Similarly, a recent regional study by the Lawrence Berkeley National Laboratory finds \$4 of market value per watt of PV across the state of California, which is similar to this study's result is \$4.92 per watt, with the average study PV system size of 2.78 kW⁸. Overall, through different methodologies in different regions, the value of solar PV picture is becoming clearer.

The EPS Properties

Energy Trust provided Watkins & Associates with a list of 716 sold properties with EPS during the time period of the study. This list was extensively vetted, and upon completion of vetting, 83 subject properties appropriate for the study were identified, with 55 of them from the Portland Metro area and 28 from the Bend area.

There are two primary reasons for the relatively small number of properties that are potentially eligible for comparative analysis:

1. Reliability of the data in the EPS list

Many of what appeared to be property sales in the spreadsheet provided did not turn out to be open-market transfers and could therefore not be used in a comparative analysis. As was the case with the solar PV spreadsheet, several land sales of the properties occurred before the new home was

⁷ The full report is available for download here: : http://assets.energytrust.org/api/assets/reports/2011_solar_market_evaluation_study.pdf

⁸ The full report is available for download here: <http://emp.lbl.gov/publications/selling-sun-price-premium>

constructed or transferred through a name change (e.g., in the case of a divorce), refinancing, or for other reasons.

2. Lack of reporting in the MLS systems

The lack of reporting of the features of list properties in the MLS systems comes in two forms: lack of reporting of EPS, and lack of reporting of green certifications.

The most striking aspect of vetting the properties included on the Energy Trust spreadsheet was that **no** listings of properties on the list included any mention of an EPS. There are several places in the MLS system used in the Portland area, RMLS, to note whether or not a property has an EPS:

- In documents that can be uploaded and attached to the listing
- In the "Amenities, Energy Score" field, Realtors can enter a numerical range
- In the "Amenities, Energy Type" field, Realtors can select "EPS, HERS, or HES."

These "Amenities" notations appear in an Amenities Supplement to the listing itself.

Forgoing the Energy Trust spreadsheet, the team instead searched the RMLS for EPS properties. The two amenities options included in the RMLS to help call out energy labels were found in a total of 54 closed sales for the Portland Metro area after May 2012 (the month the fields were added to the RMLS system) and 54 were found to include EPS references in the Amenities Supplement. 48 of these sales were of new homes built by Renaissance Custom Homes, 1 was a resale of a Renaissance home, 2 were new construction by Porcupine Design, and 3 were resales of existing homes (1 of which was a deep-energy retrofit).

In addition to these two RMLS amenities options, Realtors can describe EPS in the "public" or "private" remarks portions of their listings, and they can choose to enter comments on energy performance in other areas where some user-defined description is allowed.

Because of this, the team ran several EPS-specific searches covering the Greater Portland area to determine how other methods for noting EPS in the system may have been used. The results are listed in this table:

| Reviewed | Search Field | Search Parameters | TTL Results | Search Saved? | Notes |
|----------|---|--|-------------|---------------|---------------------------|
| CG | Amenities, Public Remarks | "eps", "energy performance", "utility" | 0 | No | |
| CG | Combined Remarks | "eps", "energy performance", "utility" | 0 | No | |
| CG | Public Remarks | "eps", "energy performance", "utility" | 0 | No | |
| CG | Public Remarks | energy performance | 12 | Yes | 1 = noncertified home |
| CG | Public Remarks | "eps" | 0 | No | |
| CG | Private Remarks | "eps", "energy performance", "utility" | 0 | No | |
| CG | Amenities, Home Warranty - Company Name | Energy Trust | 0 | No | |
| CG | Amenities, Home Warranty - Company Name | EPS | 0 | No | |
| CG | Amenities, Home Warranty - Company Name | Home Performance Score | 0 | No | |
| CG | Amenities, Home Warranty - Company Name | Home Performance | 0 | No | |
| CG | Additional Structures, Public Remarks | "utility" | 4 | No | Properties not applicable |
| CG | Additional Structures, Public Remarks | "eps" | 0 | No | |
| CG | Additional Structures, Public Remarks | "energy performance" | 0 | No | |

Figure 3: EPS searches on RMLS

Out of these searches covering the entire Portland Metro area, there were 12 properties that noted EPS in the Public Remarks section of the listing, and of those properties, 1 was not also an Earth Advantage or LEED certified home. The reliability of the data in the EPS list and the lack of reporting EPS in the MLS systems lead to 83 properties being available for analysis of contributory value of EPS.

A New Way Forward

Of the 83 properties with EPS that were open-market transactions and for which comparable data were found, all were green certified homes (either ENERGY STAR or Earth Advantage). This close tying of EPS to a green certification means that it is not possible to isolate only the possible contributory market value of the EPS without also including the green certification.

Given this, the way in which to isolate a possible market value for EPS was to collect a comparable group of green certified home sales not on the Energy Trust EPS list, essentially replacement green subject properties, and compare the premiums for that group of certified homes to our vetted group of certified homes with EPS provided by Energy Trust. If there is a difference between the premiums, it would be attributable to EPS.

This way forward altered the scope of the original proposal somewhat, but in discussions with Energy Trust it was considered the best path in light of the market and data circumstances. The scope would include data gathering of the new certified non-EPS listed properties, which were believed to be plentiful and relatively simple to locate. This path will be discussed in detail.

A Final Word on EPS in the Market

It was surprising and disappointing that there was so little presence of EPS in RMLS listings even though it had been available in the market for some years and available for brokers to include in listings since May 2012. The fact that so many builders were using EPS as an energy performance measurement but not including it in their listings led us to consider if there was any other marketing of EPS occurring outside of the RMLS.

To check on this, the builders that used EPS the most were contacted by Earth Advantage and surveyed about their marketing around EPS. Though it was difficult to get responses in a busy construction climate, the results obtained demonstrate that EPS is being marketed, but on an individual basis. Here are the builder responses to the question: "How was the EPS used in your marketing during the study's timeframe?"

Stone Bridge Homes NW

In 2012 they focused on the EA certification in their sales. Currently, they discuss the Energy Bill Guarantee and have a sample EPS score to look at as part of the conversation. But they are not usually looking at the specific EPS score because they often make pre-construction sales.

Windwood Construction

They do not use EPS in their marketing. They do not think their buyers are interested. They believe "west side" buyers are only interested in quality but do not care about carbon footprint or energy efficiency.

Fish Construction NW

The EPS scorecard was displayed on the kitchen countertop of the home during showings.

Arbor Custom Homes

It depends on the customer. If the customer is focused on energy efficiency or utility costs the sales team may use the EPS for that conversation. They do not display it in every home currently.

Also spoke to a **former** Arbor Sales Agent who said that they displayed the scorecard in every home companywide in the study time frame.

Legend Homes Corp.

Model home has a sample scorecard that pre-construction buyers can see. Finished homes have EPS score on display. They also talk about EPS when explaining the energy bill guarantee. In 2011-2013 the EPS might not have been available when the home was finished and being shown for sale because of the delay in receiving it from the program. However, they have been promoting it all along.

Discussion of Builder Survey

Some builders are marketing EPS, but their efforts are inconsistent. When marketing towards EPS does occur, it mostly is in the home itself and not entered into the RMLS. This EPS information may have been used by buyers in their decision to purchase a home, but it is not possible to measure the market impact of EPS if it is not entered into the RMLS.

Though the lack of EPS data on RMLS was unforeseen and led to an alteration in scope for the project, we believe that the research conducted was very valuable because it demonstrates the areas in which Energy Trust can provide assistance to brokers, builders, and other market actors in order to make EPS more visible, thereby having more of an influence in the local real estate market.

Data and Analysis

As described above, we assembled two groups of subject properties, which we call EPS and Non-EPS for simplicity. These two groups of subject properties were then compared to the same pool of comparable sales. The EPS group was developed from the original Energy Trust of Oregon list of sold properties with EPS, and the second, Non-EPS group of green certified subject properties was obtained from RMLS. So both subject property groups are certified home as similar to one another as possible, with the primary difference being that the EPS group had **known** EPS. The second group was similar certified homes with **unknown or unreported** EPS. If there was a difference in the results from the two groups of properties when analyzed against the pool of comparable sales, it was most likely attributable to EPS.

Some of the EPS properties were ENERGY STAR qualified, and some were Earth Advantage certified homes. These groups were broken down into their own groups as well as being considered as one larger group.

Energy Star Certification (with EPS)

With 17 Portland-area homes to look at, this sample was a bit larger than the one for solar photovoltaic properties, and is easier to interpret. There is a significant, if modest, premium paid for homes with

Energy Star certification, compared to similar homes without, as shown by the many points above the dotted line:

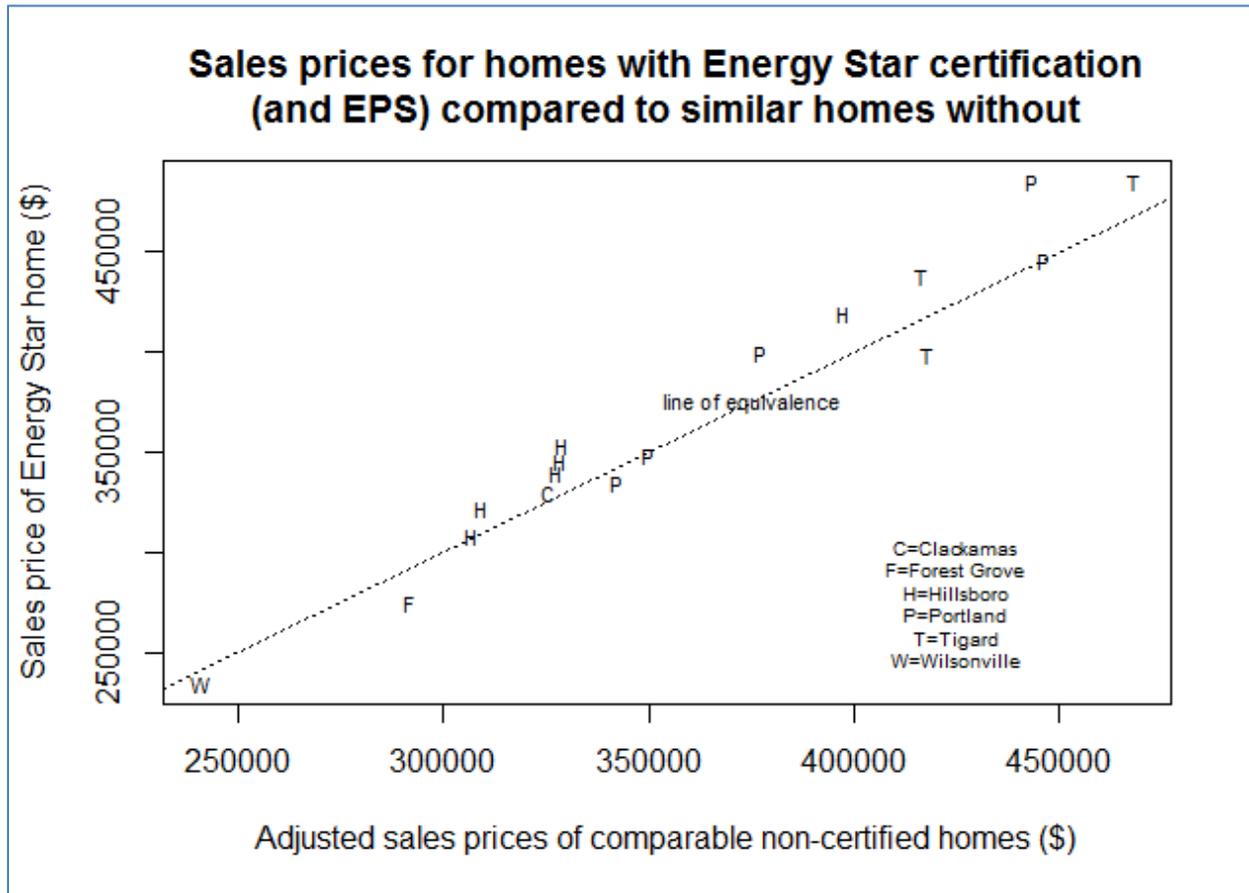


Figure 4: ENERGY STAR and EPS results.

The mean premium (V_e) is \$8,788, or 2.2% of sale price. This finding is statistically significant at the 5% level, with p-values around 0.05.

Earth Advantage Certification (with EPS)

With 40 Portland area-properties to work with for Earth Advantage certifications, the finding is clear: a small but significant price premium for certified properties, as represented by the numerous points above the dotted line:

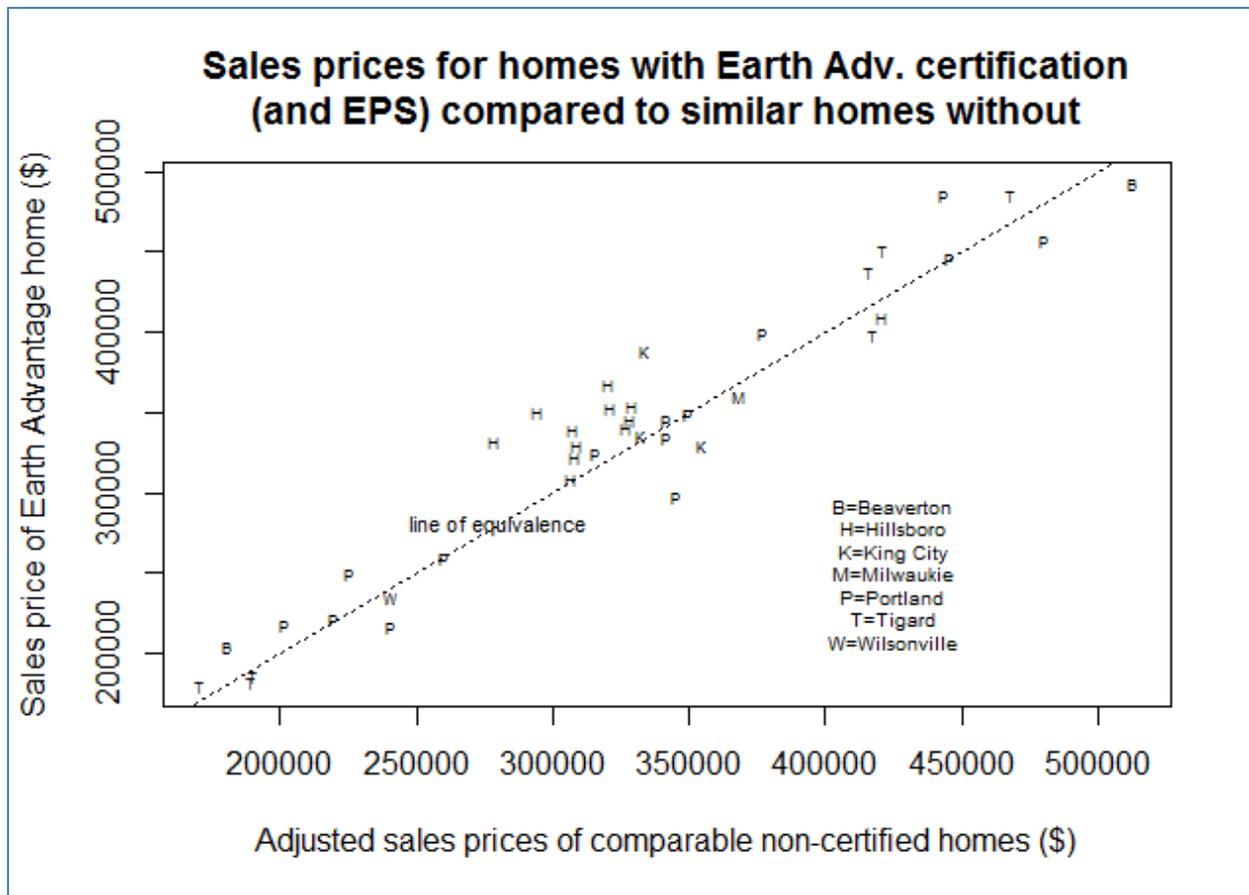


Figure 5: Earth Advantage and EPS results.

The mean price premium (V_e) is \$9,677, or 3.3% of sale price. The premium appears to be fairly consistent over most of the price range. The statistical significance is clear, with p-values around 0.01.

Energy Star or Earth Advantage Certification (with EPS)

Combining Energy Star or Earth Advantage certified properties into one “certified” group of 57 properties raises the sample size and clarifies the results a bit more. Again, certified properties have a significant, if modest, price premium above comparable non-certified properties.

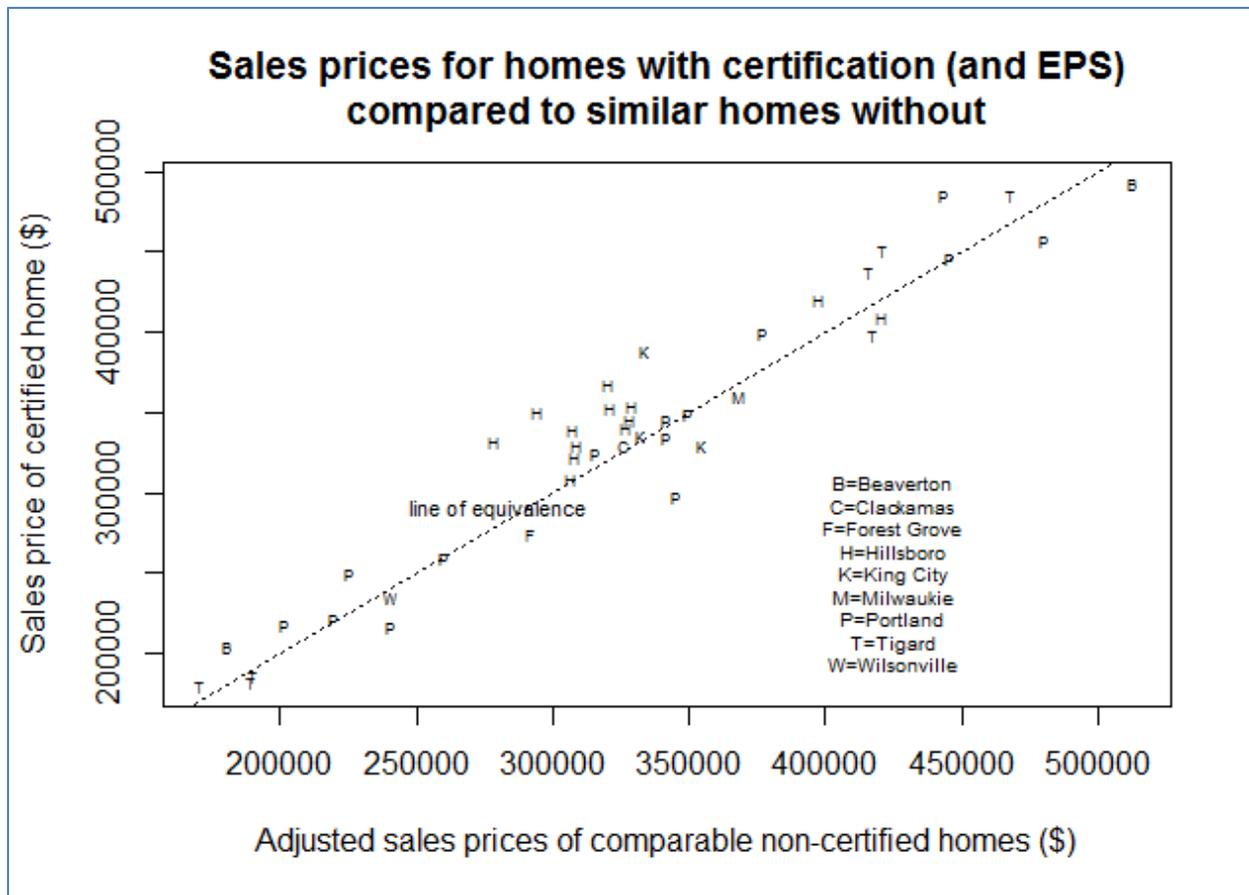


Figure 6: All certifications and EPS results.

The mean price premium (V_e) for a certified property in this graph is \$9,223, or 3.1% of sale price. This is statistically significant, with p-values around the 0.01 level.

Energy Star or Earth Advantage certification (without EPS)

When the investigation is focused on properties which have a certification (Energy Star or Earth Advantage), but records show do not have an EPS, results are similar to certified properties with EPS. There is a statistically significant, but modest, price premium for certified homes compared to non-certified, as represented by the points above the dotted line in this graphic:

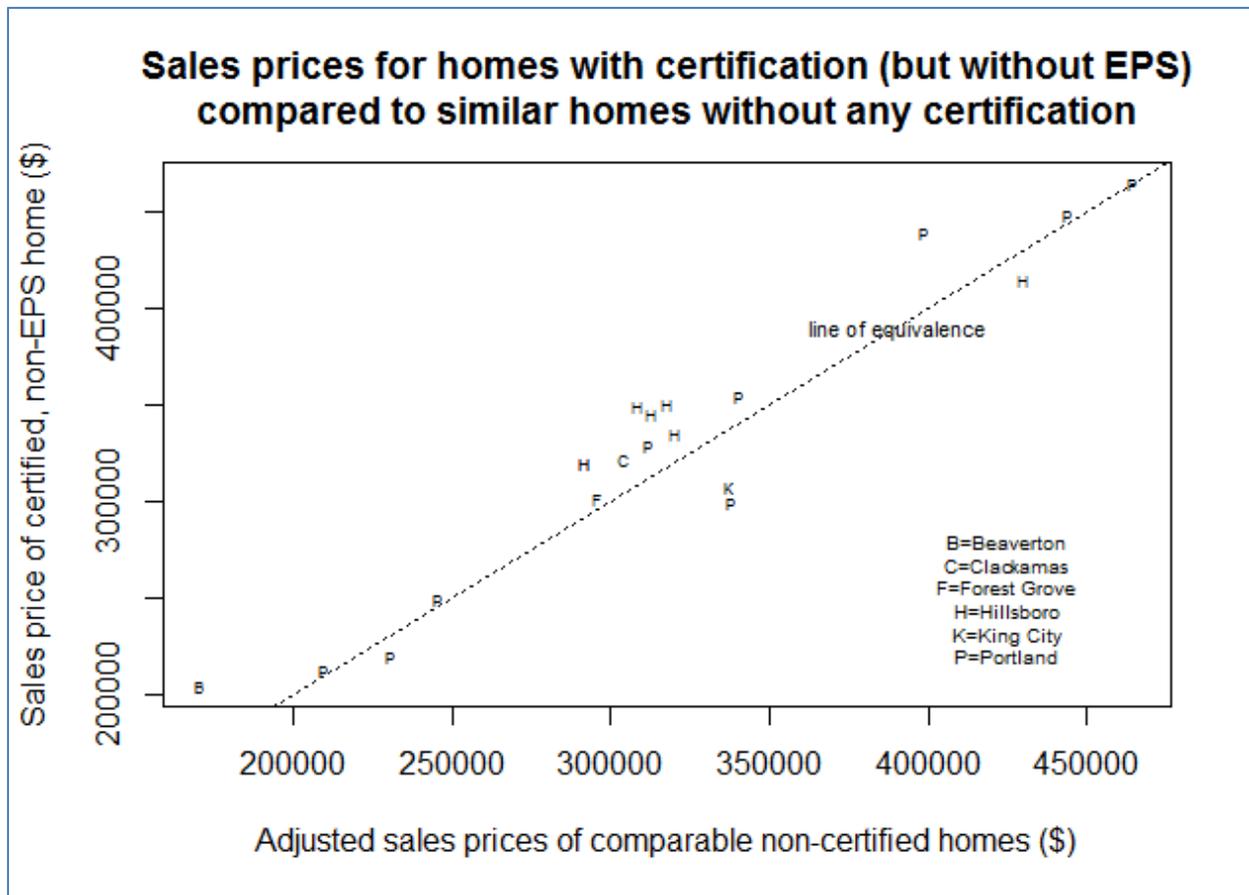


Figure 7: Non-EPS property results.

The mean price premium (V_c) was \$11,471, or 4.1% of sale price among 19 homes. This is statistically significant at the 5% level, with p-values around 0.03.

Effect of EPS among certified homes

As the previous sections suggest, among certified homes, the presence or absence of an EPS seems to have very little influence on the price premium associated with certification. The following graph shows the spread of the observed individual price premiums (as a percent of sale price) in both EPS- and non-EPS certified homes.

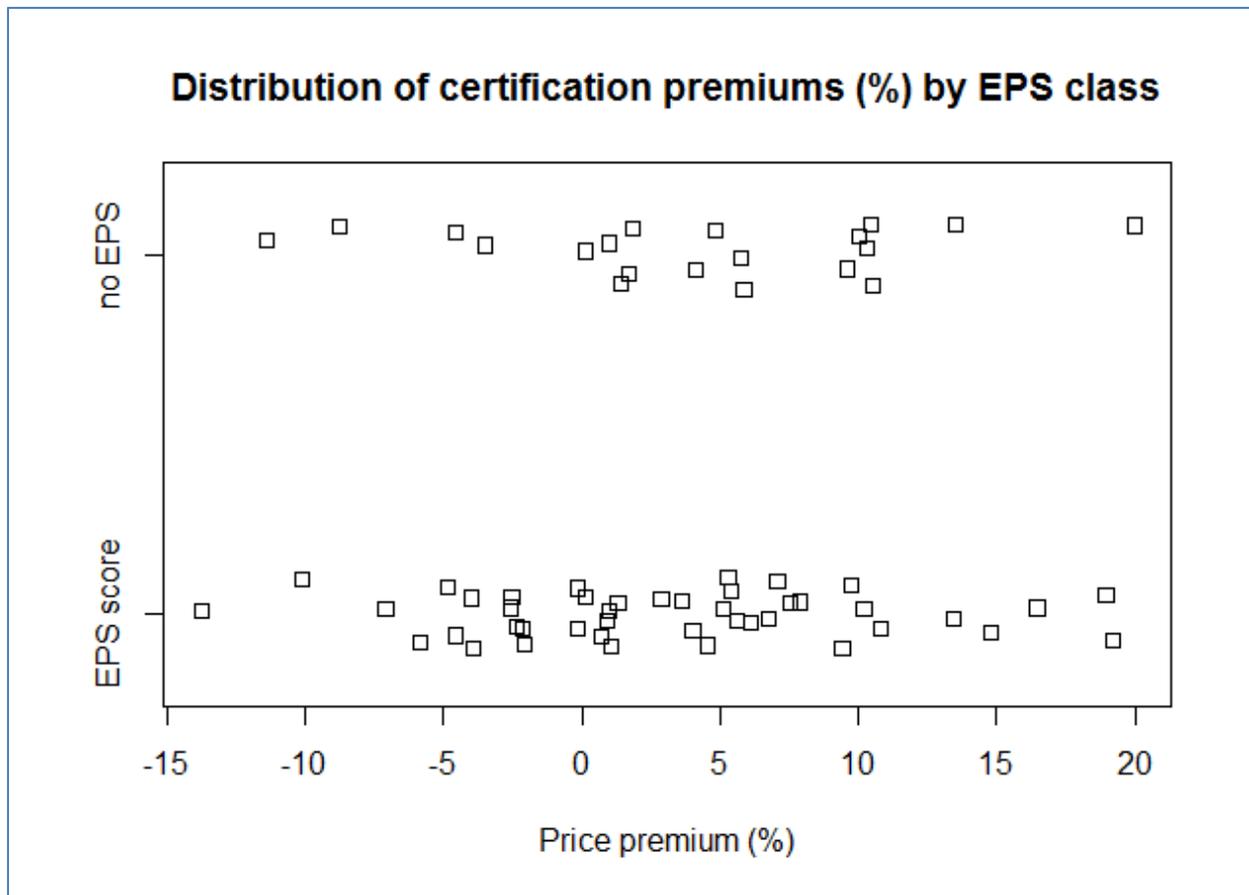


Figure 8: Distribution of EPS results.

These distributions are very similar, given their different sample sizes. Their ranges are similar, and their means are not significantly different ($p > 0.6$). Though the observed mean premium for non-EPS (4.1%) is actually higher than for EPS (3.1%), we do not believe this distinction is large enough to indicate that EPS is some sort of negative influence on the certification premium. Rather, EPS simply does not appear to be a factor that can be distinguished from the basic certification, such as Energy Star or Earth Advantage.

Discussion and Recommendations

The lack of a measurable EPS influence on values for homes in the Greater Portland area is not surprising, given the lack of EPS data available in RMLS. It is strongly recommended that Energy Trust continue its efforts to make EPS more visible in real estate transactions, and especially in RMLS, which nearly every real estate professional in the area consults on a regular basis and which represents the primary data source for all real estate data in the area.

If EPS is available for homes and is marketed on the RMLS (and therefore to buyers), then its value to the market will be revealed. Currently, any market value that the EPS has is effectively hidden. And while a +/- 1% value for EPS may be present, as noted above, it is not a strong enough presence to state with statistical certainty that it exists⁹. It is clear, however, that there is a slight market premium for certified over non-certified homes. Because certified homes are energy performance tested and the metric to measure that performance in most cases is EPS, there is a built-in opportunity to couple any value in EPS with the value of home certifications in general. It is strongly recommended that Energy Trust pursue the expansion of EPS marketing through the existing certification channels that it has already developed.

Bend Data, Results, and Discussion

Bend had some extremely dramatic changes in real estate prices over time.

Time effects in Bend can easily change prices more than 10% in either direction within 6 months. Meanwhile, our previous work, and other studies, show the typical premium associated with environmental certification is only 2-5%.

Accordingly, it is no surprise that neither certified properties with EPS scores, nor certified properties without, showed significant premiums in price. In all likelihood, the dramatic swings in price over time made any effect of certification undetectable.

⁹ An indication of 1% market value in the Greater Portland area during the time of the study is approximately \$2,500 (1% of the median home price between 2012 and 2014).

Certified, but non-EPS, Properties

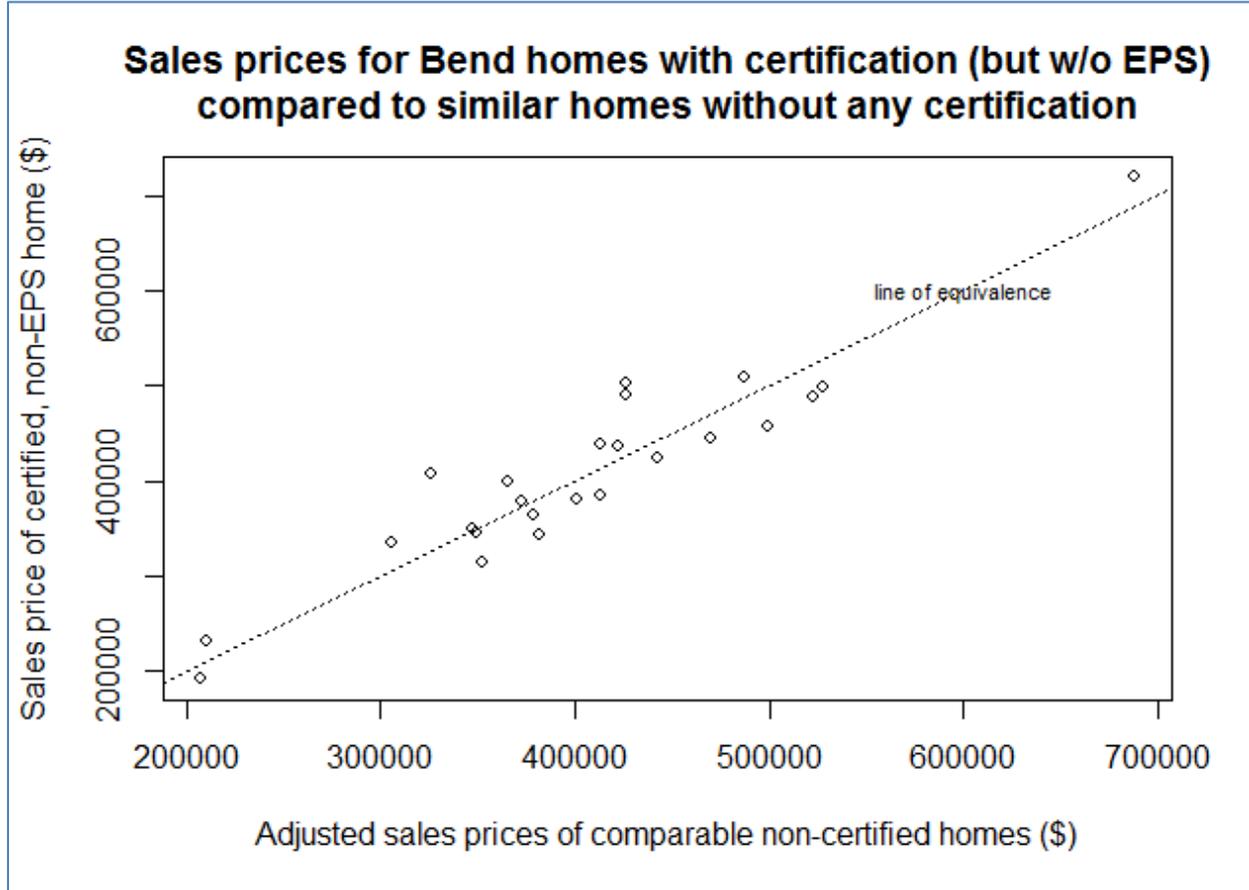


Figure 10: Non-EPS subject property price results.

This analysis combines 24 Earth Advantage and Energy Star properties. There is no preponderance of points above the line of equivalence. The mean premium is \$1,564, or 0.8% of sale price. This is not significantly different than zero ($p > 0.5$). We cannot say there is a price premium for these properties.

Certified Properties with EPS

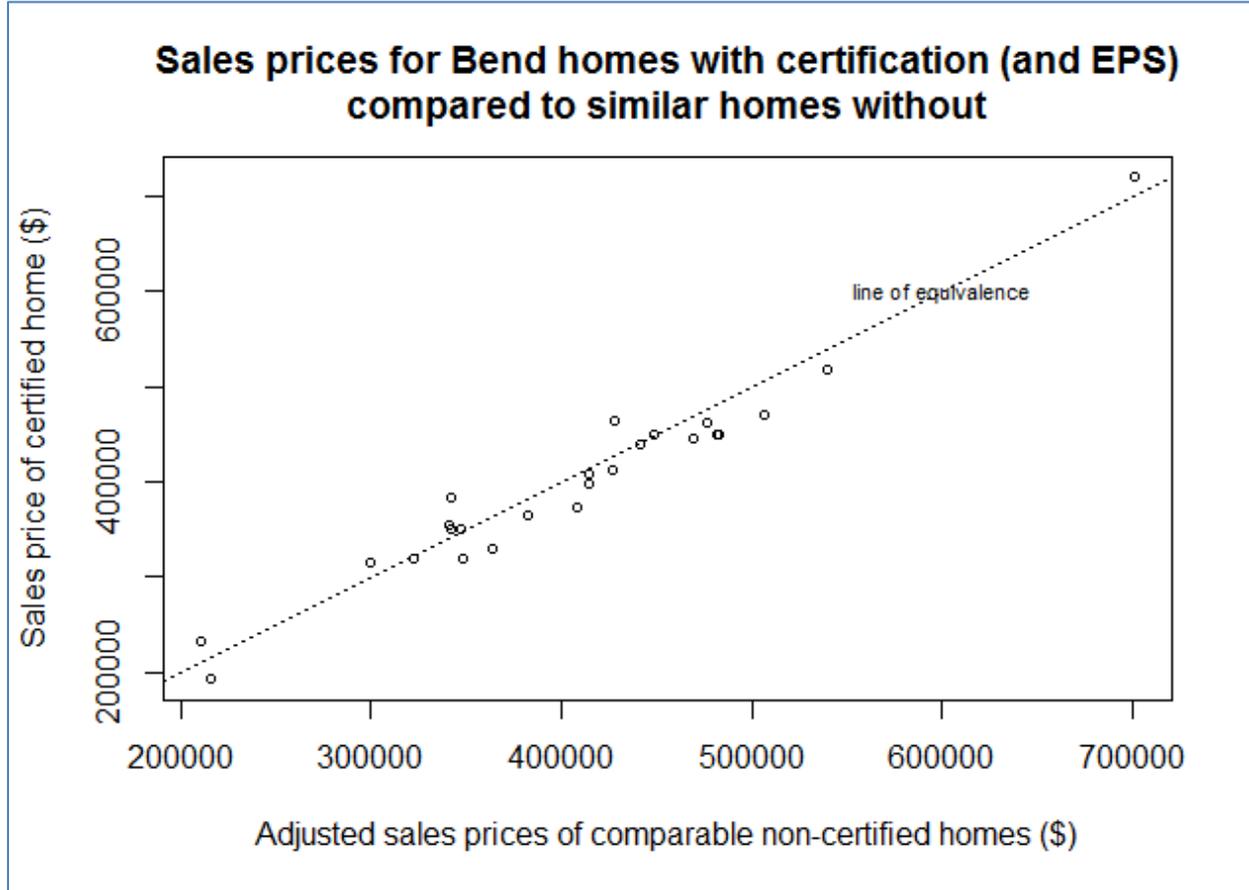


Figure 9: EPS subject property price results.

This analysis combines Earth Advantage and Energy Star properties. Again, it appears that half, or even less, of points are above the line of equivalence. The mean price premium is $-\$7,446$, or -1.6% of sale price. This is not significantly different than zero at the 5% level ($p > 0.1$). Although technically this result comes close to being a negative result (that is, there is a suggestion there may be a *price penalty* associated with certification), we do not believe this is actually happening. Bend's time trend is so wild that it throws doubt on any result with small magnitude.

Difference in Premium Between non-EPS and EPS Properties

We looked to see if there is a difference in premiums between EPS certified properties and non-EPS certified properties. As seen in the graphic below, both groups have very similar distributions, with the exception of a few high outliers in the "Non-EPS" group.

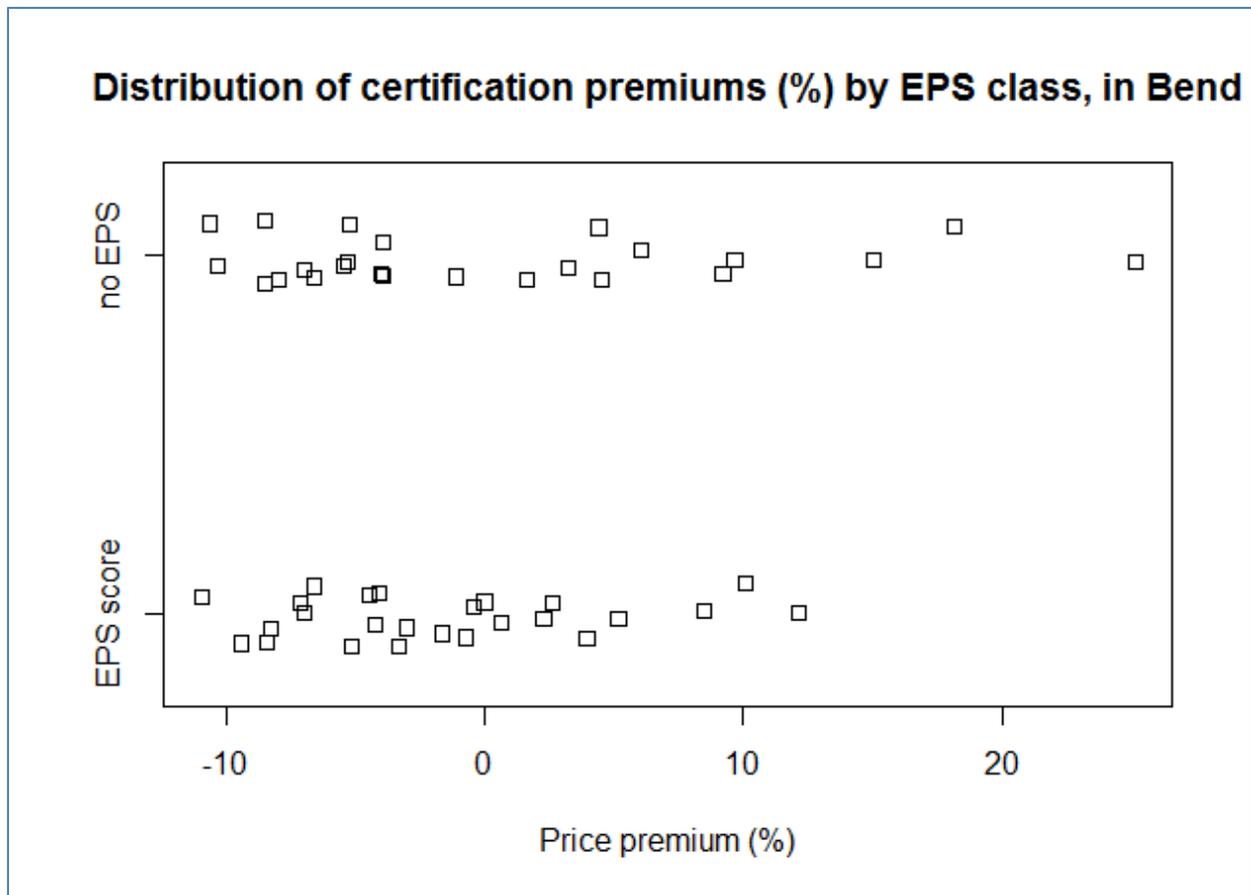


Figure 12: Bend EPS distribution.

The mean premiums for the 49 non-EPS and EPS certified properties in Bend were \$1,564 and -\$7,446, or 0.8% and -1.6% of sale price, respectively. These means do not show significant differences ($p > 0.3$). While again, there is an impression that EPS somehow confers a price penalty, the mean EPS premium is not significantly different from zero, and the Bend sample was problematic.

In summary, the Bend market has been so volatile that it is very difficult to isolate influences on value that are smaller than the value fluctuations in the overall market. The market share of certified homes in the Bend area in the past year has risen to nearly 30% of all new homes built¹⁰. With this market penetration of green homes, is recommended that the Bend market be monitored for evidence of stability and that further energy performance related study is considered at that time.

¹⁰ Data provided by Earth Advantage, November 6, 2014.

Conclusion

The goal of the study was to determine the contributory value (if any) of several different environmental features in residential single-family-house sales in the Portland, Oregon¹¹ area. These features and the value conclusions for each are:

- Solar photovoltaic installation - the mean premium is \$13,694, or 3.6% of sale price.
- Energy Star certification (including EPS) - The mean premium (V_e) is \$8,788, or 2.2% of sale price.
- Earth Advantage certification (including EPS) - The mean price premium (V_e) is \$9,677, or 3.3% of sale price.
- All certifications combined (including EPS) - The mean price premium (V_e) is \$9,223, or 3.1% of sale price.
- All certifications combined (without EPS) - The mean price premium (V_e) is \$11,471, or 4.1% of sale price.

The methodology that was developed for this analysis is believed to be one of the most advanced and granular that has been applied to such work, and the results generally agree with other valuation studies on similar environmental features at different times in various locations in the US.

Recommendations

A very large number of new homes and a significant number of existing homes (5,300 to date) that are performance tested in Oregon receive an Energy Performance Score. The metric is thus an integral part of the single-family energy efficient construction marketplace. This presence, however, has not been translated into the larger real estate market. In order for this to occur, EPS must be present in MLS listings for properties. An MLS listing is a representation of what the broker of the property believes that the likely buyers for that property will find valuable. If there is a value in EPS, then, it must be represented in the listing. If an EPS is in a series of listings of homes that sell, valuation professionals can collect and analyze that data to ascertain the value of the EPS, just as they would another property characteristic, such as square footage or view. In this manner, a long-asked question about the value of energy efficiency can be answered.

Questions of the value of green certifications are being answered, and some of those answers are present in this report. The methodology upon which the value of certifications is reached can also be applied to EPS when there is data present in the MLS systems. The continuing accumulation of the value of green certifications from sources in different geographic areas over different periods of time lends weight to the particular conclusions of each source. It also points obliquely to the value of energy efficiency, which is a part of every green building certification program, but this oblique reference is not enough to provide statistically significant valuation results for energy efficiency.

It is the sincere hope of the team that the efforts of Energy Trust will continue to focus on the promulgation of EPS in the local and regional market, EPS' accurate and consistent listing on RMLS, and

¹¹ The Bend market was part of the original research plan, but early examination of the results suggested that Bend had completely different market dynamics over the study period than Portland. Numbers of sales were low at times, and fluctuations in price over time were extreme. For these reasons, Bend was treated separately.

additional marketing of EPS to buyers of homes, whether new construction or retrofit. It will be through these efforts that the market value of energy efficiency in the region will be clarified.

Appendix A – Solar PV and EPS list development

EPS & Solar Valuation Study Dataset Methodology

In order to create the dataset for the EPS & Solar Valuation Study, three datasets had to be merged together. These three datasets included homes resold from MetroScan and homes that received an EPS rating or installed a Solar PV or Solar Hot Water measure.

MetroScan Dataset

Time Period: Houses sold from Jan 1, 2011 – October 2013

Locations included: Bend, Salem, Corvallis, Roseburg, Medford, Clackamas County, Multnomah County, and Washington County

Fields included: barcode (unique identifier), site address, transfer information (dates, prices, past, value, sqft, assessed value)

Final Number of Sites: 124,243 sites with unique barcodes

*See Attrition table for number of MetroScan barcodes that were matched to EPS/Solar homes.

EPS Dataset

New homes, EPS score (2009-2013)

4,193 sites with EPS scores were originally pulled from all measures database. Stata was used to manipulate the data enabling it to be matched to the MetroScan dataset based on barcode. In Stata, flags were created to denote the attributes of each home, the EPS measures the home participated in, and the attributes associated with each measure, including savings from measure participation.

A second dataset was created which included any other energy efficiency measures the homes from the first EPS dataset participated in. This dataset also included savings attributed to the home's participation in other energy efficiency measures.

The two EPS datasets were matched together based on Siteid. Sites without barcodes were pulled and put into ZP4 in order to obtain barcodes; these barcodes were re-matched to their sites. ZP4 was not able to generate barcodes for all sites missing barcodes due to insufficient geographic information, as a result 304 sites were dropped.

Final EPS Dataset = 2,291 unique homes with a barcode.

For details regarding the number of duplicate and dropped sites see the attrition table.

Solar Dataset

Solar PV and Solar Hot Water homes

6,131 sites with Solar PV/Hot water installations were originally pulled from the all measures database. Stata was used to manipulate the data enabling it to be matched to the MetroScan dataset based on

barcode. In Stata, flags were created to denote the attributes of each home, the solar measures the home participated in, and the attributes associated with each measure, including savings from measure participation.

A second dataset was created which included any other energy efficiency measures the homes from the first solar dataset participated in. This dataset also included savings attributed to the home's participation in other energy efficiency measures.

The two solar datasets were matched together based on Siteid. However, there were duplicate barcodes, created flag for this. Sites without barcodes were pulled and put into ZP4 in order to obtain barcodes, these barcodes were re-matched to their sites. ZP4 was not able to generate barcodes for all sites missing barcodes due to insufficient geographic information, as a result 206 sites were dropped.

The final solar dataset was matched to the EPS & MetroScan dataset by barcode. Additional variables were created, including a flag to denote projects that occurred prior to the sale price of the home and to differentiate Solar and EPS participants. 255 sites have dates that qualify them (installed before house was most recently sold).

Final Solar Dataset = 772 unique homes with a barcode.

For details regarding the number of duplicate and dropped sites see the attrition table.

Summary of Sites that are good candidates for the analysis

133 Solar Sites

732 EPS sites

Final Datasets Created

- 1) Only Matched Sites – Solar & EPS & MetroScan, 3,063 sites
- 2) Solar Sites matched to MetroScan, 772 sites
- 3) EPS Sites matched to MetroScan, 2,291 sites
- 4) MetroScan Sites that didn't match to EPS or Solar Sites, 121,323 sites

*See Data Dictionary for a complete list of variables and definitions

| EPS & Solar Valuation Study Attrition Table | |
|---|-----------|
| Total sites (unique barcodes) resold from MetroScan | 124,243 |
| # sites with transfer dates | 42,542 |
| Total Solar Hot Water / PV Measures from FastTrack | 6,131 |
| # sites dropped due to inability to barcode | 206 |
| # duplicate Sites (siteids) | 373 |
| # duplicate barcodes (includes duplicate sites) | 805 |
| Number of Unique Sites | 5,308 |
| Number of Unique Sites in MetroScan Cities | 4,039 |
| Number of Unique Sites not matched to MetroScan b/c houses not sold during study time frame | 3,341 |
| Final number unique sites matched to MetroScan | 698 |
| # sites matched to MetroScan and have transfer dates | 255 |
| # sites with installed dates that qualify (unique) | 149 (133) |
| Final number Unique sites only Solar PV | 70 |
| Final number Unique Sites only Solar Hot Water | 13 |
| Final number sites did both PV and Hot Water | 50 |
| Total EPS sites from FastTrack >2009 | 4,193 |
| # sites dropped due to duplicate siteid | 8 |
| # sites dropped due to inability to barcode | 304 |
| # duplicates (barcodes)* | 168 |
| Final Number of Unique Sites | 3,889 |
| Final number matched to MetroScan | 2,239 |
| # sites matched to MetroScan and have transfer dates | 732 |
| Total number EPS/Solar matched to MetroScan | 3,011 |
| Distinct Siteids | 2,972 |
| Total EPS & Solar Sites that qualify** | 867 |
| # siteids common to EPS & Solar | 5 |

*Same barcode, different siteid due to same address but different unit number

** EPS sites that are not missing transfer dates (dates sold) and solar sites with installation dates that qualify them

**NOTE Sites with duplicate barcodes are flagged, this generally occurs due to sites with multiple unit numbers at the same address

| Matched EPS, Solar, & MetroScan Sites by City | |
|--|---------------------------------|
| City | Number of Distinct Sites |
| Bend | 346 |
| Corvallis | 1 |
| Salem | 48 |
| Roseburg | 10 |
| Medford | 39 |
| Portland Metro Region | 2,528 |
| Total Matched Distinct Sites | 2,972 |

Appendix B – LOESS Methodology

Written by Martin J. Brown

Need for a date correction

The idea of the study is to (over a large sample) use subtraction to discover the market value of the certifications, that is, *value of certification = mean of (subject property – comparable property)*

Because real estate prices change over time, and comparable properties are not sold on the same dates as subject properties, it is appropriate to adjust the sales prices for comparable properties to account for general date-related trends in prices. The idea is to estimate what the comparable property's price would have been, had it sold on the same date as the subject property.

Goal of my date trend analysis

My goal was to create a trend line or price-date-database for each "MLS Area" in your study, representing the entire date range used in your study. This trend line or database can then be applied in your comparative valuation calculations.

Source data set and choice of response variable

From rmlsweb.com, I obtained the monthly median sales prices of all single-family-home sales in each Portland MLS Area, from August 2008 to July 2014. Because prices vary considerably between MLS Areas, and we were interested in making areas comparable, I converted the absolute median values (in dollars) to relative values (proportions) by dividing each monthly median into the July 2014 monthly median for that MLS Area.

In addition, because I was interested in creating date trends that could adjust for date spans of just a few days, and not simply whole months, I needed to assign a specific date to each monthly value. I used the 15th of the month. For example, the relative sales price index for January 2010 was associated with an exact date of January 15, 2010.

Combining these two conventions, the sales price index for July 15, 2014, will always be exactly 1.0.

Observed date trends

The attached file called "observed.pdf" graphs the sales price indexes by date, without any statistical trend added. The first page has all the MLS areas combined, the middle pages one graph per MLS area, and the last page a special "boxplot" comparing median values of the price index per month. Looking at these graphs, I see:

- Across all MLS areas that there is a general bowl-shaped trend – with higher values in 2008 and 2014, and a dip in the middle. This bowl-shaped trend is the kind of thing that should definitely be incorporated in the final date-of-sale correction, whatever it is.
- Individual MLS areas have some "noise" – extreme changes from one month to the next, that are probably just the result of luck or low numbers of sales per month. This noise is the kind of thing that should be eliminated from the final date-of-sale correction, whatever it is.
- A closer look at the individual MLS area graphs suggests that, despite the noise, there does seem to be a weak but noticeable trend with season. Price indexes look higher in summers than in winters. This is

confirmed by the boxplot on the last page, where the median sales price index per month (the middle line of each "box") is higher in July than in February, by approximate 0.06. This "seasonal" variation should be incorporated into the date-of-sale correction if possible, with a seasonal effect that averages around 0.06.

Choice of LOESS method

The two observed trends (the general bowl-shaped trend, plus the seasonal trend) will be difficult to model with standard "parametric" curve-fitting methods. Basically we would have to assume that the data has a very particular shape – for example a parabola with a sine wave inside – and then sort of fit the data to that. We would be forcing our preconceptions on to the data. In contrast, a statistical technique called LOESS ("localized regression") can draw a very reasonable line without making any preconceptions about how the data "should" look.

The only practical difficulty is that LOESS results can't be expressed with a single formula easily placed into a spreadsheet cell. Rather, the results will have to be in the form of a database – a set of predicted sales price indexes for every calendar day across the entire study. Such a results database can easily be utilized by statistical programs, such as R. I have also confirmed it can be utilized by Excel2013 using the VLOOKUP function (more on this below).

I chose LOESS because the direction I received at the start of the project was to make the results as accurate as possible. Using the LOESS results will be easiest in a statistics program, but is definitely possible in Excel if necessary.

Examining and choosing the LOESS model

The attached file called "modelled.pdf" has the observed sales price indexes for each MLS area, along with 3 smoothed lines. The 3 different lines represent the effects of setting the "span" parameter of the LOESS technique at different levels.

- A bigger "span" level, represented by the gray line, gives more weight to points that are farther away from the current date of interest, and therefore shows the bowl-shaped trend more than a seasonal effect.
- Smaller span levels, for example the light blue line, give more weight to points that are closer to the date of interest, but as a consequence may be affected by month-to-month "noise" that is probably meaningless.
- A medium span level, represented by the red line, splits the difference and seems to fit the goals of this analysis – it shows the bowl-shaped trend, a seasonal effect in most years, and also has a seasonal effect that (from a quick look) averages something like 0.05.

I propose using the trends produced by the medium span level (the red line).

Results database and how to use it

I have saved a database with the smoothed price indexes (the red line values) for each MLS Area and possible date in the study. I have a copy in R, and an Excel copy is available in "dateOfSaleCorrectionParameters.xlsx". (I'll write more about how to use this in Excel later, but read the following general information first.)

There are 12 MLS areas and 2,161 days, so this data file has more than 25,000 lines in it. The first few lines look something like this:

| MLS.Area | date | Sold.Med.R | pred |
|----------|------------|------------|-----------|
| 141 | 2008-08-15 | 0.8998333 | 0.9062138 |
| 141 | 2008-08-16 | NA | 0.9045954 |
| 141 | 2008-08-17 | NA | 0.9029873 |
| 141 | 2008-08-18 | NA | 0.9013893 |
| 141 | 2008-08-19 | NA | 0.8998014 |
| 141 | 2008-08-20 | NA | 0.8982236 |
| 141 | 2008-08-21 | NA | 0.8966560 |
| 141 | 2008-08-22 | NA | 0.8950984 |
| 141 | 2008-08-23 | NA | 0.8935508 |
| 141 | 2008-08-24 | NA | 0.8920133 |

You'll notice there are many more *predicted* values (the "pred" column) than actual observed values (the "Sold.Med.R" column). The NA's just mean "not available". To apply a price correction, we need to refer to the predicted values by MLS area and date. We won't use the Sold.Med.R values in this calculation – they are just there for reference. Say the subject property sold on August 15, 2008, and the comparable property sold on August 24, 2008. The comparable property's sale price was \$100,000. We want to change the comparable property's sale price a bit to adjust for the date of sale, to make it more like the date of sale of the subject property.

The adjustment would be:

$$[(0.9062138/0.8920133) \times \$100,000] - \$100,000 = \$1,592$$

That is, \$1,592 should be added to the comparable's price because prices tended to be higher on the day the subject was sold, compared to the day the comparable was sold.

To write it more generally, the correction formula is:

$$\left(\frac{\text{predicted value on subject sale date}}{\text{predicted value on comparable sale date}} \times \text{sales price of comparable} \right) - \text{sale price of comparable}$$

It should be easy for me to apply such corrections within R. However, should it become necessary to apply the correction within Excel, I have established that it is possible. The key operation is looking up the "pred" values for each MLS area and date. The spreadsheet file "lookUpFunctionExample.xlsx" shows the lookup function working in Excel.