The Impact of Photovoltaic Systems on Market Value and Marketability

A case study of 30 single-family homes in the north and northwest Denver metro area

Effective: May, 2013
Colorado Energy Office

Intent of this Study

This study has been conducted on behalf of the Colorado Energy Office to provide an analysis of the impact of solar photovoltaic (solar PV) systems on the home buying process. The study includes the analysis of 30 homes in the northwest Denver metro area, with homes ranging in sale price from $200,000 to $680,000. This work has been completed in conformity with the base rules of the Uniform Standards of Professional Practice (USPAP), with the exception of Standards 1-10.

The goal of the study is to better understand the impact solar PV has, if any, on the sales transaction process. All properties used as case studies were sold between January 1, 2011 and May 31, 2013. The 30 case studies each consist of a single-family residential home that had a PV system installed at the time of sale. All of the PV systems included in this study are owned, and not leased, by the homeowner.

This report was reviewed by the members of the Colorado Chapter of the Appraisal Institute and by members of the Colorado Coalition of Appraisers prior to the publication and dissemination to real estate transaction stakeholders. These reviewers provided both review and comments per terms of a memorandum of understanding signed in August 2012 with the Colorado Energy Office.

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Introduction

INTRODUCTION

Single-family, residential properties can vary greatly in value, style, function and appeal. What is appealing in one market area may hold no interest in another market area (think: a swimming pool in rural Minnesota or snowmobiling access in suburban Miami). Likewise, the features that appeal to each market segment will evolve and change over time. As a result, specific property features hold different market values[1] in different market areas and at different points in time.

Over time, the Denver metro area has experienced changes with regard to the types of elements a homebuyer desires in a house. One of these changes has been the increase in the desire for residential homes with photovoltaic (PV) systems.

A PV system is a solar electric system that is designed to convert sunlight into electricity. While that may sound simple enough, it does not explain how (or even if) a market area places monetary value on having such a system. Understanding exactly how these PV systems fit into any given market-place is a complex puzzle involving, among other things: demand, supply, resources, cost and politics. This could not be more aptly expressed than by Whitney Painter of Buglet Solar Electric Installation:

"[Photovoltaic systems] are a crossroads of several different sciences: technology, finance, natural resources depletion and sociology (to name a few), all at the same time."

Thus, to study the potential value contribution of PV systems is to consider them from many different angles: how often they are installed, why they are installed, what benefits they offer and what demand there is for them. Since the answers to these questions will vary from one market area to another, the only way to begin to understand their value contribution, is to pick a specific market area and conduct a case study of numerous residential properties in that market area. The results of the study may not be a definitive conclusion that is applicable to all or any other study areas. It is the task of the analyst to determine if the "study results" are germane to any other valuation assignment.

Case Study

To study the impact of PV systems on single-family home values and marketability, 30 single-family homes in the northwest Denver metro area were selected to be a part of a case study. These 30 homes were sold at prices ranging from $200,000 to $680,000, closed between January 1, 2011 and May 31, 2013, and are located in the cities of Broomfield, Westminster, Wheat Ridge, Arvada and Denver. To conduct the study, public information for each property was researched. This information was then supplemented with input obtained by interviewing willing participants who were party to each sale.

The 30 selected homes were found by interviewing builders and by reviewing Multiple Listing Service listings (MLS) listings. All of the PV systems installed on the 30 homes used in this case study are owned,

[1] For the definition of Market Value, see Appendix C.

not leased. Leased systems were specifically not included in the case studies because they are considered to be personal property. Establishing value for an item that is not part of the real estate owned would be tenuous at best[2].

When deciding which specific homes to include in this case study, a very simple selection process was used:

First, a study area was picked. Given that the author of this study resides and works in Broomfield, Colorado, Broomfield was used as a starting point to find homes that qualified. Second, a search was conducted of the Broomfield MLS systems[3] for any homes were sold at prices ranging from $200,000 to $680,000, closed between January 1, 2011 and May 31, 2013, and had a PV system at the time of sale. Third, if a located property that met the above criteria, it was determined whether the PV system was leased or owned. Any property with a leased PV system was removed from the study, while any property with an owned PV system was retained. No further disqualification process was used. In this way, this case study would avoid "selecting" sales and instead would truly be a random sampling of properties.

Lastly, after all data in Broomfield was exhausted, the search area was expanded into the neighboring cities until 30 home sales were located. Surprisingly, it turned out to be a challenge to locate 30 sales that met the simple criteria listed above; this is why the study area included so many different cities.

Since the properties used in this case study were a random sampling, some of the 30 case studies will be very strong indicators of the market value of PV, while others will be lacking complete information and therefore, will have inconclusive results. While at first it may seem questionable to include case studies that are weak or inconclusive, it actually turns out to be a strength of this study that no data (no matter how weak or strong), was left out. In this way, readers of the study are able to see the entire data set that was available for study, and the results are not steered towards any particular conclusion.

The homes chosen for the case study were investigated without initial disclosure to the homebuyer or seller. As a part of the study process, most of the homeowners were eventually contacted via survey. While attempts were made to contact the homebuyers and sellers, the outcome was typically not successful. Alternatively, every effort was made to contact both the listing and selling agents for each property. This method was much more successful and the agents were able to provide feedback as well as some information.

This way of conducting the study remains in keeping with real-world appraisal experiences. While the appraiser is often successful in making contact with the listing (and/or) selling agents of properties, the level of the detail of information received is typically significantly less than if the appraiser has full access to the property and the homeowner.

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[2] To develop an opinion of market value of a leased system, an appraiser would be essentially valuing the "leased fee" interest in an item of personal property. This is beyond the scope of this study and typically, this is also beyond the scope of work of most residential appraisal assignments.

[3] Broomfield has two applicable MLS systems: IRES and Metrolist

In practice, appraisers must frequently draw conclusions about comparable sales without either full input from participants who were directly involved in the sale, or without full data and specifications. This, however, is not viewed as a significant weakness in the study. Rather, it is an accurate reflection of the way in which market participants receive and access information. To duplicate the market's way of obtaining information, data was obtained by piecing it together from material obtained from multiple sources (such as Realtors, assessor's records, builder information, permit data, other appraisers, MLS listings, Internet searches and maps). Not every piece of data is available in every circumstance. For our purposes here, data that was or was not available, and how this impacted each conclusion of value and marketability, will be denoted in each case study.

To summarize, this study is meant to show how PV systems impact market value[4] and marketability in a way that is consistent with the real-world limitations of local data. This study will not only show how PV systems impact the market value and marketability of 30 specific homes, it will also carefully explain the strengths and weaknesses of various data sources, verification sources and appraisal methods that were considered during the course of this study. While these strengths and weaknesses are specific to this study, many appraisers will find similar issues in their market areas. In that way, appraisers can be on the lookout for possible limitations and capabilities of their local data sets, rather than merely blindly follow the methods that ended up being applicable for these case studies.

[4] See Appendix for the definition of Market Value that is used for this study

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Executive Summary

Executive Summary

Given that this study is a somewhat lengthy document, an executive summary is offered to present the findings and conclusions of this study. While any *exact* findings and conclusions noted on the following pages relate only to the market area (the northwest Denver metro area) that is specific to this study and to the exact time frame studied (January 1, 2011 to May 31, 2013), they do still provide useful information to the appraiser.

Relevant value influences were discovered in the course of completing this study that can be useful for an appraiser to understand. Thus, while the specific client (the Colorado Energy Office) requested that the value contribution of 30 very specific PV systems be developed, additional readers of this report will likely benefit more by focusing on (1) understanding the value influences discovered and (2) the methodologies used in this study, with less focus on the exact value conclusions.

The executive summary consists of two parts:

> **Part 1** will summarize the exact data conclusions pertinent to this study.
>
> **Part 2** will summarize relevant value influences and appraisal methodologies.

Note: While this study is a complex and lengthy analysis of the impact of PV systems on market value and marketability (for 30 specific residential properties), it is not meant to imply that the appraiser must go to such extraordinary lengths to develop a credible opinion of how PV systems are valued in their market area. Credible opinions of the impact of PV systems on market value and marketability can easily be developed with far less research and study. Since this study is written with the client (the Colorado Energy Office) in mind, it was necessary to conduct more research, analysis and reporting than would be required for the majority of appraisal assignments of which PV systems are a component. In other words, analysis made "in the field" should not only be proportional to the adjustment, but also relevant to expectations of each individual assignment. For the majority of residential appraisal assignments, the level of research conducted for this study is out of proportion to the magnitude of indicated adjustments and reasonable adjustments can be obtained with far less analysis.

PART 1: Exact Findings Based on Market Data

The findings and conclusions noted herein only show some of the more salient points with regard to how PV systems impact the market value and marketability of specific residential properties. This list is not meant to be exhaustive; rather it is a general summary of the facts and opinions considered most relevant to the client (the Colorado Energy Office). Many more details, facts, data points and conclusions are noted throughout the case study.

> *Note: Leased systems were not part of this study, as they are considered personal property belonging to someone other than the homeowner. Only systems that are owned by the homeowner were studied.*

General Conclusions about the Market Area:

- In Colorado: tax credits, rebates and incentives have played an important role in the increase in the number of PV systems being installed each year from 2004 to the present.
- Politics (laws, amendments, policies) impact demand. Currently, they are creating more demand.
- In the study area, the number of PV permits applied for have been steadily increasing each year. To date, Colorado has installed 12,200 individual PV systems. Market demand for PV systems is increasing.
- The overwhelming majority of Realtors surveyed believe *owned* PV systems increase the market value and marketability of homes.
- Realtors are continually increasing the frequency with which they use marketing materials with words such as “energy” and “solar” in them.
- PV systems are present in nearly all price discretionary ranges and ages of homes.

General Conclusions about PV Systems in this Market Area:

- The average cost of PV systems is currently $3000-$4000 per kW (before incentives).
- Residential systems are typically sized between 2kWs and 10kWs.
- The majority of homes can cover all their electricity needs with a 7kW sized system.
- The amount of electricity a system produces varies (even for systems that are the same size). Examples are noted below:

Case Study #	System Size	Estimated Yearly production	Case Study #	System Size	Estimated Yearly production
10	1.3 kW	2020 kWh	11	4.2 kW	6231 kWh
5	2.1 kW	2011 kWh	2	5.6 kW	7875 kWh
1	2.8 kW	4027 kWh	8	5.7 kW	8159 kWh
3	3.9 kW	5432 kWh	6	6.7 kW	7776 kWh
4	4.1 kW	5788 kWh	9	7.1 kW	9979 kWh

- The average home uses between 8,400 and 12,000 kWh' s of electricity per year.
- Residential electricity currently costs $0.11 per kWh.
- The economic life expectancy of a PV system is currently 25 years.
- Even after 25 years, the PV systems are still expected to be at 80% productivity.
- Typically, the market reports no negative reaction to the visual appearance of the systems.
- Repair and maintenance costs are typically extremely minimal.
- The PV systems in this case study ranged from 0 to 5 years old.
- Market conditions varied for each case study.
- PV systems currently cost more to install then they contribute to market value.

The Markets' Reaction to PV Systems:

- PV systems are unlikely to have a negative value impact.
- Marketing times were notably lower for home with PV systems.
- 22 of 30 case studies indicated PV systems contributed $1,400 to $2,600 per kW to market value.
- The market does place value on the utility savings realized from PV systems.
- A detailed chart of all 30 case studies is included at the very end of this study. Please refer to *Part 5: Summary* for a more detailed, three-page summary.
- In one sentence: The case studies, as well as general market data, support the conclusions that PV systems (that are owned) typically increase market value and almost always decrease marketing time.

PART 2: Value Influences and Appraisal Methodologies

Value Influences

In the course of this study, notable value influences were found to be relevant to tracking market demand, market value and changing market conditions. A list of the most notable value influences are noted below:

- Laws, amendments and regulations
- Tax incentives, rebates, and payments from utility companies to homeowners
- The cost of electricity to homeowners
- The cost of installing a PV system
- The number of PV permits being applied for
- Realtor perceptions of PV systems
- How often Realtors refer to PV systems in their marketing materials.
- Homeowner perceptions of PV systems
- Homebuyer perceptions of PV systems
- Sales of homes with PV systems on them

Factors that had no relevant influence on market value include:

- Age of the home
- Size of the home
- Quality of construction of the home
- Style of the home
- Value range of a home
- Size of the subdivision in which the home is located
- Number of recent sales of homes with PV systems in the subdivision
- Length of homeownership
- Maintenance costs of the PV system
- Appearance of the PV system
- Type of PV system (i.e. monocrystalline, polycrystalline or thin film)

In summary, the list above provides appraisers with an idea of what types of data they might concentrate their studies on, as well as a list of which data may yield minimally useful information. Because every market is different, this list is not the authority on what to study, rather, it is an a list of what was observed to be relevant for this study.

Appraisal Methodologies

When valuing a component, an appraiser has three approaches to value to consider. These three approaches are the sales comparison approach, the cost approach and the income approach. It is the appraiser's job to decide which approaches to value are applicable and necessary for credible assignment results. In the course of this study, it was discovered that all three approaches were applicable in almost all of the case studies.

The sales comparison approach was often applicable. The sales comparison approach was applied whenever paired sales were located (for those not familiar with the term "paired sales," a paired sales analysis is discussed in detail in case study #1). Evidence indicates buyers look to other sales of homes with PV systems to understand the value of PV systems: therefore, sales of properties with PV systems were relevant to this study.

The cost approach was most often applicable. One of the best sources of cost data was from permit information. Cost data is typically available from installers, permit data and cost services. Cost was a consideration for participants in this market area and thus, cost data was relevant.

The income approach was also almost always applicable. However, all of the data needed to develop the income approach was not always available. Income was a very important consideration for market area participants and thus, income data was relevant. For this study, the income approach was applied using two different techniques: a gross rent multiplier and the PV Value tool (for those unfamiliar with this terminology, both are explained later in this report). The gross rent multiplier is a very simple application of the income approach and it typically provided a very useful indicator of market value. The PV Value tool, on the other hand, offers a much more sophisticated analysis that requires considerable study and understanding for an appraiser to interpret its indicator of market value.

In conclusion, the market utilized data relevant to all three approaches to value. Therefore, for this market area, it was acceptable to utilize all three approaches to value (or any combination of one or more of the three approaches to value) as data allowed.

PART 1: The Market

Why Study PV Systems Now?

PV systems were first made commercially available in the mid-1950s. However, they did not generally start appearing on homes until the 1980s. With the limited exposure, the majority of homeowners and homebuyers have had no real knowledge of these systems until within the last decade. So why, after all this time, is there a sudden increase in the number of PV systems being installed in the Denver metro area? The answer is trifold and has to do with politics, cost and changing market demands. Each market force is summarized below.

Politics

In the year 2000, the federal government enacted a nationwide 30% personal tax credit known as the Residential Renewable Energy Tax Credit[5]. This allowed, for example, homeowners to install a PV system and receive a personal tax credit of 30% of the total out-of-pocket cost of the system. In 2008, this 30% federal tax credit was extended through the 2016 tax year[6].

Then, in 2004, the State of Colorado approved Amendment 37: *The Colorado Renewable Energy Act*. The amendment allowed, for the first time, private PV systems to tie into the commercial electrical grid. The amendment also required all major utility companies to derive a certain percentage of their retail energy from renewable sources. Starting in 2007, the utility companies were to derive at least 3% of all energy from renewable sources. Originally, this percentage was to gradually increase to 10% by 2015. However, the General Assembly met several more times over the years and finally voted to increase this amount to 30% by 2020[7].

Thus, the local utility provider relevant to this study, Xcel Energy, has a mandated interest in supporting renewable energy sources. To provide financial incentives for private home and business owners to install renewable energy systems, Amendment 37 allowed Xcel Energy to add a 2% charge on customers' electricity bills. These funds are then used by Xcel Energy's Solar*Rewards program to cover the cost of providing financial incentives for renewable energy. Xcel Energy uses these funds as incentives for homeowners and business owners to install on-site PV systems.

The State of Colorado has a law, known as a net metering statute, to protect the owners of on-site PV systems. Under this law, the utility is required to provide the owner of a grid-tied solar system with a bidirectional electricity meter known as a "net meter". The utility also is required to provide retail energy value for every kilowatt hour (kWh) produced by the solar system.

[5] www.dsireusa.org/incentives
[6] In 2009, the cap was lifted from $2000 to unlimited. This was a major factor in encouraging the adoption of PV. http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=US37F
[7] Colorado House Bill 10-1001

Electricity produced by the solar system during the day is utilized to meet the building's power demand. Often, the solar system produces more than the demand at any given moment. In this scenario, the net meter spins backward, rolling the excess electricity onto the utility's grid and providing the solar system owner with credit for generating electricity. The system owner acquires a "solar bank" of credit for the excess kWhs.

In the evenings and during lower-production months, the meter spins forward, drawing from the utility grid and utilizing the solar bank of credit to offset additional demand. Because the solar system produces some or all of the building's electrical power over a year's time, the solar system owner pays only for the net energy consumed from the grid, thus, the name "net meter".

Solar*Rewards funds have been used in different ways, including up-front cash incentives and/or payments over time for energy produced by solar systems. These are known as Performance Based Incentives (PBIs) to help offset the high initial costs of installing the systems.

In the PBI system, the utility provides an additional meter, known as a "production meter" for the solar system. Regardless of whether the solar system's power is utilized immediately or added to the solar bank, the production meter ensures that the system owner is paid a financial incentive for every kWh produced by the system for the first 10 years. This means grid-tied system owners are able to realize the benefits of net metering AND monthly payments in the form of PBIs.

The PBI payment level varies depending on when the solar system was installed, and the amount of financial incentive Xcel Energy offered at the time of installation. The PBI payment remains the same over the entire 10-year period (for example, it may be $.15 per kWh generated, or $0.09 per kWh generated; the exact amount is fixed but varies from one system to another).

> *It is important for the appraiser to understand that in the event of a real estate transaction, the payments transfer to the building's new owner for the remainder of the 10 years.*

The buyer, then, acquires a system that eliminates or reduces utility bills by offsetting electricity demand, as well as provides a monthly check in the mail for the system's total productivity. Therefore, this is considered income for the homeowner.

When the Solar*Rewards program first started in mid-2006, Xcel Energy offered an up-front cash incentive, rather than the current PBI. As the Solar*Rewards program grew and management of cash flow became challenging, Xcel Energy transitioned to the PBI system in 2011. When the transition began, the incentive was split so that some up-front funds were provided and the rest of the incentive was paid as a PBI. In 2012, the up-front payments were dropped entirely, in favor of all incentives paid as monthly PBI payments over 10 years.

Therefore, properties participating in the PBI program may feature a PBI benefit ranging from 1 cent-per-kWh to 15 cents-per-kWh. Because this cash benefit is transferrable to the new property owner, the appraiser should seek this specific information from the seller[8].

The Solar*Rewards program for small residential solar systems (systems between .5 kW and 10kW in size) has experienced significant tumult over the years, both in terms of what rebates and incentives will be offered, and how they will be structured. Although Xcel Energy is nearing its Renewable Portfolio Standard requirements, the PBI program is subject to a settlement under which the program is expected to continue offering new incentives into 2014 and 2015.

Also, the Solar*Rewards program requires the homeowner to sign over the rights to his/her Renewable Energy Credits(RESs) to Xcel for 20 years. REC's[9] are "*tradable, non-tangible energy commodities in the United States that represent proof that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy source"*[10]. The contract with Xcel allows Xcel to utilize the RECs for the length of the 20-year contract. For residential solar installations, the PBI payments are paid over 10 years, but the contract is a 20-year contract- meaning the incentives only last 10 years, but the homeowner still signs over his/her rights to REC's for 20 years. The payments are front-loaded in order to reduce the cost impact for homeowners seeking to implement solar, but the RECs are reserved by Xcel for 20 years regardless.

When the Solar*Rewards program expires, current trends indicate that grid-tied solar systems will continue to be installed in Xcel's service territory, as they currently do in areas around the state where the Solar*Rewards program does not exist. Thus, the precise impact of the end of the Solar*Rewards program will not be known until the program expires.

One example of how the Solar*Rewards program can work is as follows:

> *A homeowner purchases a PV system when the Solar*Rewards was offering a $0.15 per kWh PBI payment. Currently, the average household in Colorado uses around 8,532 kWh[11] of energy per year. If this homeowner goes on to both produce AND use 8,532 kWh per year, s/he would receive a payment of $1,280 per year from Xcel Energy. Without a Solar*Rewards agreement, another homeowner may also produce and use 8,532 kWh per year, but would not receive any payment from Xcel Energy- the homeowner would only receive a payment (or credit) if s/he generated more electricity than s/he used).*

[8] Ideally, many of the case studies would include these PBI payments, however, because the PBI payments are a newer incentive, only an extremely few number of case study homes had these PBI payments.
[9] REC's, represent one megawatt hour (MWh) of energy generated from any clean, renewable source (which in this case, is from a PV system). Companies purchase and trade RECs in regulated markets. Thus, the value of REC's fluctuate by state and over time very much like stocks do. For example, in March of 2013, prices in the United States varied from between $10 to $420 per REC credit. Further information is available at www.srectrade.com . For detailed information on REC's please refer to the www.etnna.org article "REC Questions and Answers". Also, when buyers sign an agreement with Xcel for 20 years, they agree to give Xcel their REC's for those 20 years. The homeowner will receive the REC's after the 20 year period is up.
[10] Wikipedia
[11] www.eia.gov, *How much electricity does an American home use*?

Because of the way these incentive programs are structured, the potential value in having a PV system is not just in its ability to produce energy, but in its ability to produce income. Since every PV system is installed with a potentially different incentive program (or no incentive program at all), an individual PV system may or may not produce extra income for the homeowner. To illustrate, one property may *only* produce energy and, thus, experience a monthly saving on energy bills, while another property may enjoy the energy produced AND produce income. For this reason the potential market value of two PV systems that produce the exact same amount of electricity may be different.

Since many PV systems produce income, appraisers will need to work to not only find whether a particular system *has* PBI payments, but how much those payments are and when they are set to expire. This can create a challenge for appraisers as this information is currently not easily accessible. Xcel Energy will not provide this information without a homeowner's permission and the local IRES and Metrolist MLS system currently do not contain fields for real estate agents to disclose this information.

While ideally it would be helpful to offer readers of this report an exact chart of when each incentive level began and ended, this did not prove to be possible. When contacted, Xcel simply responded to the request for information by stating that it is not information disclosed to the public. This is a limitation to appraisers in Colorado, and also creates a limitation in the completeness of data in some of the included case studies.

Given that there have been so many different variables with the up-front incentives Xcel offered at the beginning of the program, combined with different payback periods and different PBIs (i.e. a per-kWh payment based on how many kWhs the system produces), the only way to know what incentives a homeowner has received and is continuing to receive is to ask the homeowner to supply that information directly. It is interesting to note that over the course of this study, it was discovered that many listing and selling agents had no idea these 10-year rebates even existed. Again, this is another limitation to appraisers' abilities to gather complete data.

While incentive programs have very clearly had a significant impact on driving the market's homeowners to *purchase* more PV systems for their homes, they can only have a chance to positively impact the home's sale price (at the time of sale) if potential buyers are educated about the ongoing income stream of these incentive programs. Therefore, unless the rebate information is passed on to potential buyers, the likelihood that this additional income (i.e. the incentive program benefit) will have a positive impact on value is extremely small. Simply stated, sellers are potentially missing out on higher sale prices because these benefits are not being adequately disclosed.

While the Solar*Rewards program noted above allows participants to potentially receive income from their PV systems, additional federal incentive programs have contributed to decreasing the initial up-front cost of installing the systems.

This brings us to our next market factor: cost.

Cost

Cost of a PV system relates to two issues: the utility cost savings realized by a homeowner, and the cost to install that PV system.

Cost Savings

When considering the benefits of a PV system, one of the relevant factors taken into consideration is current utility costs. Just like buying gas for your car, if current gas prices per-gallon are extremely cheap, car-buyers are less likely to pay a premium for cars with higher fuel efficiencies. However, when gas becomes expensive, there are often almost over-night changes in the demand for those higher-fuel efficient vehicles. Likewise, higher utility costs typically result in demand for energy saving features. As a result, local utility costs are a factor for a market participant who deciding whether a PV system contributes sufficient enough "value" to offsets the financial feasibility of installing one.

For example, in Hawaii, electricity costs are about three times what they are in Colorado. Thus, in theory, consumers will pay more for a solar system in Hawaii then they will in Colorado (and these systems will hit a return-on-investment point sooner than they will in Colorado). In Texas, on the other hand, utility customers are able to choose from various electricity providers so utility costs are much more competitive. In this market area, electricity is only very moderately expensive. That said, the area utility provider (Xcel Energy) has changed its utility costs between 2001 and 2011 in the following ways[12]:

Average Rate ($/kWh)											
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Residential	0.074	0.072	0.083	0.085	0.091	0.088	0.090	0.103	0.098	0.111	0.112
Commercial	0.053	0.053	0.066	0.069	0.077	0.074	0.075	0.089	0.082	0.093	0.095
Industrial	0.040	0.041	0.052	0.049	0.056	0.058	0.055	0.065	0.057	0.064	0.065

Since periodic increases in energy rates are expected to continue, investing in a solar system has become an economically viable option for some homeowners in the greater Denver area.

Cost to Install a PV System

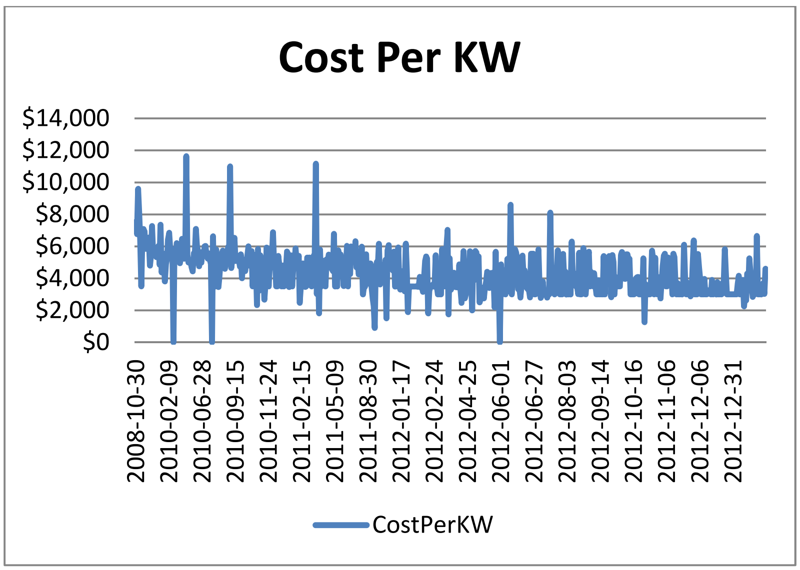
Costs not only vary around the county, they also vary within the state of Colorado. Since only a small area near Denver is being included for this study, the costs noted below are strictly for the defined

[12] Table provided courtesy of the Colorado Energy Office

market area: the cities of Arvada, Broomfield, Wheat Ridge, Westminster[13] and Denver. Pricing for solar systems is generally indexed by the per-kW cost (and larger systems have a slightly lower per-kW cost then smaller systems do, which is consistent with bulk purchasing mentality). Thus, permit data from the defined market area was compiled and is noted below[14].

Based on this data, PV systems have seen dramatic reductions in cost over the past five years. The cost per kW in 2008 was between \$5,000 and \$7,000, and in 2012 was between \$3,000 and \$4,000 per kW. As an aside, some installers quote the cost to install a PV system on a per-watt basis (i.e. \$3.00 to \$4.00 per watt instead of the kW basis noted above). These are simply different units of measurement.

When conducting research for this study, the most common local way of quoting costs was per-kilowatt. Thus, that is the unit of measurement that is being used in this study[15]:



While \$3,500 per kW is the current average installed cost, actual costs per system do vary based on several different factors (for example, inverter costs vary by type and size of the overall system, different roof surfaces are more difficult to install on, some homeowners may opt for a battery back-up system, and there are different panel types). As a result of these differences, some systems are more complex to install than others. However, overall, a general average cost of \$3,500 per kW is currently a reasonable estimate for the typical system installed a typical home with a composition roof (homes with concrete tile roofs generally cost ranging from \$4,000 to \$5,000 per kW). Appraisers should continually monitor the costs of PV systems as the expectation is that they will continue to see changes in costs over the next several years.

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[13] It was not possible to assemble specific cost data for the City and County of Denver, however, I was assured by local installers that costs are comparable between Arvada, Broomfield, Wheat Ridge, Westminster and Denver.

[14] The data noted in this report is a summary of photovoltaic permits from 2009, 2010, 2011 and 2012 for the cities of Broomfield, Westminster, Wheat Ridge and Arvada (as well as some parts of Jefferson County). These costs reflect the cost before incentives and rebates are taken into consideration.

[15] A few of the data points indicate solar systems were purchased for \$0. This is obviously incorrect. This slight anomaly in the data is simply a consequence of dealing with any large bulk data set (like the one that was used to generate this chart).

The costs of installing PV systems have decreased to a point at which the cost is much less prohibitive than it was just five years ago. These lower costs are a significant part of the reason there has been an increase in the number of homeowners buying PV systems (as noted in the chart below[16]):

City	Year	Number of Permits
Westminster	2009	52
Westminster	2010	89
Westminster	2011	104
Westminster	2012	124
Broomfield	2009	17
Broomfield	2010	52
Broomfield	2011	58
Broomfield	2012	94
Arvada	2009	52
Arvada	2010	81
Arvada	2011	85
Arvada	2012	242
Wheat Ridge	2009	12
Wheat Ridge	2010	12
Wheat Ridge	2011	13
Wheat Ridge	2012	14

In fact, to date, since Xcel Energy's Solar*Rewards program began in Colorado, residents and businesses have installed more than 12,200 PV systems[17].

Clearly, with such rapid increases in the number of buyers of PV systems, the demand for them is nearing a tipping point in relation to market demand: buyers are starting to actually look for homes with PV systems already installed on them). In other words, when the number of buyers of a particular product increases, this can directly impact the real estate market. Changing market demands for PV systems directly impacts market value and marketability of homes. This, then, brings us to the third factor having an impact on the interest in PV systems: changing market demands.

The market demands section is divided into three categories: Market Demands, Market Area and Market Participants.

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[16] Data for this chart is as per building permit information obtained directly from each municipality. The information was compiled with the help of John Wrucke, a building materials expert.

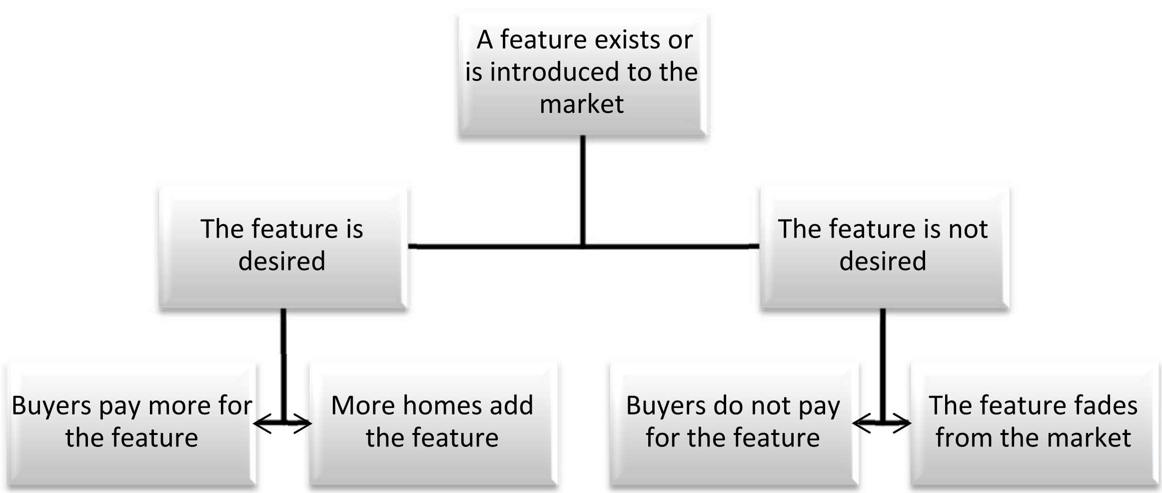
[17] www.xcelenergy.com, Solar*Rewards incentives information

Market Demands

As indicated by one study, the three main reasons homeowners install a PV system are "*(1) environmental concerns, (2) reduction of dependence on foreign oil and (3) being able to produce one's own electricity*[18]." While these may be the some of the reasons PV systems are installed by homeowners, the more important question for this study is not why PV systems are *installed,* but rather, do they add value to the property on which they are installed?

To be able to determine this, we must first study area market demands.

"Market demands" are the features buyers look for, or "demand," when purchasing a home. As demonstrated below, buyers directly interact with market values by either desiring or *not* desiring a given feature:



The demand for a given feature and the supply of that feature work hand-in-hand. When demand changes (and demand can change very rapidly at the whim of market participants), supply will change (though supply is typically much slower to change in relation to the exhibited demand). Demand and supply each impact one another and can actually lead to a point of saturation (i.e. a supply in excess of demand or vice versa). As a result, the value a particular feature adds at any given time is dependent on the number of people who are *looking* for the feature, and the number of homes that are *available* with that feature. The feature may be something a large portion of the market desires, or that only a small portion of the market desires. As long as the supply and demand of that feature are in balance, or demand outweighs supply, the feature will be desired and buyers will typically pay for that feature.

An example to illustrate this phenomemon of this is an "Earth Ship" home, many of which are located in the foothills of Boulder, Colorado. Earth Ship homes are designed with extreme energy efficiency in

[18] *Photovoltaic Incentive Programs Study (SEPA Report #06-09),* Yasmeen Hossain, Mike Taylor and Ming-Jay Shoa November 2009

mind, and they do not function or look anything like homes located in a typical suburb. These homes are partially buried beneath dirt, have sod roofs and utilize recycled materials such as tires and soda pop cans for walls. While the vast majority of the population near Boulder has no desire for an Earth Ship home, there is enough of a market segment to sustain demand for the limited supply. Thus, while only a few Earth Ship homes will come up for sale every few years or so, they always sell well and are very marketable.

Where do PV systems fit in with current market demands? One way to find out is to consider the information available in the Denver metro area's MLS systems.

PV systems are related to energy consumption. To understand where PV systems fit into the market-place, it is first necessary to understand, in general, how important "energy"-related features are to the market.

Take, for example, the information from the local MLS (Metrolist), contained in the following table:

Table 1: How often the word "energy" is used to describe homes listed for sale in MLS

Time Period	Total number of home sales in MLS	Total number of sales in MLS with the word "energy" in the comments section	Percentage of sales in MLS with the word "energy" in the comments section		Total number of new home sales in MLS	Total number of new home sales in MLS with the word "energy" in the comments section	Percentage of new home sales in MLS with the word "energy" in the comments section
2012	54911	1317	2.4%		1697	215	12.7%
2011	43996	872	2.0%		1785	163	9.1%
2010	42500	518	1.2%		1359	44	3.2%
2009	44675	513	1.1%		1470	45	3.1%
2008	50863	381	0.7%		1937	30	1.5%
2007	29762	307	1.0%		1042	9	0.8%

Table 1 shows how often Realtors use the word "energy" in the comments section of MLS[19] listings (this comments section is labeled in Metrolist as the "*Public Remarks*" section).

This *Public Remarks* section is the only part of the MLS listing where the Realtors provide their own, personal description of the property they have listed for sale. Since these comments are typically fewer than 100 words in length and are unique to each property, the words Realtors choose are an indicator of which features are typically of interest to homebuyers. In downtown Denver, for example, Realtors

[19] The "MLS" referred to here is *Metrolist* from the Denver metro-area, Colorado. This data includes shared data from *IRES* MLS (Loveland, Colorado) and *PPAR* MLS (Colorado Springs, Colorado).

would not use the words "grain silo" or "great fishing" since that is not what those buyers value or react to. They may instead use words such as "2 blocks to shopping" or "easy access to light-rail".

Table 1 shows that Realtors have increased their usage of the word "energy" (when referring to new homes) by 11.9% over the past five years. For existing homes, however, that increase has only been 1.4% over this same time period. This is a typical trend. When the market is reacting to and seeking out a new feature, such as energy efficient appliances, this feature tends to show up first in new homes; then, if the feature continues to gain popularity, it will work its way into the remodeling projects of older homes[20].

The increase in usage of the word "energy," however, must be placed within the context of other words Denver-area Realtors have increased their usage of:

Table 2: Words that increased in frequency in MLS for all homes (new and resale)

Word	2012	2011	2010	2009	2008	2007
Granite	24%	22%	21%	17%	13%	13%
Carpet	18%	18%	17%	16%	15%	15%
Updated	17%	14%	13%	11%	10%	10%
Furnace	10%	8%	7%	7%	6%	7%
Green	5%	4%	4%	4%	4%	4%
Energy	2.4%	2.0%	1.2%	1.1%	0.7%	1.0%
Utility	3%	1%	1%	1%	1%	1%
Insulation	1%	1%	.05%	.04%	.03%	.03%

Table 2 shows that the 1.4% increase over five years for the word "energy" is in-line with several other words[21] so this is not a unique change. Also note that the word "utility" increased at a similar rate as the word "energy."

Now, regarding *only* new homes, "energy" and "utility" were the only words found to be increasing at a frequency rate above any other words (see *Table 3* noted below)[22]:

Table 3: The frequency of common words used in MLS when describing new homes

Word	2012	2011	2010	2009	2008	2007
Energy	13%	9%	3%	3%	2%	1%
Green	7%	5%	4%	4%	3%	5%
Utility	6%	.1%	.1%	.1%	.1%	.1%
Insulation	5%	1%	1%	.5%	0	.1%

[20] Part of the positive trend changes toward energy efficiency are due to stricter building codes and part are due to market participants demanding energy efficient features.
[21] 40 words were tested.
[22] 40 other words were tested (i.e. "granite", "den", "schools", "view", "basement", etc.). None were found to have the same significant increase in frequency of use as the words "energy" and "utility".

In conclusion, while the overall market has seen a modest increase in the use of the words "energy" and "utility," new home listings have been rapidly increasing their use of these same words.

Like Realtors, builders also direct their marketing materials to topics that interest buyers. Based on the data summarized thus far, we can begin to reasonably conclude that the increase in the frequency of use of the words "energy" and "utility" by Realtors and builders shows a probable increase in interest by homebuyers for energy-saving features.

To further test this conclusion, Internet marketing materials for 14 local builders were researched. Twelve of these builders (*Village Homes, New Town Builders, Standard Pacific Homes, Taylor Morrison, Meritage Homes, Century Communities, Ryland Homes, Richmond American Homes, KB Homes, Dell Webb, David Weekley and Oakwood Homes)* had easy-to find language on their websites describing energy-efficient features in their homes.

Five of these builders (*Meritage Homes, New Town Builders, Century Communities, Standard Pacific Homes* and *Ryland Homes*) even made specific reference to PV systems as being either standard or available as an upgrade. Interviews with these builders show that, PV features have only been offered (either as an option or as a standard feature) for a year or so. Thus, PV is a newer feature being advertised by some area builders. However, it must be noted that these builders do not offer the same type of solar package. To illustrate, *Century Communities, New Town Builders, Ryland Homes* and *Standard Pacific* include PV as a standard feature on their homes (*Century Communities* includes a 1.92 kW pre-paid lease, *Ryland Homes* includes a 2 kW pre-paid lease, *New Town Builders* includes a 3.0 kW owned system and *Standard Pacific* includes a 1.4 kW owned system, whereas *Meritage Homes* offers two different sized PV systems (that will be owned) as an upgrade option only).

While the web-advertising and the builder interviews confirm there is a trend towards making PV being available to new home buyers, it is still important to quantify this increase. Like with the word "energy," the words "PV," "photovoltaic" or "solar energy" were researched in the local MLS for all residential properties (new and resale homes) and the results are summarized below:

Table 4: "PV" references made in MLS

Year	Frequency
2002	1
2003	0
2004	0
2005	1
2006	0
2007	1
2008	4
2009	8
2010	11
2011	17
2012	37

Clearly, up until 2008, solar energy and PV systems were not even on the radar for most potential buyers and they were rarely (if ever) noted in MLS listings. In fact, up until 2010, the only way Realtors could disclose the existence of a PV system in the MLS was to add specific language in the *Public Remarks* section (this is the information that is summarized in *Table 4*). Between 2010 and 2012, however, the local MLS systems added “Green Fields”. These “Green Fields” allowed the Realtors to indicate (in addition to *or* in lieu of adding language to the *Public Remarks* section), whether a property has any “Green” or energy-efficient features (such as PV). This change has resulted in the further increase in the frequency of PV being disclosed in MLS listings[23]:

Table 5: PV systems as noted in the MLS “Green” fields

Year	Frequency
2010	5
2011	30
2012	59

Based on the above information, we can conclude the Denver metro-area is actively experiencing an increasing interest in disclosure of energy-efficient features and/or PV systems in residential homes. At this point, the acquisition interest is still a relatively small segment of the market; however, it is slowly increasing as the total number of systems increases and new-home builders add PV packages to their homes.

[23] These figures are not the same as were used to generate *Table 4*. Thus, the total frequency of photovoltaic systems being disclosed in MLS is a combination of *Table 4* and *Table 5*.

Market Area

For this study, a specific market-area was located. This market area is located in an area that is northwest of the city of Denver, Colorado. and includes the contiguous cities of Arvada, Broomfield, Wheat Ridge and Westminster as well as some northern sections of the city and county of Denver. A summary of Arvada, Broomfield, Wheat Ridge, Westminster and Denver is noted below:

Arvada[24]

Year incorporated:	1904
Physical size of city:	32 sq. miles
Median House Value in 2009:	$241,800[25]

Median income in 2009:	$66,378[26]
Unemployment as of Aug 2012:	7.7%
Persons living in poverty:	7.3%

Population in July, 2011: *Population in July, 1991:*	107,541 *90,886*
Number of people per household:	2.5
Population/Number of people per household= number of households:	43,016

Broomfield[27]

Year incorporated:	1961
Physical size of city:	27 sq. miles
Median House Value in 2009:	$262,904[28]

Median income in 2009:	$76,380[29]
Unemployment as of Aug 2012:	7.1%
Persons living in poverty:	5.1%

Population in July, 2011: *Population in July, 1991:*	57,352 *25,061*
Number of people per household:	2.6
Population/Number of people per household= number of households:	22,058

Westminster[30]

[24] Per www.city-data.com and www.google.com/publicdata
[25] The Colorado median house value at the same time period was $237,800.
[26] The Colorado median income at this same time period was $55,430.
[27] Per www.city-data.com and www.google.com/publicdata
[28] The Colorado median house value at the same time period was $237,800.
[29] The Colorado median income at this same time period was $55,430.

Year incorporated:	1911
Physical size of city:	31 sq. miles
Median House Value in 2009:	$225,500[31]

Population in July, 2011: *Population in July, 1991:*	106,486 *76,222*
Number of people per household:	2.5
Population/Number of people per household= number of households:	42,594

Median income in 2009:	$60,662[32]
Unemployment as of Aug 2012:	7.8%
Persons living in poverty:	10.6%

Denver[33]

Year incorporated:	1858
Physical size of city:	154.9 sq. miles
Median House Value in 2009:	$244,600[34]

Population in July, 2011: *Population in July, 1991:*	603,440 *unknown*
Number of people per household:	2.2
Population/Number of people per household= number of households:	301,720

Median income in 2009:	$46,410[35]
Unemployment as of Aug 2012:	8.3%
Persons living in poverty:	19.1%

Wheat Ridge[36]

Year incorporated:	1969
Physical size of city:	9.1 sq. miles
Median House Value in 2009:	$238,142[37]

Population in July, 2011: *Population in July, 1991:*	30,218 *unknown*
Number of people per household:	2.1
Population/Number of people per household= number of households:	14,559

Median income in 2009:	$45,428[38]
Unemployment as of Aug 2012:	9.1%
Persons living in poverty:	10.1%

The five cities are a viewed as a good representative sample of the general Denver-metro area for housing in the noted value ranges.

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[30] Per www.city-data.com and www.google.com/publicdata
[31] The Colorado median house value at the same time period was $237,800.
[32] The Colorado median income at this same time period was $55,430.
[33] Per www.city-data.com and www.google.com/publicdata
[34] The Colorado median house value at the same time period was $237,800.
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[36] Per www.city-data.com and www.google.com/publicdata
[37] The Colorado median house value at the same time period was $237,800.
[38] The Colorado median income at this same time period was $55,430.

Market Participants

As noted earlier in this study, every market-area reacts differently to different property features. Our market area includes the cities of Arvada, Broomfield, Westminster, Wheat Ridge and parts of Denver. In order to understand how or whether PV systems have an impact on marketability or value, it is very important to first understand the market area participants and how that they view PV systems.

To do this, a number of data points were checked:

1. Number of PV permits applied for
2. The location of homes with PV permits (i.e. subdivision and city)
3. The sssessed value of homes with PV permits
4. Length of homeownership before a PV permit was applied for

This information, combined with the number of households per city, will show how common PV system are, which price range of home is likely to have a PV system, where those PV systems are located (by subdivision) and how long homeowners have lived in the property prior to purchasing a PV system.

Note: Only data from Arvada, Broomfield, Westminster and Wheat Ridge is included in these data sets because, as will be explained later, it was not possible to obtain bulk permit data from the City and County of Denver.

Data Point 1: Number of PV Permits

City	Year	Number of Permits	City	Year	Number of Permits
Arvada	2009	52	Westminster	2009	52
Arvada	2010	81	Westminster	2010	89
Arvada	2011	85	Westminster	2011	104
Arvada	2012	242	Westminster	2012	124
Broomfield	2009	17	Wheat Ridge	2009	12
Broomfield	2010	52	Wheat Ridge	2010	12
Broomfield	2011	58	Wheat Ridge	2011	13
Broomfield	2012	94	Wheat Ridge	2012	14

Based on the number of permits previously, the following percentages of households per city have applied for PV permits between 2009 and 2012:

- Arvada 1%
- Broomfield 1%
- Westminster .9%
- Wheat Ridge .3%

In conclusion, PV permits are evenly distributed throughout the cities, with the exception of Wheat Ridge. Thus, three of the cities are experiencing a similar level of market interest in PV systems.

These PV permits are being applied for on a wide range of home ages:

DATA POINT 2: Age of Homes with PV

The number of PV permits applied for (arranged according to decade)												
City/Year	**1900**	**1910**	**1920**	**1930**	**1940**	**1950**	**1960**	**1970**	**1980**	**1990**	**2000**	**2010**
Arvada	1	1	2		3	10	26	38	20	35	48	44
Broomfield						11	6	31	32	69	77	5
Westminster				1	1	10	6	33	28	43	41	8
Wheat Ridge	1	1	4	1	7	29	9	4	2	2	4	0

At first glance, it appears that homebuyers in Arvada are more inclined to install systems on newer homes, while Wheat Ridge is inclined to install PV systems on homes built in the 1950s. It should be noted, however, that Arvada and Broomfield have a much higher percentage of homes that were built after 2000 (whereas Wheat Ridge is comprised mostly of homes built in the 1950's, and Westminster consists mainly of homes built between 1970 and 2000). Additionally, all cities have very few homes that were built before 1950. Based on the makeup of each city, the number of permits applied for (based on the decade in which each home was built) is actually pretty evenly distributed among the actual makeup of each city.

In conclusion, based on the above data, the market area is just as willing to install a PV system on a home built in the 1970's as it is to install one on a home built in the 2000s. The age of the home is not a major factor in deciding whether to install a PV system and PV permits are generally evenly distributed by the ages of homes that are typical for each city.

DATA POINT 3: Location of Homes with PV

Location (Subdivision and City)

While many of the subdivisions in Arvada, Broomfield, Westminster and Wheat Ridge have only seen between one and three permit applications between 2009 and 2012, several subdivisions have had multiple permits. Those subdivisions are as noted below:

Arvada					
SUBDIVISION	Number of recent Permits[39]	Number of properties	% of properties with PV permits	Age Range of homes	Median home value for entire subdivision
Five Parks	19	876	2%	2002-2010	$419,700
Candelas	19	601	3%	2012-Present	$435,000
West Woods	16	1105	1%	1994-2006	$350,000
Ralston Valley	13	974	1%	1954-1999	$156,500
Lamar Heights	13	997	1%	1956-1989	$142,000
Lakecrest	8	696	1%	1980-1999	$203,100
Cameo	7	99	7%	1963-1999	$252,900
Wild Grass	6	668	.8%	2009-Present	$478,381
Lake Arbor	5	1468	.3%	1970-1998	$142,500
Landing	5	559	.8%	1987-1996	$234,900

Broomfield					
SUBDIVISION	Number of recent Permits	Number of properties	% of properties with recent PV permits	Age Range of homes	Median home value for entire subdivision
Aspen Creek	21	394	5%	2000-2007	$480,800
Broomfield Hgts	19	1684	1%	1956-1987	$173,000
Mckay Landing	19	743	3%	2001-2009	$349,000
Brandywine	18	890	2%	1979-1999	$214,000
Ridgeview Heights	17	326	5%	1982-1999	$275,000
Highland Park	13	416	3%	1979-1993	$222,000
Willow Park	11	529	2%	1993-1999	$270,000
Westlake Village	8	1241	.6%	1972-1998	$172,000

Westminster					
SUBDIVISION	Number of recent Permits	Number of properties	% of properties with recent PV permits	Age Range of homes	Median home value for entire subdivision
Legacy	19	1376	1%	1994-2011	$335,857
Bradburn	15	641	2%	2002-2006	$395,000
Village	11	1950	.5%	1980-2011	$178,500
Sunstream	8	916	1%	1976-1997	$172,900
Home Farm	8	311	3%	1994-1998	$316,800
Ranch	7	1268	.5%	1990-2006	$373,200
Amherst	6	698	1%	1993-1998	$212,000
Walnut Grove	5	748	.6%	1976-2010	$207,300

Wheat Ridge					
SUBDIVISION	Number of recent Permits	Number of properties	% of properties with recent PV permits	Age Range of homes	Median home value for entire subdivision
Barths	19	191	10%	1877-2011	$188,500
Applewood	16	3581	.04%	1953-1996	$205,000
Bel Air	12	338	4%	1947-1957	$220,000
Lakeside	13	916	1%	1882-1995	$155,000

[39] Issued between 2010 and 2012

Note the median value for all of these subdivisions compared to the median value for the entire city:

Arvada median value for specific subdivisions:	$243,900
Arvada median value for the entire city:	$241,800
Broomfield median value for specific subdivisions:	$246,000
Broomfield median value for the entire city:	$262,904
Westminster median value for specific subdivisions:	$264,000
Westminster median value for the entire city:	$225,500
Wheat Ridge median value for specific subdivisions:	$192,000
Wheat Ridge median value for the entire city:	$238,142

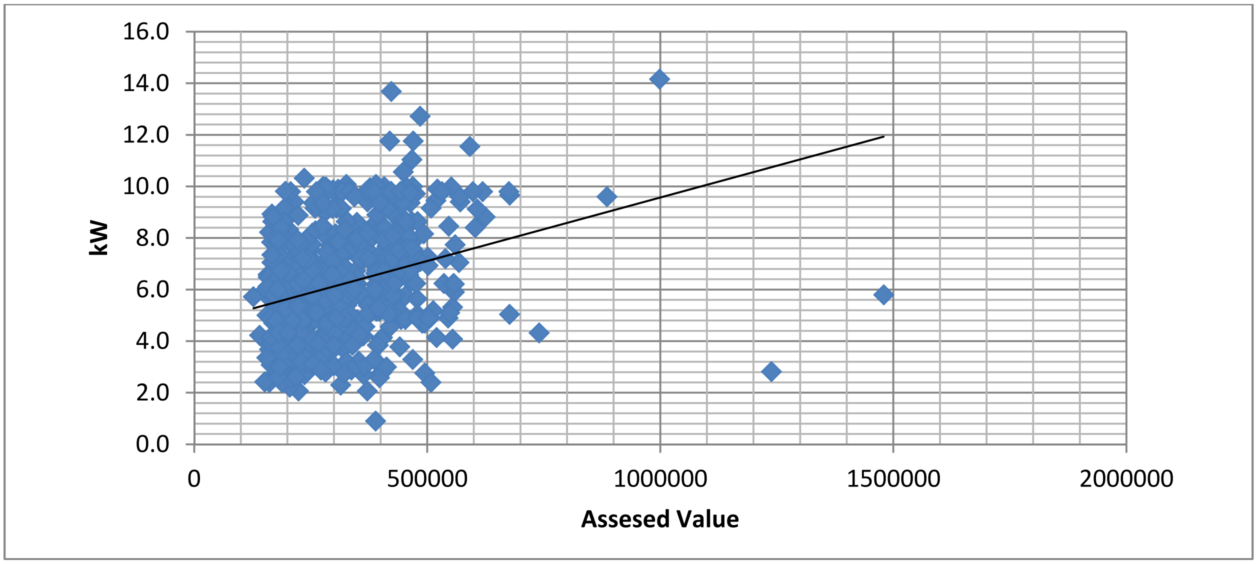
It should be noted that the median value for the entire city is dated 2009, while the median values for the specific subdivisions are taken from local MLS data and are current figures (from 2012)[40]. Since values have increased slightly between 2009 and the end of 2012, it is reasonable to conclude that the median home price for the entire city is slightly higher today. Thus, the median values for the entire city and for the specific subdivisions are generally comparable to one another, except for Wheat Ridge.

As a general observation, PV systems occur in all price ranges of home. It can be concluded that the PV permits are evenly spread out across the cities and by subdivision.

[40] For reasons too lengthy to explain here, the median home price of each city is from 2009 and not from 2012. This has to do with the limitations of different data sources (i.e. what data they reflect and how they are compiled). Thus, after taking into consideration all limitations of various data sets, the decision was made to use the median value from 2009, even though it is a few years old.

DATA POINT 4: Value of Homes with PV

Assessed Value Versus Number of Kilowatts Installed



The data above indicates there is only a .3 correlation between the assessed values of the properties and the number of kWs homeowners install on their homes. This demonstrates that energy needs and wants only slightly correlate to the overall value of the home. Therefore, there is no particular price range of home that is more likely to installed PV than any other price range of home. There is, however, a clear indication that PV systems are typically not installed on homes assessed under $150,000, and are minimally installed on homes valued over $700,000. This statement must be tempered by the fact that there is a very limited number of single family homes in the study area that are worth under $150,000 or over $700,000.

The conclusion within this data set is that the size of the PV system is only very slightly correlated with the assessed value of the home.

DATA POINT 5: Length of Homeownership

While conducting this study, two Realtors mentioned they felt that those inclined to buy PV systems were those who intended to stay in their homes for longer than the average homeowner. This, however, did not turn out to be the case. To study this data point, permit data was compiled to determine how long (on average) a property owner had owned a property before applying for a permit to install PV. This data ONLY reflects those who applied for PV permits in 2010, 2011 and 2012. Thus, the data set shows how long the owners had lived in the property before applying for a PV permit in 2010, 2011 or 2012.

LENGTH OF OWNERSHIP (IN YEARS) BEFORE A PERMIT FOR PV WAS APPLIED FOR

Between 31-40 years	9 permits
Between 21-20 years	53 permits
Between 11-21 years	167 permits
Between 01-10 years	381 permits

Since the average length of homeownership is eight years[41], it is interesting to note that 37% of all permits pulled were on properties where the owners had lived on the property more than 10 years. This, however, does not reflect how long the homeowners will live on their property *after* PV is installed.

Since the purchasing of PV permits (en mass) is a relatively new activity, it is only possible to track how long PV buyers have lived in their homes PRIOR to the purchase of PV. It is not yet possible to track how long PV buyers will live in their home AFTER they purchase the PV systems (since most of those owners still live on the properties).

In conclusion, this data point is inconclusive with regard to how long a PV buyer will live in his/her home after the purchase of the PV system; however, it does show that buyers of PV systems are not just new homeowners.

Therefore, there is moderate tendency for a homeowner to apply for a PV permit within the first 10 years of homeownership, versus after 10 years of homeownership.

This data point, however, is given little weight since the data point only tracks permits applied for between 2009 and 2012.

[41] US Census data

Market Participants: Conclusions

As the data has shown, the distribution of PV permits is very even regardless of the age of the home, the assessed value of the home, the size of the PV system, the subdivision in which the home is located, or the city within which the home is located. This is a clear indication that there is no one particular market segment that has an interest in PV systems. Rather, homes with PV systems represent nearly all price discretionary ranges, ages of homes and locations within Arvada, Broomfield and Westminster.

While the PV systems are noted in all areas, the next logical question to ask is, “How accepted are PV systems by homebuyers?” For that, we turn to a survey of area real estate agents.[42]

[42] It was necessary to resort to telephone interviews of real estate agents, as enough homeowners did not respond to a written survey that was mailed to them to create reliable data conclusions.

Real Estate Agent Survey

What do Real Estate Agents have to Say about PV Systems?

In March 2013, more than 60 real estate agents were contacted. These agents had experience listing homes with PV systems (the 60 agents from this survey are different from the agents who listed and sold the 30 homes used in the case study). Of these 60 real estate agents, 39 responded and provided feedback about how they saw the market reacting to PV systems in general. A summary of their comments is provided in the table noted below.

The comment boxes are highlighted with various colors. The colors have the following meanings:

PV had a *negative* impact on value and/or marketability.
PV had a *neutral* impact on value and/or marketability.
PV had a *positive* impact on value and/or marketability.

Note that very few of the boxes are colored red. Also, the percentage of neutral comments boxes start out representing the majority of sales, but, over time, all comments changed to almost all positive experiences.

The comments are taken mostly from telephone interviews. A very serious effort was made to use the exact words the real estate agents themselves were using. However, it should be noted that the conversations were not recorded- handwritten notes were taken during the interviews with careful attention paid to the exact phrasing used by each agent. A few of the comments were taken from email responses from the real estate agents. In those few instances, the exact phrases the agents used are noted below (though they are shortened for brevity and any words removed were peripheral statements such as "I would love to help" or, "The other agent said the system was about 3kW, but we found out it was 3.8kW," etc.).

CITY	YEAR OF SALE	LEASED/OWNED	REAL ESTATE AGENT COMMENTS
Englewood	2009	Owned	Good marketing (showing utility bills and giving a depreciation table) was key. Value contribution was around $7,000. Buyer specifically wanted a "Green" house. PV was key to sale, as the market was dead at the time.
Ft Collins	2009	Unknown	Added no value.
Longmont	2010	Unknown	No feedback on PV system. Sold very quickly. PV had little or no impact on value.
Boulder	2011	Owned	The system was very old. The buyer was neutral to the system. It was not leased, but leased systems are a negative on the selling process.

Boulder	2011	Owned	Was a plus that the system was not leased. It increased marketability. Buyers liked the energy efficiency but not sure they would paid more for it.
Denver	2011	Unknown	Buyers, after education, liked the idea of saving on utilities. No impact on marketability. Did not add or subtract from value.
Denver	2011	Owned	2.8kW. Took longer to sell because potential buyers had to be educated on the system. Buyers liked the system after they learned about it. At the time, there were not enough sales of PV systems and buyers did not understand them.
Denver	2011	Leased	Buyer liked the system, but was not willing to pay more. The lease complicated the transaction and was a hassle.
Lafayette	2011	Owned	Cost $15,000 after rebates for 4.5kW. Utilities decreased around $60 per month. Few buyers cared about it and minimal feedback was received. Seemed to have zero impact on value.
Lafayette	2011	Owned	Cost $30,000, contributory value was between $0-10,000. Having the system was a bonus and a benefit to the sale, but was not the reason the home sold.
Louisville	2011	Owned	Attractive feature but did not add significant value. Homes in this area sell well with or without a PV system.
Louisville	2011	Leased	Buyer assumed 18-year balance of lease. This was not a negative or positive issue. Buyer paid over asking price, but not because of the PV.
Louisville	2011	Leased	System was a perceived hassle. Most people were not interested and did not want to sign a lease, even though it was pre-paid. In the end, it was not a negative or a positive: it was a neutral feature.
Arvada	2012	Owned	Had to be proactive as a Realtor for value to be realized. Buyers loved saving energy. All potential buyers liked it. Added $20,000 to $25,000. Buyers see a lot of value when systems are owned, not leased.
Arvada	2012	Leased	A tremendous resistance from buyers because it was a lease.
Arvada	2012	Leased	Lease did cause a negative issue in negotiation of the sale. The system was brand new.
Broomfield	2012	Leased	No comments received at all. Lease was paid in full. If the lease was not paid, it would have been a big deal.
Boulder	2012	Owned	PV made no difference. Buyers could have cared less. Sellers spent a lot of money on the system.
Boulder	2012	Owned	3.5kW. System was worth no more than $10,000. PV was a selling point and brought the value up. Probably reduced marketing time. Big appeal in the nearly non-existent energy bills.
Denver	2012	Unknown	Overall: it was a perceived hassle. The buyers, however, were very interested in saving energy. It did add value, but not sure how much. The market does not know enough about the systems.
Denver	2012	Leased	Leased by Solarcity. The transaction was very smooth and easy to transfer. Listing agent liked the system so much, he had it installed on his own personal home after this sale.
Denver	2012	Leased	Nobody cared about the lease. The home sold so quickly the PV did not matter. The market was a seller's market.
Erie	2012	Owned	People like the very low energy bills. PV was a major marketing factor, but not all people had interest in it. Maybe got $8,000 to $10,000 more for the PV system. Leases are a negative if they are not paid off.
Evergreen	2012	Leased	Leased was paid off prior to sale of home. The buyers thought the system was a "little perk" only because the lease was prepaid. They would have bought the home with or without the PV. Did not add much value. A lease that was not prepaid would appeal to

			someone with eco sensibilities.
Golden	2012	Owned	Solar did help, but did not make the deal. Lucky if the seller got $10,000 of value for it. Had practically free utilities.
Highlands Ranch	2012	Owned	5 kw system. The PV system was a big factor for the buyer. The agent very actively promoted the system. Added $9,000 to $10,000.
Lafayette	2012	Owned	4.8kW. Almost no electric bills on property. Estimated it added $5,000 to $10,000 in value. PV was a major plus for marketing. Most Realtors had little reaction, but many potential buyers really liked the energy savings. Sold very fast. Buyer saw value in PV. Appraiser stated PV added no value. Buyer bought the house anyway at the contract price, even though it appraised below contract price.
Lafayette	2012	Owned	No comments received on system. Was a nice extra feature but not important to this buyer. Added a nominal benefit. Most people do not understand benefits of system.
Lakewood	2012	Unknown	No one mentioned the PV. Home sold very quickly.
Louisville	2012	Owned	No electric bills on property. The buyer who purchased the system, liked it but did not want to pay more to have it.
Louisville	2012	Owned	Nice bonus, but not a deciding factor for buyers. The home did sell faster because of the PV. Added to value, but not sure how much.
Nederland	2012	Owned	PV helped the seller sell the home. Buyer had a large focus on solar. Had one of the better rebate contracts with Xcel.
Arvada	2013	Leased	The lease was a bad issue. Seller had to pre-pay (or buy out the lease). Lending company required lots of extra documentation. Was a negative.
Broomfield	2013	Leased	Lease did create complications. Buyer and seller split the cost to pay it off. Buyer felt that was a good deal since he then would get his money back in saved utility costs. Buyer felt he paid more for the home because of solar (even with lease).
Black Hawk	2013	Owned	Seller believes he got $18,000 back. Realtor actively marketed and educated buyers on system. Every potential buyer was “impressed” with the system. Sold much quicker than other homes.
Denver	2013	Owned	PV systems are common and expected in this particular area. System adds minimally to value, but the house was more attractive to buyers because of the PV. Homes without PV are seen as lacking a feature. Having PV is “something extra” to offer.
Erie	2013	Owned	Biggest interest for the buyers was the PV system and the neighborhood. Utility bills were $5 per month. Added $15,000 to $20,000 to value.
Lafayette	2013	Owned	4.8kW. PV was a plus. Had multiple offers and bidding war. Sold very fast. If systems are leased, they are not viewed favorably. Buyers loved that the system came with the house.
Platteville	2013	Unknown	A system where the lease is paid off makes a huge difference. Added value to the property. PV was a huge plus for this buyer.

In summary, when PV systems were first appearing on homes that were listed for sale in 2009, most real estate agents were noting the systems had a neutral impact on the marketability and value of the property (and only a few felt the PV had a positive impact). Overtime, this shifted to an even number of real estate agents stating that PV was having a neutral *or* positive impact. Eventually, trends continued to the most recent sales, which show that PV systems clearly have a positive impact on value or marketability.

In addition to the quotes noted above, roughly an additional 100 real estate agents were interviewed for this study (i.e. the 100+ agents noted later in this study that were contacted in the case studies). The most resounding comment received was that many people were "scared" of PV systems until they learned about them. In fact, it became very evident that real estate agents who perceived having received the highest quoted values for the PV systems were those who actively marketed the system and felt had spent time educating the buyers[43]. Thus, according to real estate agents, education equaled higher values, or:

BEEHV

(pronounced "Beehive")

Buyer Education Equaled Higher Values

Information Learned from the Real Estate Agent Survey

When conducting interviews with real estate agents, it was noted that a few points continued to be brought up again and again with regard to what information buyers were seeking about PV systems). The key concerns buyers had were:

- What are the maintenance costs?
- How much electricity does the PV system generate?
- What percentage of my total electrical costs will the PV system cover?
- Is the PV system owned or leased?

While other concerns were noted as well (for example, What happens when they are damaged by hail? How to I read the meter? What is my final carbon footprint?), those listed above were by far the most common concerns.

To help real estate agents address these concerns, they may choose to utilize the following two forms:

1) The Appraisal Institute offers a very comprehensive Residential Green and Energy Efficient Addendum ("RGEEA") that standardizes the information on a national basis and can be used by anyone. This provides a way for anyone to disclose all the relevant specifications about a system.
2) A Realtor Estate Information Sheet is less concerned with specifications and is aimed more to be a visually interesting document that is intended to merely pique the interest of potential homebuyers.

[43] In addition to the Realtor quotes noted above, this conclusion was drawn from other conversations that were had as well.

Therefore, the two forms work nicely together. While the RGEEA is extremely useful for disclosing the exact specifications of any given system and also provides information that is very much needed by appraisers, real estate agents and potential homebuyers, the Realtor Information Sheet is intended for marketing purposes and is designed merely to catch the eye of homebuyers, and thereby prompts the homebuyer to ask more questions about the PV system.

It was surmised by a total of 10 real estate agents (all of whom were contacted for their feedback and input) that combining the two documents allowed the agents to both create interest in the PV system and provide specifications for that system. Without *both* documents, the agents felt they were servicing fewer potential buyers. If only the RGEEA addendum was used, the agents felt they were essentially assuming potential buyers had the knowledge to understand what each specification meant. Likewise, if the agents used only the Realtor Information Sheet, they were then assuming buyers didn't want to know the specifications (when clearly, some buyers were very savvy about the income and value of PV systems). Thus, when used in conjunction with one another, both forms have the potential to serve all potential buyers (those who savvy about PV systems and those who are just learning about them).

Regardless of how (and if) real estate agents decide to market and disclose specifications about a specific PV system, one thing was clear: educating buyers and providing information about the system typically resulted in a positive selling experience (which, for this study, typically resulted in lower marketing times and/or potentially higher sale prices).

PART 2: Photovoltaic Systems

Photovoltaic Systems-What Appraisers Need to Know

Components

A PV system converts sunlight into electricity. One of the reasons homeowners install these systems is to generate renewably sourced electricity. Currently, it is very common for homeowners to tie their PV systems into the electric grid (meaning, they are connected to the area utility provider's power line infrastructure). While a homeowner can opt to be entirely off grid, this is not the type of system that was researched for this study. This study addresses only grid-tied systems[44]. Thus, only the components of a grid-tied system are explained here.

For a grid-tied PV system, two different components are important for the appraiser to understand:

- The inverter
- The PV array of panels (note: multiple panels comprise an "array")

An "*inverter*" converts DC current (which is what PV panels produce) into AC current (which is what is used for household electricity). There are many different types of inverters. The larger a PV system is, the larger the capacity the inverter(s) will have.

A photo of several inverters and a photo of the additional electrical components associated with having a grid-tied PV system are noted below:

Three Inverters

Utility Meter, etc.[45]

These components usually are located on the building exterior near electrical service equipment. However, it is possible to install a wall-mounted inverter in a garage or living space, and sometimes this will be the case.

[44] Also, this study only addresses free standing panels and not integrated photovoltaic roof shingles. The roof shingles are rarely noted in this market area, and thus, was not a part of this study.
[45] This particular photo has <u>significantly more hardware</u> than a *typical* solar system requires.

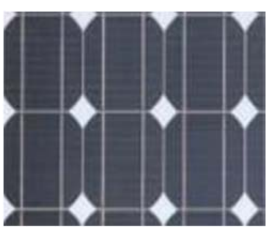
Some solar systems are installed with micro inverters, rather than a wall-mounted central inverter. In systems of this nature, each solar panel has its own inverter mounted underneath each solar panel. The micro inverter will be tucked out of sight underneath the solar array ("PV array") but the system will still contain the switchgear noted in the labeled photo on the previous page.

A "PV array" consists of numerous PV panels connected together. PV panels are the large, flat panels that are typically installed on the roof of a home (some are installed in backyards; however, in this market area, most will be found on the roof).

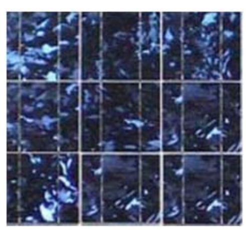
A photo of a PV array containing eight panels is noted below:

There are three different types of PV panels and each has a different efficiency level. The three common types of PV panels are as follows:

Monocrystalline:



Polycrystalline:



Thin film:

Monocrystalline panels are the most efficient and vary in efficiency from 14% to 17%.
Polycrystalline panels are the next most efficient and vary in efficiency from 11.5% to 14%.
Thin-film panels are the least efficient and vary in efficiency from 6% to 8%[46].

In this market area, monocrystalline and polycrystalline panels are the most common.

In summary, not only are there different types of panels, those panels can vary in physical size and output (i.e. 120 watts, 175 watts, 240 watts, etc.). Simply stated, it is not possible for an appraiser to

[46] Solar Electricity Basics, by Dan Chiras, 2010 (though by 2013, the efficiency level has increased a bit).

simply count the number of panels on a home, calculate the area of square footage the panels cover or look at the inverter to know the kW output of the PV system. Many appraisers mentioned the preference for all details of the system to be labeled and posted inside the electrical panel. The labeling of solar systems, however, is regulated by the National Electric Code and rather than being designed for appraisers or homeowners, is designed for the safety of personnel who typically interact with the systems, such as electricians and firefighters. Thus, while a label is already required by code and is posted on the inverters, the label is currently not designed to meet the needs of appraisers.

With such a variety in the components that comprise a PV system, it is typically beyond the appraiser's expertise level to determine the size and type of any given PV system simply by looking at it. Therefore, the appraiser should rely on other sources to determine the specifications of the system s/he is studying (again, another good reason for the AI's Residential Green and Energy Efficient Addendum). For this study, those sources were either generally via building permit data or, in some cases, interviews with real estate agents. For an appraisal assignment, it would be very important to interview the homeowner (or builder) and even more useful to review any documents that were issued with the PV system. Very often, it was not possible to obtain all the specifications of a given system. This problem will be discussed in detail under the "Data Sources" section of this report.

Specifications of PV Systems

There are certain details of each PV system that the appraiser must research and will need to know in order to use some of the appraisal methods discussed later in this study. The easiest way to learn the various specifications and components of a specific PV system is to contact the actual installer. The installer's name will be listed on the label that is posted on the inverter. Another source of information would be the homeowner. Ideally, the appraiser can provide a copy of the Residential Green and Energy Efficient Addendum[47] to the homeowner and the homeowner can fill it out (or have the solar installer fill it out). In reality, however, most homeowners need assistance with the form. Then the appraiser can request to see all the documents the homeowner has about the system. The documents will typically have all the information the appraiser needs.

If the appraiser is studying the PV system of a comparable sale, s/he will most likely not have access to the homeowner, as was the case for this study. Unless otherwise noted in the individual case studies, the homeowners were typically not available to disclose specific details about their PV systems. In fact, unless an appraiser is performing a full appraisal on a specific property, there may not be a way for him/her to access the specifications of individual PV systems. Likewise, even when performing a full appraisal on a house, that homeowner (or listing agent) may not know or understand how to find the information the appraiser needs. Regardless, the appraiser should attempt to locate specific information

[47] A copy of this addendum is contained in the Appendix B of this study.

about the PV system being studied and disclose the confirmed data and the assumptions being made about the system[48].

While there are many details associated with a PV system, the details that were found to have the most relevance for this study are noted below. (Note that not all of this information was possible to gather for each and every case study, however, the inability to gather all data points is an accurate reflection of the data obstacles any appraiser will face in measuring the value impact of a PV system in the Denver market area.)

- **Is the PV system leased or owned by the homeowner?**
  - The owner or listing agent (if the property is listed for sale) will be relied upon to disclose whether the PV system is leased or owned. There is no public data source in the Denver metro area for finding this information. If leased, the appraiser should request a copy of the lease to view the terms and conditions of that lease. In a lease situation, the PV system is owned by a third-party and is not owned by the homeowner. Also, even if a system was originally leased, it is possible for homeowners to eventually purchase the system (depending on the terms of the lease).

- **What is the size (total number of kWs) of the system?**
  - For this study, most, but not all, listing agents knew the size of the PV system of the home they sold. If the homeowner was not available to provide this information, it was sometimes found in the MLS listing by interviewing the listing agent (or sometimes the selling agent) and/or by obtaining a copy of the building permit from the municipality. There were circumstances in a few of the case studies in whidh the size of the system was not able to be determined.

- **Who is the manufacturer of the panels?**

- **How long is the warranty on the panels?**
  - Warranties are not the same for every module a manufacturer creates. If the appraiser cannot find this information, it is currently acceptable to make an assumption[49] that the warranty period is for 25 years, since this is the industry standard. This information is useful when using the PV Value valuation tool (discussed later in this report).

[48] And, as per the appraisal industry standard known as USPAP Standard 2-2(b)(x), the appraiser should disclose in any written summary appraisal report that those assumptions (known as “extraordinary assumptions) could impact the conclusions and opinions reached in the appraisal report.
[49] Again, the appraiser, as per the appraisal guidelines found in USPAP Standard 2-2(b)(x), the appraiser will need to disclose in any written summary appraisal report that an “extraordinary” assumption was made and that this assumption might impact the assignment results.

- **What is the age of the panels?**
    - This information was found by looking at the building permit, or by contacting the homeowner. The age is important to know in order to estimate the level of degradation the system has and the estimated remaining economic life. Age helps the appraiser estimate depreciation and is also necessary information when using the PV Value tool.

- **What is the energy production (kWh) per array?**
    - This information was found by looking at the building permit, talking to the installer or obtaining documents from the homeowner (or listing agent). In many cases, when the installer applied for a building permit, the PV Watts[50] calculation will have been included in the actual permit.
    - The energy produced, or the estimated production is the basis for the income approach. This is also an important piece of information to know so that the appraiser will know if the system is working properly or not (if the estimated production and actual production amount vary significantly from one another, the appraiser will need to conduct further investigations).

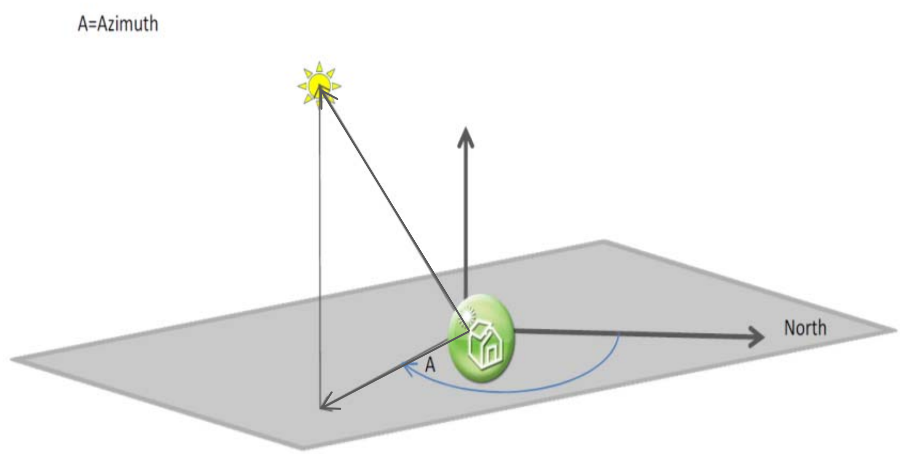
- **What is the tile/slope of the array?**
    - The tilt relates to the angle at which the array is laying on the roof. If the panels are laying flush with the roof, the tilt will be the slope of the roof. Some examples of tilt angles are noted below:

Roof Pitch	Tilt Angle (i.e. degrees)
2/12	9.5
4/12	18.4
6/12	26.6
8/12	33.7
10/12	39.8

The tilt is very important to know in order to use the PV Value tool that is discussed later in this report. The tilt of an array impacts how much energy the system will produce. Some permits have this information listed right on the permit. Otherwise, it should be fairly easy for an appraiser to eyeball a roof line and determine its roof pitch (if not, using a protractor will help).

[50] PV Watts is a calculation tool that is free to access and use online. Installers use the PV Watts calculations to estimate the production of each particular PV system they are installing.

- **What is the azimuth of the PV array?**
  - The azimuth angle of the *sun* is different than the azimuth angle of the PV array. The sun's azimuth is the compass direction in which the sunlight is in relation to the PV array. In our hemisphere, this means the sun tracks along the southern sky from sunrise (east) to sunset (west). The drawing noted below illustrates azimuth:



In this drawing, the sun moves throughout the day, thus, the azimuth of the sun keeps changing throughout the day. The azimuth of the PV system, however, will not change though out the day (The only exception occurs when the PV system is designed to physically move to track the sun. It is currently not typical for homeowners in the Denver area to install the type of PV systems that track the sun. Rather, local PV systems are "fixed" and are aligned to face one specific azimuth.). The azimuth of the PV system is one set value.

  - Globally, azimuths range from 90- to 270- degrees. The most directly south-facing azimuth is 180 degrees.
  - Because PV systems collect energy from sunlight, the orientation of the solar array with regard to the south-facing sky is important. In Colorado, the *ideal* orientation is slightly southeast facing, with an azimuth of about 165 to 170 degrees. This is because afternoon clouds and thunderstorms are common in our most productive summer months. A slightly east-facing orientation allows the system to efficiently harvest energy during the most light-saturated skies, minimizing the impact of afternoon sky cover. If a homeowner is installing a flush-mounted, fixed PV system on the roof, the homeowner cannot choose the azimuth: the direction the roof surface is facing will determine the azimuth.
  - In general, variations in tilt and orientation have a surprisingly small impact on the productivity of PV systems. An east-facing array at 90 degrees azimuth will make about 7% less energy than a south-facing array at 180 degrees. A west-facing array at 270 degrees will make about 11% less energy than a south-facing array at 180 degrees.

  - The azimuth can be determined in several ways: by contacting the homeowner or installer, to look up the permit information, by using the www.tools.solmetric.com/tools/roofazimuthtool website, or by using a compass. Please refer to Appendix I for instructions on how to use the azimuth tool to determine the azimuth of the PV system.

- **Shading**
  - If even part of a PV system is shaded, this may negatively impact the entire system. Shading impacts a PV system the same way one weak battery impacts a flashlight's ability to work (it works at the lowest common denominator.
  - Shading, however, does not have the same effect on systems with microinverters, which is one of the main reasons that microinverters are utilized. This approach preserves efficiency of the overall system despite periodic shading, as each solar panel is maximized by its own inverter. Additionally, companies are now producing dual-channel central inverters that can address the same type of situation and minimize shading losses.
  - In conclusion, assumptions should not be made about shade impacts without more in-depth information. Understanding the impacts of shading is beyond the expertise of the appraiser. Therefore, if the contributory value of the system is crucial to the appraisal, the appraiser will either need to have the system performance tested by a qualified individual, or the appraiser will need to disclose through extraordinary assumptions, conclusions s/he ise making about the performance of the system.

- **Inverter**
  - The most common type of inverter is a wall-mounted unit, which has been around about for 30 years. However, in the last five years, microinverters have emerged on the market. Microinverters are small inverters mounted directly under each panel on the roof. Mircoinverters are extremely appealing, as they come standard with very elaborate, computer-based monitoring systems that are not available with the wall-mounted inverters (although wall-mounted inverters will have to upgrade to have this feature).
  - For example, in some wall-mounted units, the appraiser can tap the front panel to backlight the display screen. With each additional tap, the screen will cycle through the information that is available on the system. In this way the appraiser can see how large of a system this inverter services, how much energy it has produced today, how much energy it has produced over a lifetime, and other performance measures.. If there is more than one inverter, the appraiser should tap through the screen on each system and add all the output figures together to determine what the entire PV system is generating. The lifetime number of kWhs produced would be good information to compare to the figures generated when using the PV Value tool (which will be discussed

later in this report). If the numbers are radically different, something may not be functioning correctly in the system.

- **What is the age of the inverter(s)?**
    - Typically, the appraiser will need to ask the homeowner how old the inverter is. If this information is not available, the appraiser can reasonably estimate the age of the inverter if s/he has access to the permit information. Since an inverter is warranted for 10 years (and most microinverters are warranted for 25 years), it is typically acceptable for the appraiser to assume the inverter is the same age as the PV panels if the entire system is less than 10 years old.
    - It is typical for the inverters to have shorter warranty periods than the panels. The inverters have many electrical components (which do wear out) and do most of the "heavy lifting" when it comes to inverting DC to AC. It is reasonable to expect that this component will not last nearly as long as the panels do. The age of the inverter is important because the cost to replace one figures into the value of the income stream when using the PV Value tool.

- **What rebates/incentives are associated with the system?**
    - Rebates and incentives are taken into consideration when developing the current costs as of the effective date of the appraised value. Therefore, regardless of what the incentives were at the time the system was installed, the appraiser should be researching what the rebates and incentives are as of the effective date of the appraisal. Current incentive information can be obtained at www.dsireusa.org.
    - If working on an appraisal with a retroactive value, this information is not always available. While www.dsireusa.org has current incentive data, it was not possible to locate retroactive incentive data (i.e. dates and specific details). All of the case studies have different effective dates, being the dates each property closed and sold. It was not possible to know the exact incentives available for each effective date. This was a limitation of the data available for this study.
    - One exception is in the case of Performance Based Incentives (PBIs). If a system has PBIs, those figures should be the exact rebate amount associated with the system and not the PBI's available as of the effective date of the appraisal. PBIs create income and are not just a one-time rebate or one-time incentive.

- **What utility savings are realized by the homeowner?**
    - While different homeowners use electricity at varying levels, utility savings were still a data point that was often mentioned by real estate agents and builders. Xcel Energy's utility costs for individual homeowners are not public information in Colorado, and, as a result, the only way to obtain this information is by contacting the homeowner or listing agent who may be able to disclose it.

- While useful information, the actual dollar amount saved is not a necessary piece of information an *appraiser* needs in order to calculate the potential value of a PV system. The information, did, however, prove to be a data piece that provided insight into the minds of market participants. After many interviews with agents, it was clear that many buyers took the utility savings amount into account when looking at their monthly expenses associated with owning a home. Often, homebuyers used the past homeowners bills to estimate how much money they would save per month, even if, in reality, the homeowner and the homebuyer would likely use electricity at different rates.

How Long Do PV systems Last?

PV panels degenerate at a very slow rate over time.

Currently, most manufacturer performance warranties for PV panels average 25 years[51]. Does this mean the PV panels will be fully degraded in 25 years' time? No. These warranties guarantee that the PV system will be operating with at least 80% productivity after 25 years. In conclusion, while the panels degenerate, they actually degenerate at a very slow rate. Thus, the manufacturer warranty is typically not a good indicator of the actual physical life expectancy of PV panels.

So how long do they actually last? According to one delightful quote from Joel Davidson[52], a PV installer: "*A PV cell is a rock*[53] *that makes electricity. Unless something corrodes the electrical contacts, it will still keep working."* Since there are no moving parts in a PV system, there is a general expectation that the panels will last longer than 25 years.

However, since most PV panel systems today were built in the last 10 years; they have not been in service long enough to determine what their actual, physical lifespan will be. One interesting study from 2010 featured a homeowner testing his 30 year old Arco Solar 33-watt PV Panel. After 30 years, the panel was still performing to factory specifications and had minimal degradation. One additional study found that after 20 years, a 10kW PV system (comprised of 37 watt panels) had degenerated only .2% each year between 1983 and 2002[54]. In fact, it is reasonable to assume the panels will continue to make electricity for at least 50 years.

However, insufficient time has passed to conclude the precise known physical lifespan of PV panels. Even so, the actual physical life of the PV panels is not relevant for appraising purposes. Appraisers are concerned with how long a PV system is considered to be useful especially if the useful life is much shorter than the expected physical life. For the purposes of this study, an estimated useful lifespan estimate of 25 years is used (this is the warranty period of the panels themselves). This is because technology is ever changing, especially with regard to electrical equipment. What may be considered efficient and adequate today, most likely will not be in 25 years.

The 25- year estimated useful lifespan, however, only applies to the panels. As noted, inverters typically have a shorter expected lifespan. The wall-mounted inverter typically has a warranty life of 10 to 15 years (but may last up to 20 years). Some microinverters have warranties offered up to 25 years. As a result, over the span of 25 years, the homeowner may need to replace the inverter once, but not need to replace the panels. In conclusion, it is reasonable to conclude the physical life of the PV systems can

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[51] As per www.canadiansolar.com, the following manufactures have 25 year warranties: Suntech, First Solar, Sharp, Yingil, Trina, Canandian Solar, Hanwah Solarone, Sunpower, REC Solar and Solarworld.

[52] As taken from the article *Musings of an Energy Nerd*, by Martin Holladay, May 2010

[53] The silicon in the solar panels is derived from sand, thus, his reference to a PV cell being a "rock".

[54] CAT Information Service, *How Long do Solar Electric PV panels last?,* published date unknown

be at least 25 years and should be extended to 50 years, while their useful life[55] is typically considered to be 25 years.

At the end of 25 years of useful life of the PV system, it is probable that the home will require a new roof. At this point in time, given that technology will have advanced, it is likely that most homeowners would opt to install a new PV system, which would likely have an increased productivity level, rather than reinstall the old one on the new roof , assuming the homeowners wish to continue to have a PV system[56].

What Sizes Are Available for PV Systems?

For residential properties, systems tend to range from 2 kW to 10 kW. A kW is an instantaneous power rating, which refers to the potential power that the system is capable of producing at any one given moment. Therefore, a 2 kW system does not produce 2 kWs of electricity all the time, it only produces that amount under certain conditions.

There is often considerable confusion regarding the terms “kilowatt” and “kilowatt hour.” A watt is a unit of electrical energy, as determined by James Watt in 1889. A kilowatt (kW) is equal to 1,000 watts. As described above, the watt and the kilowatt are measurements of instantaneous power. When one flips a light switch, the power required to power the bulb instantaneously is the wattage. In the case of a 60-watt light bulb, turning on the bulb requires 60 watts of electricity. For a 1,000 watt (1 kW) space heater, the instantaneous demand is 1 kW. In the same way, a 2 kW solar system is capable of producing 2,000 watts of energy instantaneously.

When a time component is added, the watt hour and the kilowatt hour(kWh) come into play. If the 60-watt light bulb remains on for five hours, it will consume 300 watt hours (i.e. 60-watts X 5 hours = 300 watt hours). In the same way, a 2 kW solar system is capable of producing 10,000 watt-hours (10 kWhs) in that same five hour period (i.e. 2000 watts X 5 hours =10,000 watt hours = 10 kWhs).

While the potential of a solar system is measured in kilowatts (kW), the production of a PV system is measured in kWhs. Our energy consumption is also measured and billed by our utility company in kWhs.

Thus, every 2 kW PV system can potentially produce different amounts of electricity, based on many different factors (for example, weather, location and tilt towards the sun). However, while it is true that

[55] “Physical life” is how long a component of a property will physically last, “Useful life” is how long a property component is expected to perform the function it was designed for (based on changing technologies, etc.). A PV may be able to physically last 50 years, but the owner might only be planning to use it for 25 years, than get a new system with the latest features.

[56] As per Whitney Painter, photovoltaic installer: “*As fossil fuel availability decreases and the cost of these fuels increase, experts predict that electricity will become a very valuable commodity in 25 years. This supposition is based on today’s cost of electricity, but given the statistically projected increase in fossil fuel costs, we can expect that any device capable of generating free electricity will be valuable 25 years from now, rather than landfill fodder*.”

each system produces a different amount of electricity, there are some general statements that can be made about how much electricity is produced by PV systems in the study market-area.

Given the current cost of energy and the average number of peak sun hours per day[57], agents interviewed for this study generally indicated a perceived savings (if averaged over the course of a year) of around $30 per month for a 2- to 4 kW system, $60 per month for a 5-to 6 kW system and around $110 per month for a 10 kW system. These figures are a very loose correlation to individual PV systems, but assist in understanding how much the PV system can contribute to a household. These figures are based on the average current utility costs of $0.11 per kWh for residential properties in the Denver metro area.

In the study area, the average household can meet all of its electricity demands with a 5 kW to 6 kW solar system. While many homes do have 10 kW systems, this is not the average size for a homeowner. A 10 kW solar system typically generates an average of 1,300 kWhs per month. The typical household in the study area only consumes about 711 kWhs per month. Thus, a 10kW system is typically above the average for what is needed in this market area.

[57] A Peak Sun Hour is the maximum solar irradiance available at a particular location on a clear day. The market area used in this study averages around 5 hours per day for the year.

Concerns about PV Systems in General

Energy Costs to Build and Instal

One concern noted by potential buyers of PV systems was about whether the system required more energy to manufacture and install, compared to the savings they would generate during a useful lifetime. This was not found to be the case. In the Boulder area, one source stated that the average time it took for the PV system to produce as much energy as it took to build the system, was approximately 3 years[58]. Another source (NREL) stated that this time period actually varied by manufacturer, and that some manufacturers had time periods as low as 18 months. In conclusion, this was an unfounded concern.

Appearance

Newer PV systems in this market area lay parallel to the roof. It is not typical for the systems in this area to be on tilt bars (since Colorado homes typically have 4/12 or 5/12 pitched roofs). Thus, in the more than 100 interviews conducted for this study, only one party cited concerns about the PV system having a negative appearance. All other parties had either no negative concerns about its appearance or felt it was a positive feature because it gave them visible “bragging rights” (i.e. the system offered a way for the homeowner to be identified as someone with environmental concerns or energy conservation concerns). In other words, a visible PV system is a way to communicate something about your beliefs (kind of like driving a fuel-efficient vehicle that the neighbors will notice) without having to directly state them. Also, the panels currently being produced do have a very sleek and modern look to them (as this was something several real estate agents commented on).

In conclusion, PV panels under 10 years of age are felt to be generally visually appealing in this market area. However, this should be tracked over time to see if attitudes change about the appearance of today’s PV panels as new technologies and profiles become available.

Maintenance & Repair Costs

Minimal maintenance is required on a PV system. Typical maintenance includes: trimming any trees that may grow and cause shading over the years, periodically washing the panels with de-ionized water (though, in the Colorado climate it is unnecessary to wash the panels)[59], dealing with any bird nesting under the panels and/or repairing wires if animals chew on them. No other maintenance is expected if the system performs as designed, though failure of a module or inverter can occur and wiring issues can occur if not installed properly.

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[58] Per the two data sources: www.appropedia.org, *LCA of silicon PV panels* and *Application of Life-cycle Energy Analysis to Photovoltaic Module Design,* by John Wiley and Sons, Ltd, 1997.

[59] Buglet Solar Installations has studied this extensively and monitored the results of washing panels vs. allowing precipitation to take care of it. No measureable difference in production was noted.

With regard to costs, the owner can expect to replace a central inverter once every 10- to 15 years or so (this cost varies by inverter type and size, though some estimates are between $998.75 (for a 2.0 kW inverter[60]) and $2,952 (for a 4.8 kW inverter[61]). Like other electrical equipment, these costs are expected to decrease over time. By the time today's newly installed solar systems require inverter replacement, these costs are expected to be lower.

The only other anticipated cost would occur if the owner had to remove the panels to replace the roof. This will vary by job difficulty and system size, but currently averages around $2,500[62]. If roof replacement occurs as part of an insurance claim for hail or other damage to the roofing material, the cost of removing and reinstalling the solar system generally is covered by homeowners insurance (assuming the panels are owned and not leased. If they are leased, the lease will spell out what will be done in this circumstance). One side note: If the panels are removed for any other reason, the removal will result in damage to the roof (by leaving penetrations in the roofing material). The roof can then be patched, or at the option of the homeowner, replaced.

Even though maintenance costs are extremely minimal, numerous real estate agents interviewed for this study stated that potential buyers often had concerns about maintenance costs. The real estate agents who stated this concern could be divided into two groups: (1) those who went on to educate the potential buyers about maintenance costs and (2) those who did not understand maintenance costs themselves. In the first group, they were careful to state that upon education, these fears and concerns were typically eliminated. In the second group, they went on to note that in several instances, the potential buyers decided not to purchase the property.

Therefore, the conclusion can be drawn that educating potential buyers had somewhere between a neutral and a positive impact on the buying experience and NOT educating the buyers about maintenance costs had a negative impact on the buying experience.

How Much Energy They Produce

Energy production is not a constant. The amount of energy each PV system will produce and save will vary by system size, location, weather, tilt towards the sun, age, azimuth, type of panels, and other factors. Also, every homeowner uses electricity differently. What is adequate for one family may not be adequate for another family.

It was noted in this study that if listing agents of properties with PV made an effort to disclose the utility bills associated with the property, this had varying degrees of impact. The agents often reported this was a large selling point when the utility bills were very small (i.e. less than $50 a month on average). If,

[60] PV Powered PVP2000-SD-240 2.0 kW Inverter cost as of April, 2013
[61] PV Powered PVP4800-SD-240 4.8 kW Inverter cost as of April, 2013
[62] Per Whitney Painter of Buglet Solar, this is the estimated cost to remove and replace the PV system as of April, 2013.

on the other hand, the utility bills only reflected a minor reduction in average monthly costs (say, a yearly average savings of $30 per month), then buyers tended to place a very small emphasis on the added benefits of having the PV system. The survey of listing agents suggests buyers do care about utility costs, and this suggests the income approach is an applicable approach to value.

How Much Electricity Most People Uuse

Energy usage varies from property to property and from one owner to another. Despite the common assumption that a certain square footage home requires a certain amount of electricity, electricity usage is dependent upon behavior rather than building size.

That said, Xcel Energy states an average single-family residence uses between 700 and 1000 kWh per month[63] in this market area (while census data states the average usage is 711 kWh per month). In this market area, utility information on individual households is not public information, thus, without a homeowner's consent, it is not possible to obtain specific utility information for specific homes. This information, however, would be very useful for appraisers in order to compare one property's energy costs to another. Ideally, sellers could give consent for buyers to click a "green energy button" on the utility website showing all relevant energy data pertaining to the property being researched.

When utility information is not available to the appraiser, one alternative to estimating utility costs for a specific house is to access the following website: www.hesprolbl.gov . This website allows the user to input the address of a specific property as well as specific information regarding the structure for that specific property, and *estimate* the probable energy usage expected for that home. The more specific information that is known about a property, the more accurate the estimate will be. When comparing the figures generated to actual energy usage, it did vary a fair amount, but again, this is mainly because people use energy- houses do not. Computer software cannot exactly know each homeowner's energy usage habits. Therefore, the information from this web site served only as a very broad data-point for the case studies noted herein.

For illustrative purposes only, permission was obtained to disclose the energy usage for one household in the study area over the past year. This one household consists of two adults and one minor child. The occupants have no particular energy-efficient practices in place, noPV system and no Energy Star appliances. The information for their property is noted on the following pages:

[63] *Guide to Home Energy Savings*, Xcel Energy

Benchmark property location: Broomfield, Co 80020			
Year Built:	1993	**Style/Type:**	Two Story/Tract home
Assessed Value:	$346,530	**Quality of Construction:**	Average to Good
Above Grade Sq.ft.:	2554	**Garage Type:**	3 car tandem, built-in
Bed Count:	4 plus study	**Bath Count**	2.5
Basement Sq.ft.:	1304	**Basement finish:**	Unfinished
Heating Type:	Gas Forced Air	**Cooling type:**	Air Conditioning
Furnace:	19 years old, 80% operating efficiency	**Air Conditioner:**	16 years old, 4.0 ton 10 seer
Air Leakage in home:	19% of heating and cooling energy is lost through leakage	**Appliances:**	dryer, washer, refrigerator and dishwasher
Insulation:	Ceiling: R34 Walls: R7 Floor: R0	**Hot water heater:**	19 years old 53% energy efficient

Energy Usage by current homeowner (electricity only)			
Time Period	**Kwh Usage/Month**	**Avg. Daily Temperature**	**Cost**
January 2012	1167	31 degrees	$126.49
February 2012	948	39 degrees	$98.06
March 2012	907	31 degrees	$93.25
April	740	48 degrees	$77.44
May	519	55 degrees	$56.20
June	603	59 degrees	$65.74
July	1078	72 degrees	$136.35
August	1554	78 degrees	$214.93
September	1331	74 degrees	$188.10
October 2012	1056	71 degrees	$139.96
November 2012	652	54 degrees	$75.64
December 2012	725	46 degrees	$82.14
TOTAL per YEAR	**11,280 Kwh**		**$1,354.30**

In conclusion, this particular homeowner averages about1000 kWh per month for an average cost of about $112 per month, or $0.12 per kW (this figure includes summer tiered rates of $0.15 per kWh above 500 kWhs of usage, taxes and fees).

How would a solar PV system impact the electric utility billing of the above property? For an answer to this question, the following information was provided (all figures are from Buglet Solar Electric Installation, with exception of the Present Value of Future Energy Production based on my inputs into the PV Value application):

SAMPLE PV SYSTEM FOR BENCHMARK PROPERTY (to offset 100% of utility costs)

SYSTEM SPECIFICTIONS (30 LG Electronics 230 watt-panels, SMA inverter)	
Peak System Capacity	7.8 kW
Estimated Energy Production	11,400 kWh per year
Guaranteed payment from Xcel for all energy produced ("PBI"[64])	$0.09 per kWh generated for the first 10 years

FINANCIAL SUMMARY	
Panels (25 year warranty)	$9,750
Inverter (10 year warranty)	$3,720
Racks	$3,900
Other materials, Structural Report, Building Permit fee, Xcel Energy Fee, Shipping	$2,260
Labor	$6,100
TOTAL	$25,730 (plus sales tax)
Estimated Federal Tax Credit	-$7,719
TOTAL cost after Federal Tax Credit	$18,011 (plus sales tax)

MONETARY BENEFITS SUMMARY ("PBI")

Estimated Annual Payments from Xcel (per PV Value)

YEAR	PAYMENT		YEAR	PAYMENT
1	$948.92		6	$757.06
2	$907.05		7	$723.57
3	$867.01		8	$691.53
4	$828.71		9	$660.90
5	$792.09		10	$631.61

Present Value** of Annual Payments from Xcel	$7,582.01

Present Value of Future Energy (per PV Value)**[65]	
Present Value of Future Energy (energy generated over the next 25 years)	$18,602.32

***NOTE to commercial appraisers: The present value being calculated here is not your typical present value calculation; please visit the section of this study that describes in detail what the PV Value tool is, how it is used in this study and how to use it to calculate a present value figure relating to energy production.*

[64] PBI stands for "Performance Based Incentive"

[65] Figures used to generate value estimates were: 3.59% discount rate (current Fannie Mae lending rate), 125 basis points (market derived average), $0.09 utility rate (current PBI offered by Xcel). This is for a net metering system with 10 years of guaranteed PBI payments.
PRESENT VALUE vs. NET PRESENT VALUE: *Present value* is the result of discounting future amounts to the present. For example, a cash amount of $10,000 received at the end of 5 years will have a *present value* of $6,210 if the future amount is discounted at 10% compounded annually. *Net present value* is the present value of the cash inflows *minus* the present value of the cash outflows. In relation to this study, net present value is used as a feasibility tool and is most often used by investors to determine if purchasing an item will meet their goals.
PRESENT VALUE vs. MARKET VALUE: See Appendix C for the definition of Market Value. Present Value is the "The current worth of a future sum of money or stream of cash flows given a specified rate of return." In other words, market value is what the market will pay (as of a specific date) and the present value is the perceived worth (but not necessarily what the market will pay). In relation to this study, the market value considers the present value of the energy produced.

Average Net Present Value	
Total cost (after incentive): $25,730 - $7,719 =	$18,011 (plus sales tax)
Present Value of Future Energy	$18,602.32
Monetary Benefits of PBI:	$7,582.01
Total Cost PLUS Present Value of Energy & PBI Payments (not including sales tax):	(-$18,011) + $18,602.32 + $7,582.01 = $8,173 net present value
Since this is a 7.8 kW system, the current net present value per kW is $8,173/7.8 kW=	$1,047 per kW

The above example is provided to help the appraiser understand exactly what types of costs and benefits are associated with a PV system. The net present value is not the appraised value of the system. The appraised market value will be developed by the market area's reaction to the system in terms of the amount paid for the real estate.

The Monetary Value of the PV System

When homeowners decide to purchase a PV system, they will typically take into consideration three things (listed in no particular order):

1) *How much the PV system will contribute to the value of their home.*
2) *How long it will take to realize a payback[66] on their investment.*
3) *How much money they will save per month in utility costs*

Concerns (1), (2) and (3) are typically the concerns of those who purchase PV systems and install them on their homes, while those who buy homes with PV systems already installed on them; typically only take (1) and (3) into consideration (these justify using the income approach since buyers are considering money saved by producing their own energy).

CONCERN 1: How much the PV system will contribute to the market value of their home

This case study demonstrates there is not one answer to that question. Every answer is unique to both the property being appraised, and the effective date of the appraisal. There will never be a set "formula" for determining the contributory value of a PV system (as is true of virtually every feature in a home and in every market area). Appraising is not a set formula. It is a continual interpretation of the actions of market participants. Thus, the value contribution of one particular feature will continually evolve and change with market demands. It must be noted that some features may hold a very stable value in one market area and/or for one particular type of home, but a similar home in a different market area may not realize the same contributory value of that feature. No feature contributes value in all circumstances, and those features that do contribute value may contribute different values at different times[67].

Upon completing research for this study, it was noted that numerous PV installers market their PV systems by including a statement about how much the PV system contributes to the value of a home. These statements should typically not be given any weight for those who seek to understand how a PV system would contribute to the market value[68] of their property. Without a qualified and competent appraiser (1) defining the word "value," (2) disclosing an effective date for that value and (3) deriving an opinion of contributory value by performing adequate market research, the "value" opinion has no context or worth in relation to "market value." Even so, this does provide further evidence that when buyers are making decisions about purchasing PV systems from installers, they are mainly considering the energy production (and utility savings), and the actual cost of the system.

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[66] This includes taking into consideration financial incentives realized through the Solar*Rewards program and the federal tax credit on renewable energy systems.
[67] "Time" being a loose reference to the passage of time. Some features may see their contributory value change in a matter of weeks, others may not see their contributory value change for numerous years.
[68] The definition of market value is contained in the appendix of this report.

CONCERN 2: How long it will take to realize a payback on their investment

Return on investment ("ROI") analyses are typically provided to the homeowners by installers of PV systems. While installers do provide ROIs to the buyers of PV systems, the vast majority of *homebuyers* looking to purchase residential homes do not run an ROI analysis. Thus, the appraiser should use the methods the market itself uses to develop an opinion of market value for a particular property (or feature).

To run an ROI analysis one would need to understand mortgage rates, current utility rates, utility escalation rates, yearly rebates, Xcel's two-tiered billing rates in the summer months, what impacts the energy production of the PV system, how large their PV system is, how much energy the owner expects to use, how long the rebates last (and how to adjust the calculations once the rebates expire in 10 years), and how much degradation a PV system experiences every year. In other words: it is complex.

As an alternative, the appraiser (and the homeowner) can use the PV Value software application (a valuation tool that will be discussed later in this report) to determine how long the payback period would be.

CONCERN 3: How much money they will save per month in utility costs

This was probably the largest topic of discussion in this market area. There are many features about a PV system that can be marketed, such as using renewable energy, decreasing the impact on non-renewable energy sources, social responsibility, low maintenance and providing electricity. Builders and real estate agents continually remarked that while they could discuss all of these various features, only a few very specific buyers were interested in these benefits. However, once it was pointed out to homebuyers that they would be saving money on their utility bills, they were at full attention. Again, this supports the use of the income approach as an applicable method for determining the market value of a PV system.

As discussed earlier, there was no need to provide homeowners withl elaborate calculations on the precise and exact amount of money they could save every month. Rather, simple statements such as the following were sufficient to satisfy most buyers:

- "Utility bills are only $5 per month."
- "Homeowner saved nearly 50% on utility bills"
- "Low, low energy bills."

In addition, numerous listing agents stated that merely providing a summary sheet of the utility savings that were realized in the last year was enough to spark a real interest in the PV system (and typically resulted in the buyer wanting to know more details about maintenance, durability and other details). This, again, is why the disclosure of PV system specifications is so important: the details of the PV system will assist not only the appraisers, but also the homeowners and agents in marketing the property. Education of the public was found to be very important with regards to the valuation of PV systems.

In conclusion, this market area does appreciate a summary statement of energy saved, but is happy with a loose understanding of how the system can generally help them save money. Given that the average homeowner spends about $100 per month on electricity, it is easy to see that any savings on this bill would be appreciated, but would not result in the need for the homebuyer to be assured of an exact savings amount. In other words, a savings differential of $10-$20 per month would not impact a typical buyer's purchasing decisions when it comes to buying a home (especially given that the average homebuyer in this market area finances an average mortgage amount of over $220,000[69]). Just knowing that a PV system saves homebuyers money in one of the three following groupings[70]: $20-$30, $50-$70, or over $100 each month (on average) is sufficient information.

[69] www.Lendingtree.com

[70] These precise groupings are not market-derived, they were just chosen for illustrative purposes. The market did not show a preference for any precise dollar ranges, rather, they simple showed an interest in *relative* savings.

Purchasing/Leasing a PV System

In the study's market area, PV systems can be paid for either by an outright purchase of the system, with a solar lease, or with a power purchase agreement(PPA). While the homes used for the case studies in this report all have PV systems that are owned, it was important to describe some of the differences between buying and leasing a PV system.

The exact terms and conditions of specific solar leases and PPA's vary. Some of the general differences are noted below.

Differences between a PV Purchase, Solar Lease and Power Purchase Agreement[71]

	Purchase *(this includes financing the system with a home equity loan, etc.)*	**Solar Lease**	**Power Purchase Agreement**
Cost	Pay in full upfront (or the homeowner gets a loan from a bank or financial institution).	Pay a set monthly lease payment, regardless of the amount of power generated by the homeowners system.	Homeowner agrees to buy the power generated from your system. The purchase rate is typically defined per watt produced, with an annual escalation rate.
Payment escalation	n/a	Some leases include a percentage escalator over time, rather than matching the lease payments directly to the anticipated energy costs.	n/a
Fees (other than maintenance and repair costs)	After the system is purchased, there are no fees (except maybe interest on any applicable loan payment).	At the beginning of the lease, the fees typically are commensurate with the amount of energy saved. If energy costs increase, the monthly lease payment does not increase. This insulates against rising energy costs.	At the beginning of the PPA, the fees typically are commensurate with the amount of energy saved. The PPA features a predictable escalator based on the anticipated rate of increasing energy costs and thus, insulates the homeowner against rising energy costs.
Loan Qualification	Varies. May not be applicable if buyer is paying cash.	Must have an very high credit rating (over 660)	Must have a very high credit rating (over 660)
Who owns the system	Homeowner does.	The leasing company does.	The PPA company does.
Incentive/Rebates	Homeowner keeps them.	The leasing company keeps them.	The PPA company keeps them. Sometimes the leasing company will allow the homeowner to keep any Solar Renewable Energy Credits(REC's). NOTE: IF however, the PPA is financed in part by Xcel

[71] While this specific table did not come from Energy Sage, Energy Sage does have a similar format and provides a much more in-depth discussion of the differences between a PPA, a lease and the purchase of a PV system. They can be found at www.energysage.com/solar-lease/lease-ppa-whats-the-difference

			Energy's Solar*Rewards program, Xcel utilizes the RECs associated with the system for 20 years.
How long the agreement lasts	There is no agreement. Homeowner owns the system. If, however, the homeowner has an agreement with Xcel, then they must keep the system as long as that agreement is in place. After the agreement ends, the homeowner can do as they see fit with both the system and the (RECs)[72], which revert to the owner of the system at the end of the 20 years.	Typically 20 years. At the end of the 20 year agreement, the system owner retains ownership of the (RECs) associated with the system. If the agreement is continued, the RECs are owned by the lessor.	Typically 20 years. At the end of the 20-year agreement, the system owner retains ownership of the RECs. If the agreement is continued, the RECs are owned by the PPA company.
Maintenance & Repairs	Homeowner pays for them.	The leasing company pays for them.	The PPA company pays for them.
What you can do when the lease/PPA ends	Trade RECs on a carbon trading market and continue to generate free electricity in perpetuity.	Buy the system at the price stated in the contract, or, have the leasing company remove the system at no cost, or, renew the lease. Typically, the lease does not state the price for the buy-out at the end of the term, rather, they often refer to the "market value" of the system.	Buy the system at the price stated in the contract, or, have the PPA company remove the system at no cost, or, renew the agreement.
What to do when selling house before lease/PPA expires	Nothing: there is no lease or PPA.	The lease will determine this. Sometimes the homeowner can purchase the system. Sometimes the new homeowner can take over the lease. Often the homeowner ends up paying off the remaining lease payments in order to sell the home.	The PPA will determine this. Sometimes the homeowner can purchase the system. Sometimes the new homeowner can take over the PPA. Often the homeowner ends up paying off the remaining terms of the PPA in order to sell the home.
Marketability	As will be demonstrated in this study, owned PV systems typically increased the marketability of homes in the study market-area.	There were many instances in which the lender required the lease to be paid off before closing. Realtor's mentioned many instances in which the leases were a "hassle". If the homebuyer was to assume the loan, the lease typically required the purchaser to have a credit rating over 660.	Realtors typically did not know the difference between a PPA and a lease, and, thus, reacted to PPA's the same why they reacted to leases. See comments to the left.

While there are differences between a purchase, a solar lease and a PPA, this market area did not appear to distinguish between a system that was purchased outright and one that had either a PPA or a solar lease. Rather, agents and homebuyers referred to the PV systems as being either "owned" or "leased." The market, in other words, did distinguish a system as being owned or not, but it did not distinguish between a s*olar lease* and a *PPA*.

Based on feedback provided by agents, the leases (and PPA') typically do not have the same positive impact on value and marketability as PV systems that are *owned*. In many instances, agents commented on the negative issues surrounding trying to sell a home with a lease. This was certainly not the case for all home sales; however, it was the overriding observation. Note: for the purposes of this study, only PV systems that were owned were studied; however, comments from agents regarding leased systems were still sought out for general data and comparative purposes.

PART 3: Appraisal Methods

Introduction to Appraisal Methods

In this case study, various appraisal methods and tools were considered. Some were considered and abandoned as not applicable to specific case studies, while others were considered relevant and applicable. In order to understand which methods were considered, a summary presented below. Then, in the case study section, an explanation will be given as to which methods and appraisal tools worked for which case study.

MLS Listings

MLS listings were the very first place data was researched. The MLS listings provided a clear framework for how many properties were available to study and how the market was talking about and perceiving PV systems. This appraisal database was invaluable and was considered to be a key element to understanding the overall impact of PV systems on marketability and value.

The minor negative with the local MLS systems was the infrequent use by real estate agents of the Green MLS fields (which made it difficult to locate which properties did or did not have PV systems). Over time, if PV systems gain importance in the market area, it is assumed that area real estate agents will use these Green MLS fields to disclose whether or not a property has a PV system, and a separate field will disclose the size of the system. It should become easier over time to gather PV data, but this study, it proved very time consuming just to find properties that had PV systems. Even so, the MLS was an invaluable resource for these case studies.

Interviews with Real Estate Agents

To conduct this study, attempts were made to reach nearly 200 real estate agents for their feedback and input. Of those 200, nearly 70% responded. This, then, proved to be one of the most fruitful and useful research tools. The listing and selling agents provided extremely useful feedback and information. This is a highly recommended appraisal tool that proved to be one of the backbones of the entire study.

The only weakness in this approach is that the conversations were not the result of formal interviews. Rather, they were free-flowing discussions. As a result, information was more fluid and answers to posed questions were not always straight-forward and easily categorized. Thus, it was necessary to sometimes make inferences about what each real estate agent was saying.

Homeowner Surveys

With cooperation from the Colorado Energy Office, a survey was written and sent to just under 40 homeowners who purchased homes with PV systems (both leased and owned). A copy of that survey is contained in Appendix D. Seven of these surveys were returned.

Most appraisers will probably not have the time to conduct formal surveys; however, the survey questions can serve as a general guide when appraisers are interviewing homeowners during the inspection phase of the appraisal.

A drawback of the survey process was that most surveys were not returned. Those that were returned were done so anonymously and thus, could not be tied directly to a specific property. This was by design as the goal was to maintain the homeowner's privacy. While only seven surveys were returned, they provided excellent insight into the overall mindset of buyers who purchased homes with PV systems installed on them.

A summary of those three surveys is provided below:

- Five indicated the PV system was a positive feature. Two indicated the PV system was "between a neutral and a positive" feature.
- With regard to how important the PV system was, the following 7 responses were received:

"It was important"	"It was moderately important"
"It was a plus"	"It was a plus"
"It was pretty important"	"Not very important- I wanted one but the lease made me nervous"
"Nice to have but not of high importance"	

- All liked that the system was energy efficient and saved them money. Several mentioned they liked having a smaller carbon footprint and/or that the system is "Green Energy."
- The only negative comments came from one party who "wished it generated more power" and from another party who stated s/he were "concerned it covered all but one attic vent."
- Two parties liked the system more than they had when they purchased the home; the other five liked it the same as when they purchased the home; no one liked it less than when they bought the home.
- Five felt the system added monetary value to the home, while the other two felt that because they had a leased system, no value was added.
- Five felt they would look for a home with a PV system when they went to buy their next house. The remaining two had leased systems and would either look for a system that was not leased, or did not place a high importance on having one.
- Only one party knew the size of their PV system.
- Six felt the PV system positively influenced their decision to buy the house.

- Two parties felt they could afford a larger mortgage because they saved on utility bills (these parties had systems that covered at least half of their electric bills). The other parties did not feel they could afford a larger mortgage because they saved on utility bills (these other parties had much smaller systems that saved only about $20 to $50 per month).
- Each of the respondents marked which home features were MORE, LESS or of EQUAL importance to having a PV system. Those responses are tallied below[73]:

	MORE	LESS	EQUAL		MORE	LESS	EQUAL
Location	●●●●●●●			School	●●●	●	●●●
View		●●●	●●	Deck/Patio/Porch	●●●	●●●	
Updating	●●●		●●●	Price	●●●●●●●		
Garage (size)	●●●	●●●		Square Footage of home	●●●●●●●		
Fireplace		●●●●	●●	Basement	●●●●●	●●	
Number of bedrooms	●●●●●●		●	Basement features (finished, walkout, etc.)	●●●●	●●	●
Number of bathrooms	●●●●●●	●		Energy Efficiency	●●		●●●●
Condition of home	●●●●●●●			Size of lot	●●	●●●	●
Den/Study	●●	●●●	●●	Big kitchen	●●●●	●	●
Formal Dining Room	●	●●●●●		Architectural Details of the house	●●●●●		●
Instant hot water	●	●●●	●●	Newer windows	●●●		●●●
Appliances	●●●		●●●	Flooring material (carpet, wood, etc.)	●●	●●	●●
Heating system (type and age)	●●●●		●●	Air conditioning	●●●	●	●●
Landscaping	●	●●●	●●	Green Features	●		●●●●●

In summary, the following features clearly had a ***higher value*** to homeowners than having a PV system:

Location	Price	Architectural details of home
Number of Bedrooms	Square footage of home	Basement features
Number of Bathrooms	Basement	Big Kitchen

In summary, the following features clearly had a ***lower value*** to homeowners than having a PV system:

Fireplace	Formal Dining		

[73] Some responses only add up to less than 7. This is because not every respondent filled out every section of the survey.

In summary, the following features had a mixed level of importance to homeowners as compared to having a PV system:

View	Instant Hot Water	School	Newer windows
Updating	Appliances	Deck	Flooring material
Garage	Landscaping	Size of lot	Air conditioning

While a sample size of seven is not enough to place any relevance on the survey's findings, the appraiser should keep the above research points in mind when developing the value opinion for a PV system.

The Residential Green and Energy Efficient Addendum

The *Residential Green and Energy Efficient Addendum* was designed mainly by Sandra K. Adomatis, SRA, LEED GA in cooperation with the Appraisal Institute and other market participants. This is a very useful reporting tool to convey facts not only about green features, but, also about the specific PV system a homeowner has. The addendum, however, was not able to be utilized for this study. This form is designed for anyone with knowledge of the PV system to fill out and disclose the relevant green and energy-efficient features of their particular home. Since contact with homeowners or persons in possession of the necessary knowledge about the PV system was minimal for this study, it was not feasible to use the addendum for this study.

In most circumstances, the Residential Green and Energy Efficient Addendum will be a useful way for appraisers to collect PV data pertaining to the home they are appraising. The form will not, however, typically be able to be utilized when trying to collect the PV specific data for a comparable sale unless, for example, the filled out form is attached to the MLS listing in some way.

PV Value® (Using The Income Approach)

PV Value is an appraisal tool that is new to most residential appraisers and is explained in detail below.

Beyond the social benefits of having a PV system (such as decreasing the nation's dependence on oil, coal, and natural gas; and reusing renewable energy sources) an operable PV system will save a homeowner money by reducing his/her out of pocket utility costs.

In a way, owning a PV system is like having an income-producing asset (without having to do anything). The sun comes up, the PV system turns sunlight into energy, and you get to use the income from that energy tax-free. As a result, you don't have to pay someone else (the utility company) to use their energy[74]. Since, since you do not have to pay for some (or all) of your electricity costs, you can now allocate that money to something else. For the purposes of appraising, generating electricity to offset electric utility bills is considered income.

Some residential market-areas place value on this future income. If there is an understanding that PV systems generate income over time, market area homeowners may be willing to pay one fee now for the right to own the asset and collect all of the future income.

So how does an appraiser develop a value opinion for this income stream?

Research was done to determine which methods the defined market area was using to calculate the value of this "income" stream. After speaking with many area builders, consulting PV installer websites, talking to real estate agents and having a few discussions with homeowners, one thing became clear: buyers either did not make any specific mathematical calculations, or, if they did, they were typically using incomplete (or inaccurate) methods. A typical flaw in the vast majority of these calculations was that they were generally too simplistic, and did not adequately account for all the variables that go into estimating energy production. Thus, the market itself is trying to mathematically calculate the present value of this future income- it just does not know how. The above information builds a case supporting the use of the discount cash flow method (which is what PV Value utilizes).

Herein lies the dilemma: the appraiser's job is to use only appraisal methods that reflect how the market is developing the value of the income but the market has not figured out *how* to make these calculations. While there are many financial analysis methods available to calculate the value of an asset and its corresponding income stream (such as *Internal Rate of Return, Modified Internal Rate of Return, Simple Payback, Modified Payback or,, Return on Investment*), these are tools which are not typically used for residential appraising because they do not reflect how residential purchasers make value decisions. Thus, applying appraisal methods that are usually used only for commercial appraisal would not be a reflection of the market.

But what if the market is attempting to use math to figure out the value of the income, but hasn't determined how to do that yet? What if the market needs guidance? What solution(s) does the appraiser have?

One suggested solution is to ask the experts. The experts, in this case, are Jamie L. Johnson of Energy Sense Finance, Geoffrey T. Klise of Sandia National Laboratories and Sandra K. Adomatis, SRA, LEED GA of Adomatis Appraisal Services. Sandra K. Adomatis is a nationally known expert on appraising properties with green features ,such as those with PV systems, and was

[74] In some instances, certain PV systems have signed agreements with their utility companies where the utility company will pay you for every kWh your PV system produces (even if you use the energy yourself). So there is also the potential for an even greater income). Often, homeowners will need to pay taxes on this income.

instrumental in suggesting Geoffrey Klise and Jamie Johnson work to create an appraisal valuation tool for PV systems.

Jamie Johnson has a background in mortgage banking and asset management and initially developed an algorithm that uses the income approach to estimate the value of the income a PV system will produce. Geoff Klise from Sandia Labs worked to bring the algorithm into a proof of concept spreadsheet known as "PV Value," which can be used anywhere in the U.S. by appraisers to aid in developing an opinion of value for a PV system[75].

This Excel spreadsheet is USPAP-compliant and follows the Income Capitalization Approach to provide an appraisal range of value estimate for a specific PV system. To summarize what the tool is meant to accomplish, the following quote was taken from the user manual available for download from the website: "[*One way to find an indication of value for a PV system is to use] the income capitalization approach, which considers the present value of projected future energy production along with the estimated operating income and maintenance costs that are anticipated to occur during the PV module power production warranty timeframe."* In other words, the value of this income stream is related to the system's energy production, existing electricity rate, utility escalation rates, discount rates, the operating and maintenance expenses over the remainder of its useful life. This tool is available for free at www.pvvalue.com and is proving to be very promising as a reasonable and reliable way to estimate the present value of the future energy production of a particular PV system.

Above all other income approach tools available to the appraiser, this is currently one of the better solutions offered for how to value the income of the PV system, as it accounts for all probable variables in a simple and easy-to-use format. Since this is a newer tool and most market participants are not aware of its existence, the market is just beginning to utilize it. As it becomes better known, the belief is that it will provide one of the more well understood income approach methods available to appraisers looking to properly value the energy produced by a PV system.

PV Value was utilized for this study and its relevance and applicability to each individual case study is disclosed within each case study. For that reason, it is necessary to discuss PV Value® since it proved to be a potentially applicable appraisal tool.

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[75] www.pvvalue.com

Due to the sophistication of the tool, PV Value should only be utilized by appraisers who have taken time to:

- Understand how PV systems operate.
- Study the user manual and understand how the tool works (and how to apply it).
- Understand discounted cash flow valuation method[76].

Additionally, a word of caution when using PV Value: the tool can be very useful but can also be misleading if used incorrectly (this is true of any appraiser tool and not just of the PV Value tool). While the tool does identify a total future benefit of energy produced: it is only the appraiser (and not the PV Value tool) who can decide how much of that benefit will actually be paid by a buyer. Simply inputting data into PV Value will not be sufficient. PV Value will produce a credible calculation but the appraiser still needs to interpret what the calculation means. The relevance and applicability of that calculation can only be determined from the market.

Due to the many inputs necessary for developing the present value of future energy production, it will take practice and study to learn- especially for the residential appraisers who are not familiar with the discounted cash flow aspects of the income approach. One way for the appraiser to work towards competency in valuing PV systems is to consider taking the Appraisal Institute two-day course titled, “Residential and Commercial Valuation of Solar PV.” This course provides assistance in understanding these three components. A summary of these three requirements is outlined below.

1) Understanding How PV Systems Operate.

This has already been covered in detail in another section at the beginning of this study. The appraiser should study that section to know what to look for in a PV system. However, this study alone is not sufficient to provide the required knowledge of PV systems. Appraisers are strongly encouraged to take a solar PV valuation course.

2) Study the User Manual and Understand How the Tool Works.

Studying the user manual is a necessity as it explains why certain information about the PV system is important. It is beyond the scope of this study to explain the manual. However, there are a few new terms in the PV Value tool that merit further discussion with reference to other areas of this study. These few things will be explained below:

- **Derate factor:** A derate factor as applied to a solar PV system, encapsulates the many losses that occur from converting photons from the sun into AC electrical energy that is produced

[76] As required by USPAP.

by the PV system. The PV Value tool uses a default derate factor of 0.77[77], which is directly taken from PV Watts[78]. To fully understand why the derate factor is 0.77 and why the appraiser will have to support the need to overwrite this value from time to time (either from existing documentation on the PV system or from a certified PV installer), please refer to http://rredc.nrel.gov/solar/calculator/pvwatts/version1. As used in PV Value, the derate factor should take shading into account. So if a tree that doesn't currently shade the PV system, ends up creating shade in 10 years, the derate factor will have to be adjusted accordingly (downwards) to account for this future energy loss.

For the purposes of this study, it was necessary to assume the derate factor was 0.77 for each case study (since each property was not visited). While this is a reasonable derate factor to use, if this factor were to be higher or lower than what the PV performance indicates, this could alter the conclusions and opinions reached in this study.

- **Module Degradation Rate:** The PV system will degrade slowly over time. So for every year of life of a PV system, the amount of energy it produces decreases. The factor used by PV Value reflects a factor of 0.5% for an annual degradation rate. This degradation rate is the most common degradation rate for crystalline systems, and not thin film. If an appraiser is evaluating a thin film system, the degradation rate can be closer to 1% or more per year. Thus, the degradation rate of 0.5% is typically acceptable, unless the appraiser has more specific information about his/her particular system. This degradation rate will decrease the amount of energy production, which reduces the energy value in the present value calculation.

- **Historic Energy information:** While PV Value does not ask the appraiser to have the historic energy production data for the subject's PV system, this is a good piece of information for the appraiser to have. The appraiser can then compare the energy production amount that is estimated by PV Value to its *actual* production rate. This data can help the appraiser understand if the PV system is operating normally or not. For example, if the historical PV energy production is 17,000 kWh over the past three years, and the PV Value estimates the energy production at 23,000 kWh, the information that was input into PV Value should be verified first, and then the system should be determined to be is underreporting or underperforming. If the inverter was replaced two years ago under warranty, then the replacement inverter may not show the previous kWh production prior to replacement, causing it to underreport the kWhs produced.

[77] In the Colorado climate, unshaded systems in the real world perform much more strongly than indicated by PV Watts's predications. Rather than the .77 derate factor, most systems in Colorado perform at about a .8 derate factor (per Whitney Painter of Buglet Solar Installation). Since there was no data available for this study regarding the specific rerate factor of each case study, a derate factor of .77 was used. This had no material impact on the calculations.
[78] PV Watts® is available (for free) on the National Renewable Energy Laboratory website. It is beyond the scope of this study to explain PV Watts®, thus the appraiser should visit the website for more information.

- **Utility Rate:** The utility rate is tied to the average residential electricity rate paid in that particular service area. This information is not necessarily always current, but another source of average utility rate data is available at www.openei.com. For the most recent information, the appraiser should contact the local utility, or determine it from the homeowner's utility bill. The utility escalation rate is calculated based on a long term average using a compound annual growth rate (CAGR). This represents the state-wide growth rate for all utilities, and should only be changed if long-term utility-specific data can be gathered to calculate a CAGR with a period that matches the remaining warranty lifetime. If positive, the escalation rate has a positive influence on the value of the PV system, as the utility rate increased using the CAGR in each year of calculation.

- **Operating and Maintenance:** The only real operating and maintenance costs of significance are associated with the need to replace the inverter. Other operating expenses include trimming trees and washing the panels, both of which are extremely minimal expenses for homeowners. Inverters are currently typically warranted for 15 years. Operating and maintenance inputs in PV Value reflect an inverter replacement at 15 years. These costs reduce the value of the PV system.

  For the purposes of this study, it was necessary to make the assumption that the system was operating normally and at its expected capacity. It was necessary to make this assumption because this information was not available during the course of this study. If this assumption were to be incorrect, the conclusions and opinions reached in this study could be altered.

- **Other items of note-** When observing the PV system, the appraiser should note the condition of the system, the underlying roof condition and the presence of any shading. All of these items will impact the value developed using the income approach, as all of these items impact the PV system's ability to generate electricity at its expected capacity, or they impact maintenance expenses. If the appraiser suspects the system may not be performing up to standard and the PV Value data is a relevant indicator of market value, the appraiser should request that a system performance test be performed by a properly certified party[79].

[79] Two organizations certify installers: The North American Board of Certified Energy Practitioners (NABCEP) at www.nabcep.org and Underwriters Laboratory (UL) at www.uluniversity.us.

3) Understand Discounted Cash Flow

The PV Value modeling tool uses the "discounting" concept to determine the present value of future energy production.

Just what is discounting?

To explain discounting, let's turn to an example:

One specific PV system that is being studied is expected to generate $25,000 worth of electricity over the next 25 years. How much should someone be willing to pay today for those future benefits? Typically, someone will pay less today in one lump sum than the total value of the income s/he will receive over the next 25 years. But how much less will s/he pay? Let's say one will pay X$ today for $25,000 in future benefits at a discount rate of 6%. The amount paid today would be: $5,824.97. The mathematical calculation is:

PV[80] = FV[81] X PV Reversion factor at 6% for 25 years (0.232999) = $5,824.97

The same calculation can be done using an HP12c with the following keystrokes:

1. f clear FIN
2. 25 n
3. 6 i
4. CHS $25,000 FV
5. PV
6. Solution: $5,824.97

Thus, this person received a 6% annual compounded discount rate for paying in one lump sum today, what s/he will receive in future benefits over the next 25 years[82].

What we need to solve here, however, is: What *is* the appropriate discount rate for PV systems? 1%, 4%, 15%? That is what the appraiser will need to decide. There are no hard and fast rules for choosing a discount rate other than choosing one that makes sense in a specific market. Discount rates weigh the risk of the potential return on the investment, and are a factor in choosing between other opportunities. A *higher* discount rate will give a lower valuation, and therefore reflects greater risks, and a *lower* discount rate will give a higher valuation, and therefore reflects lower risks.

So what is a good discount rate for residential PV systems? The PV Value tool uses the current Fannie Mae 30-Fixed or the Fannie Mae 15-year fixed interest rates for the borrowers weighted

[80] This "PV" is meant to be an abbreviation for "Present Value" and should not be confused with the "PV" abbreviation term used throughout this document that is referring to "Photovoltaic".
[81] FV= Future Value
[82] TI BA-II PLUS calculation (FV = $25,000, I/Y =6%, N= 25, (CPT) PV = $5,824.97. Discount rate factor = 0.233 or 76.7% discount to Future Value.

average cost of capital (WACC), which is a component of the discount rate[83]. The question is, does that seem reasonable for the appraiser's market area? For the market area used in this study, this was indeed a reasonable cost of capital for the discount rate to use. These rates reflect the interest rates available to homeowners when they purchase or refinance their home. Per the instructor of the Appraisal Institute's PV course, appraisers were indicating that they thought an appropriate discount rate for residential PV would be similar to the equity mortgage rate or rate charged for solar PV financing. These two rates are higher than current interest rates , accounting for a higher risk. Therefore, the basis points can be adjusted in the PV Value tool to take this higher risk rate into consideration.

Other discount rates, such as those tied to the Treasury Bond Yield Rate, are not reasonable to use in these case studies as they do not accurately reflect an available borrowing rate that is accessible to the PV system purchaser. n other words, since the PV system is a part of the home and can be financed using mortgage rates, this is a reasonable cost of capital for supporting the discount rate to use.

Whichever discount rate appraisers choose, they need to include a risk premium or margin of safety within the discount rate calculation. No one can accurately predict the future, and as an investor in a PV system, a homeowner needs to be compensated for that risk. A "margin of safety" relates to the adequate compensation of unforeseen risks associated with an investment in a PV system, such as accidental module breakage, windstorm damage, corrosion to electrical components needing replacement or roof replacement which requires the PV owner to pay for the removal and reinstallation of a roof mounted PV system). Typically, a *higher* discount rate will result in a lower indication of value.

Here is an example that explains the risk premium: If a homeowner can borrow at 5% and re-invest in an income producing investment that yields 5%, would s/he make that investment? Probably not. Since there is no compensation for taking on the extra risk, the borrower would simply choose not to make the investment or take on that extra risk if it is not to his/her benefit in doing so. Therefore, the discount rate should be higher than the borrowers cost of capital.

PV Value includes this margin of safety. The official term for this margin of safety is a "basis point spread". Another way to look at it is as a risk premium.

One basis point = 0.01%

The PV Value tool uses as its range or basis points the following: 50 basis points (0.50%) to 200 basis points (2.00%). Thus, the average basis points are 125 (50+200/2 = 125), or 1.25%. These figures are used to apply to the discount rate to account for a margin of risk. Typically, when interest rates are lower, the spread over the interest rate is higher, and when interest rates are higher, the spread over the interest rate is lower.

[83] https://www.fanniemae.com/singlefamily/historical-daily-required-net-yields

When looking for an appropriate risk premium, it is important to remember that not every homeowner will perceive risk in the same manner. An expected return on capital invested and the risks associated with ownership will be different from one homeowner to the next due to their reason for purchasing a PV system or their knowledge of financial analysis methods. This is why PV Value has used a range for the "basis point spread." When calculating the risk premium or basis point spread, one can also look to other markets such as higher yielding corporate debt instruments or municipal bonds that a homeowner may otherwise invest in and that can generate income with some degree of risk over a similar expected PV system lifetime. The basis point spread can be calculated by taking similar debt instruments across two different risk categories such as A and B rated instruments, and deducting the current 30-year Fannie Mae mortgage rate to determine the difference or basis point spread. For this study, the basis point spread was developed after taking into consideration all of the paired sales found and utilized in the study.

Once appraisers understand the PV Value tool, its variables and how to work it, they can competently apply it when applicable. However, there is one last step.

Knowing how to competently fill out the variables needed to use PV Value for developing an income approach value, the appraiser cannot simply rely upon the outputs generated without understanding how those output numbers were generated. In other words, how does PV Value use the information to generate its "*Appraisal Range of Value Estimate*"? USPAP (the appraisal industry's published standards of professional practice) require an appraiser to fully understand any method or tool s/he are using, before s/he can competently use it. Specifically, USPAP addresses the appraiser using the Discount Cash Flow Analysis in Statement No. 2. One particularly relevant quote from Statement 2 is as follows:

> "*If using commercial software, the appraiser should cite the name and version of the software and provide a brief description of the methods and assumptions inherent in the software. [USPAP] requires that projections of anticipated…income potential and expenses be based on reasonably clear and appropriate evidence."*

The assumptions and methods utilized in PV Value have already been adequately addressed. To understand the mathematical computations in greater detail, the appraiser should refer to the PV Value user's manual. Equations are shown for how to calculate present value, as well as how a compound annual growth rate is calculated.

The PV Value tool has been evaluated by appraisal industry experts and they both accept and approve the data inputs and the mathematical computations used. Thus, the stamp of approval has been received by competent appraisers for PV Value to be considered an industry-accepted way to use the appraisal method known as the Income Capitalization Approach.

Further information

In addition to the information provided above, there are a few more instances in which the appraiser will need to modify the standard input in the PV Value tool to arrive at an accurate value estimate. These instances include when an appraiser is appraising a property with an effective date in the past, when the system has microinverters and when the homeowner is receiving PBIs. Each will be discussed below.

- **Appraising a property with a retrospective effective date of value**

For this study, homes studied were sold between January 1, 2011 and the March 31st, 2013. Over this time period, utility rates changed. Therefore, some of the sales used in the study occurred in the past. Current utility rates are not applicable and would result in erroneous calculations if they were used. In this case, PV Value allows an appraiser to input alternate custom utility rates[84] as well as the appropriate discount rate.

If the appraiser is trying to determine the present value of future energy production where the effective date of value is, say, June 3, 2011 (and not the current date of March 15, 2013), then the appraiser will need to use utility information from 2011 and not from 2013. This, however, was not done for this study for two reasons.

First, when using a retrospective utility rate, it necessitates changing the utility escalation rate. Since the utility escalation rate is based on a long-term average using a CAGR, that would require additional knowledge about how utility billing dynamics (which are incredibly complex) and additional research that are beyond the typical scope of work and the expertise of residential appraisers. Since the creators of PV Value have developed an algorithm to determine what this rate is, and they are experts in such types of data collection, it is reasonable to state that the appraisers relied upon this figure and did not generate it themselves (similar to the way an appraiser relies on cost data estimates from cost data providers such as Marshall & Swift).

In other words, the appraiser will not be able to generate a retrospective utility escalation rate. This, then, is a limitation of the figures generated for retrospective effective dates. However, this limitation is a minor one for this study, since the oldest case studies are only from 2011. Based on an interview with a PV installer, utility costs have risen fairly steadily over the past 10 years. It is therefore reasonable to conclude that the current escalation rate is extremely similar to the retrospective escalation rate from 2011.

Second, when using a retrospective effective date of value, the appraiser should input the utility rate from that time period. Again, this is not an easily accessible data piece. After many inquiries and phone calls, it was determined that historic utility rates were not easily found. This seeming

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[84] The appraiser can change the utility rate noted in the “Electricity Rate Inputs” section by placing a check in the small box that reads “User Defined (check box) /kWh”. The field will then turn orange and the appraiser can enter in their own rate.

innocuous information was not reasonably accessible due to the existence of so many different utility billing structures. Since utility rates (per the authors own utility bills) are less than $0.007 higher than they were in 2011, it was considered reasonable to use the current billing rate of $0.11 per kW for the case studies from 2011 and 2012. This does result in slightly higher indications of the present value of the future energy production; however, this limitation is taken into consideration in the reconciliation section.

This utility information is further complicated by the fact that in 2010, Xcel implemented a two-tier billing system for the highest energy usage months, June to September. The first 500 kWh used each month are billed at the standard rate of $0.11 and any kWhs used above 500 are billed at $0.15 per kWh (remember, the average household in the study area consumes 711 kWhs per month on average, so this impacts most households). One solution is for the appraiser to use a weighted average of the utility bill, which will consider both the amount of electricity purchased at the lower rate, and the amount purchased at the higher rate.

For this study, since there was no access to utility bills, the average annual utility rate (not taking into account tiered billing) was used, as this was the only reasonable option for reporting utility costs. The reason for this was that while the tiered billing system may increase the ROI for a PV system and can be even more valuable for a homeowner to reduce electricity demand enough to get out of the higher tier from June to September, some homeowners may not use enough electricity to ever reach the second-tier billing level. This billing system also favors PV system owners who use more electricity, because the most productive months for a PV system coincide with the months when Xcel is utilizing the two-tier billing system. Thus, for the purposes of this study, all calculations are made assuming the second-tier billing level is never reached by the homeowner. This is an extraordinary assumption and could impact the opinions and conclusions made in this study, though not significantly.

- **Microinverters**

While most PV systems come with wall-mounted inverters, some have microinverters. PV Value uses both warranty data and replacement cost estimates for inverters based on central-inverters, which have been available in the marketplace for a longer period of time. Microinverters are now starting to offer a longer warranty period of 15 to 25 years (compared to the standard warranty period of 10 to 15 years for wall-mounted units). PV Value uses a lifespan estimate of 15 years. This is based on the fact that central inverters have been around longer, and microinverters have only been around for five years or so. There may be better data in the future to support a lifespan estimate of longer than 15 years.

- **Performance Based Incentives**

As noted earlier in this study, there are many instances in which a homeowner is receiving PBIs. The PBIs did not start until 2012, so if a PV system was installed prior to 2012, the reasonable conclusion was made that the system had no PBI's. If PBI's are being received, the income the homeowner is receiving is even greater than is being reflected by the PV Value tool. To account for this, PV Value has a procedure that allows the appraiser to run a second calculation, and add its to the first calculation. Those steps are as follows:

1) Pick a relevant discount rate. In this market area, PBI payments run for 10 years. Determine how many years are left on the contract and decide what discount rate is applicable based on that information.

2) Set the utility rate to whatever the utility is buying the electricity at, in whole cents[85]. To do this, just check the "User Defined Check box", which will allow you to input your PBI rate.

3) Set the utility escalation rate to "0." This is done because the PBI rate will not escalate, it is an agreed upon amount and it will not change.

4) Set the operating and maintenance expenses to "0." Again, this is because operating and maintenance expenses are not applicable to this situation.

5) Consider the year in which you are valuing the PV system. If it is new, then you'll start with a new system with the age set at "0." It won't matter which warranty period is chosen for this calculation as it is only the value of the PBI that is being calculated, which has a contract length shorter than the typical warranty for the PV modules and inverter.

   - Add the value in the cells "below" the appraisal range of value for the number of years, starting with the year 1. For a 20-year contract, you will add the present value of the energy savings for either columns E, G or I in row 47 depending on the risk spread you're applying to the discount rate. If you were to pick the module warranty of 20 years, and the system is new, then it would be the value that shows up in the "Appraisal Range of Value Estimate." If the contract term is 10 years then take the accumulated energy present value in either columns E, G or I, as reported in row 37.

   - If the system is older than one year, then you'll have to add the age of the system to Cell I14. For example, if the system is five years old, then put "5" in that cell. The calculation then starts in year 6 for the remaining 15 years of that payment (assuming you have a 20-year PBI payment period).

6) You can then take this value and add it to the value you would calculate for the PV system, again considering its current age.

Note: While it is possible that the new owner will have to file income taxes on this income (depending on how much s/he gets paid by the utility every year), income taxes are beyond the scope of consideration of an appraisal and should not be taken into consideration by the appraiser.

[85] In this market area, the purchase rates currently vary from $0.15 to $0.11 (i.e. as of March, 2013). Homeowners lock in their rate for one specific amount. The newer the contract is, the lower the PBI will be. Going forward, these rates are currently at $0.09 and will reduce by $0.01 increments until a PBI payment of $0.03 is reached. There are only so many contracts available at each PBI level, thus, once one tier is filled up, the PBI will reduce and new customers will receive that lower amount.

Note: With regard to this study, it was not possible to know which properties had PBIs and what amount they were for. However, it was possible to reasonably *estimate* what rate certain systems had based on the permit date. Any permit prior to 2012 is assumed to not have any PBIs, as those homeowners received cash rebates from Xcel. The PBIs in 2012 started at $0.15 per kWh then slowly declined to $0.11 per kWh by March 2013. This assumption is reasonable to make; however, if the figures used were incorrect, this could alter the conclusions and opinions reached in this study.

Conclusion

Finding an accurate way to account for the potential value contribution of the income generated by a PV system can be a mathematically daunting task. The PV Value tool is a proven way to make these calculations.

It is currently a reasonable solution to offer up PV Value to the market as a viable way to develop the present value of future energy production. Given that most of the mathematical models found throughout the course of this study[86] are lacking or just plain incorrect, this can be seen as an indication that the market is looking for a reliable way to perform such calculations. It therefore seems only fitting that appraisers should expose the market to the PV Value tool, and let the market decide if this proven tool is the best way to estimate the value of the income stream generated from PV systems.

In other words, the appraiser can use the PV Value tool and report the contributory value that was developed for the PV system in his/her appraisal. In the final reconciliation, the appraiser can discuss the relevancy and weight that this valuation method has on the final opinion indication for a particular market segment (which is how appraising is done anyway). This way, the appraiser can demonstrate that the market has been used to determine an acceptable mathematical way to estimate the contributory and/or present value of the future energy production from a PV system. Using the PV Value tool when no other market data is available provides a proven tool to support a conclusion. USPAP requires even a zero adjustment to be supported. Therefore, appraisers should use more than one method when possible, and reconcile those methods. The PV Value tool offers a method to support a conclusion.

Marshall & Swift Residential Cost Data

"Marshall & Swift" is a cost service that researches current building costs and sells that data to appraisers (among others). Cost services provide a wealth of important cost data, and no residential appraiser can function without reliable and accessible cost data. There are several cost service providers. However, since the author of this study is very familiar with Marshall & Swift cost data, it is the only cost data source utilized for this study.

That said, the Marshall & Swift cost data for PV systems is relatively new and is currently far too limited in scope to be useful. Also, the cost data is only updated a few times per year. Normally,

[86] In regards to marketing materials distributed by various market participants.

this periodic updating of costs is not an issue. To compensate for changes in costs over short time periods, Marshall & Swift issues “time adjustment” multipliers four times per year. However, given the rapid *decrease* in the cost of PV systems, there is no way for Marshall & Swift to adequately address these swift, downward changes in PV costs. Thus, the Marshall & Swift data did not currently provide useful cost information. For that reason, cost service data was not utilized for this study.

For an in-depth explanation of the current limitations of the Marshall & Swift cost data, please refer to the Appendix.

Building Permits

Building permits are public information in Colorado, but the data they provide can be hit or miss. Every city and county has a different system for recording and communicating its building permit data. The limitations and availability of permit data for this study are as follows:

City of Broomfield

- **Bulk data requests:** The staff is immediately responsive to requests for large data sets pertaining to PV permits. This data was delivered in Excel format for easy downloading and processing. The Xcel files contained all relevant bulk information (property address, installer, date of permit, size of system and the estimated cost of the system). The only minor issue is that the size of the system is recorded in an inconsistent manner (“5.0kw,” “5.0,” “5,” “5kw,” etc.), so without editing each field for consistency, the data cannot be sorted by system size. This proved to be an extremely *minor* inconvenience.
- **Permit information of single properties:** This is by far the most comprehensive and easy to use system. The permits are well organized by type and contain more than enough information about the PV system. The permit system in the City of Broomfield is extremely well organized, useful, and accessible.

City of Arvada

- **Bulk data requests:** The staff is immediately responsive to requests for large data sets pertaining to PV permits. The data was easily delivered in an Excel format for easy downloading and processing. The Xcel files contained all relevant bulk information (property address, installer, date of permit, size of system and the estimated cost of the system). The only minor issue is that the size of the system is contained in a field with other narrative comments, so the data cannot be sorted without manually reading and re-configuring each field.
- **Permit information of single properties:** Arvada lumps all of its permits into one PDF file that has been scanned in. The permits are not organized in any

way, so one must manually read each and every permit to see which permits are applicable to the PV system and which permits are not. Also, the permit data is limited, so not all information the appraiser is looking for will be on file (such as warranty information, panel type, inverter type and other data).

City of Westminster

- **Bulk data requests:** Staff was able to immediately respond and provide bulk permit information for PV systems. The permit information, however, was only available in a PDF format and had to be hand-transcribed into Excel. This was a very time consuming process for the information that was needed.
- **Permit information for single properties**: The information was easy to access. The files were complete and it was easy to obtain all information regarding the PV system.

City of Wheat Ridge

- **Bulk Data requests**: The data was immediately emailed in PDF format.
- **Permit information for single properties**: Much like Broomfield data it was possible to access everything one needed from a home computer, and all data points needed by an appraiser were easily located.

City and County of Denver

- **Bulk data requests:** Staff was able to immediately respond, but could not provide specific data for bulk permit data (such as a list of permits for PV systems). Thus, it was not reasonably possible to study PV permit data in bulk for the city of Denver, since it was not available. One reason for this is that Denver does not have a permit category for PV systems; rather, this information is filed with the general electrical permits.
- **Permit information for single properties**: The data was extremely sparse and very few, if any, details were available. As a result of the limited data, the case studies contained herein (related to homes from Denver) will have gaps with regard to the specifications of their systems. There was minimal permit information available and even that was only occasionally useful.

In conclusion, permit data from Broomfield, Arvada, Westminster and Wheat Ridge is very useful, relevant, easy to access and well-organized. Denver, on the other hand, had virtually no useful data and no way to access bulk data. In the end, it was necessary to conclude that Denver permit data could not provide any relevant information for this study.

It is important to note that the builder permit data includes the actual gross costs and not the costs after any rebates or incentives. In keeping with proper appraisal procedures, cost data should include any rebates or incentives, excluding any tax credits. In this market area, actual rebates and up-front cash incentives ended very early in 2011. Xcel will not provide retroactive incentive data, so it was not possible to disclose what past incentive rates were. Then, in 2012 and in lieu of up-front cash incentives, Xcel started the PBI program, which is a form of income to the buyer and does not reduce actual up-front costs. Thus, for this study, rebates and incentives were not deducted from the cost approach since all case studies closed during a time period when there were no rebates and incentives.

Rebates and incentives should not be confused with tax credits (which should *not* be deducted from the cost approach) or PBIs (i.e. payments made to homeowners over the first 10 years the system is in operation). In other words, for this study, there were no "rebates or incentives" to deduct from the cost approach, since none were in effect from January 2011 to March 2013. The only cost deductions a buyer of a PV system could realize between January 2011 and March 2013 were the 30% federal tax credit and possibly a future income agreement relating to a PBI of somewhere between $0.15 and $0.09 per kWh generated.

Local Builder Costs

As noted earlier in this report, several homebuilders were located who offer PV systems as a standard feature, or as an upgrade. This was useful information and was collected from the builders. The data was, when applicable, reconciled with the cost data obtained from the building permit information noted above.

This was very applicable data since it represented the true cost of the system for a particular house.

Local Installer Costs

In theory, it would be useful to contact actual installers to estimate how much PV systems cost to install. Rightfully so, they will not be able to provide that answer without performing a full analysis on the exact house you might be referring to. For this study, a local installer was contacted (Buglet Solar) and they were able to provide extensive information about how systems are priced. While this data was not specifically applied to each case study, it was taken into consideration when learning which features were important to note on PV systems.

In conclusion, the cost data the local installer is able to provide is more of a general data point, and it is highly recommended appraisers that interview local installers to understand the particulars of PV systems that are relevant to their market area. Additionally, the local installer can give interesting feedback about how owners of PV systems interact with their systems. The appraiser might come up with the following delightful observation nugget:

> *"Although electricity is invisible, the work of installing solar systems is surprisingly tangible. When the installation is complete, an inspector shows up to tell you it's good. Then, you can monitor every kilowatt-hour of energy produced by the system. And the best part is receiving those excited phone calls from solar system owners on a beautifully sunny high-production day. It is so exciting for them, and for us!"*[87]

Who knew PV owners couldn't wait to get home and watch their electricity meters tick? AND that they were in fact *so* excited, that they felt compelled to call their installers to report their electricity savings? We sure don't hear of people calling their plumber to report how excited they were to have hot water that day (though mind you, we probably should).

Depreciation

As noted earlier in this study, current PV systems have warranted lives of 25 years. While the system may still operate at 80% efficiency at the end of those 25 years (it may have a physical life of 50 years or more), its useful life is only considered to be 25 years.

For the purposes of economic depreciation, the current PV systems researched for this study are estimated to have useful lives of 25 years.

A straight-line depreciation method is used in this study as it is the most reflective of the current data available on the PV systems, and, all of the PV systems researched for this study are only a few years old. Thus, the straight-line age/life depreciation method is currently the most applicable way to estimate depreciation.

However, the straight-line age/life method only measures depreciation and not functional obsolescence. As will be disclosed later in the actual case studies, this study strongly indicates that PV systems in this market area are superadequacies. If incentives are not received by the person installing the system, then the contributory value is less than the cost of the system from day one. Currently, homeowners receive a 30% federal tax credit when installing a system. After analyzing all of the cost data associated with the case studies, this was the exact amount of functional obsolescence due to superadequacy the market recognizes in the cost to install these systems. This conclusion was reached after studying all of the paired sales utilized in the study, as well as comparing every value reached using the income approach. All conclusive showed the cost approach to value is higher than market value because of this superadequacy. Therefore, the superadequacy was taken into account in each circumstance where the cost approach was applicable.

Without incentives to offset the gross costs, the market is simply not willing to pay full cost based on the sales data. Since the current per kW cost is $3,500, 30% of this cost is $1,050

[87] Whitney Painter, Buglet Solar Electric Installation

(rounded to $1,000 per kW). This $1000 per kW figure proved to be the correct amount of functional obsolescence PV systems are experiencing in this market area.

Highest-and-Best-Use Analysis

A highest-and-best use analysis is a fancy appraiser way of saying "What kind of home fits best in this area?" In other words, if you live in a residential neighborhood consisting of 1,000-sq.ft., ranch-style homes built in the 1950s, then your property is probably a 1,000-sq.ft., ranch-style home that was built in the 1950s (and not, say, a 9,000 sq.ft., three-story Victorian-style home).

PV systems are the same. People buying homes in a certain neighborhood will consider whether a photovoltaic system is something that conforms to, and is acceptable to, the rest of the neighborhood. Take, for example, two subdivisions that are side-by-side with identical homes: *Doing Just Fine* and *Happy Camper*s. If buyers in the *Doing Just Fine* subdivision do not care about PV systems but buyers in the *Happy Campers* subdivision do (and are willing to pay to have them), then only the PV systems in the *Happy Campers* subdivision will represent the "highest-and-best-use."

For a PV system to be something that represents the highest-and-best use of a property, then it must meet four criteria:

- It must be legally allowed.
    - Some subdivisions have deed restrictions that do not allow PV systems to be installed. That was not the case for this study. Colorado state law bars all homeowners associations from disallowing PV along with any renewable energy sources (including clotheslines). Thus, legal permissibility was not an issue for this study.
- It must be physically possible.
    - It is not always physically possible to install a PV system on every house. Sometimes there is too much shading, or the roof is not conducive to having a productive PV system installed on it. Again, this was not an issue in this study since clearly every property in this case study has a PV system installed. The system was physically possible.
- It must be financially feasible.
    - Herein lays the crux of the appraisal problem for PV systems. Typically, "financially feasible" means an item contributes as much to value as it costs to install. PV systems are not like decks or garages: they do not just *cost* money to install, they then go on to *produce* money (they create income by proxy, they reduce utility costs). Thus, financially feasibility for PV systems relates not just to their initial cost but to their future income potential as well.

- It must be result in the most possible profit.
    - This is really just a reconciliation and conclusion of the three other tests noted above. Would a higher profit result if the PV system did not exist? The answer to this question is addressed individually in each case study. If the system contributes as much to value as it costs (and contributes via income), then a PV system is a property's highest and best use.

With regard to the 30 case studies included in this report, all PV systems cost more to install than they contributed to value. Thus, PV systems are currently superadequacies. As noted earlier, this illustrates that using the physical age/life method for determining depreciation is not appropriate by itself in the cost approach. The net cost approach should also be used (the gross cost less incentives and rebates). Tax implications, however, should not be considered in the cost approach.

Gross Rent Multiplier

A gross rent multiplier is a mathematical way appraisers convert income into value. For example, if a property has a value of $100,000 and rents for $900 per-month, then the GRM for that property is 111:

$100,000/$900 = 111.

Say part of that $900 per-month rent includes a garage. The market pays $50 per month to rent garages. Thus, of the $900 total rent, $850 is for the house and $50 is for the garage. Thus, the likely value contribution to the entire property of that garage is $5,550:

$50 X 111 = $5,550

In theory, if a property is rented, or the market area sees value in renting a property in a particular neighborhood, then a property with a PV system *may* rent for more than a property without a PV system. If two homes that are identical (except one has a PV system) are rented, one may have higher rent because it has a PV system.

This method was taken into consideration for each case study, and provided useful information for only a few of the properties.

Also, it should be pointed out that energy produced is income. The GRM is a ratio between the sale price and the income amount. Therefore, the GRM does not only apply to a property with a PV system. Applying a relevant GRM to the monthly energy produced provides one indication of value that should be reconciled with the other methods used.

Paired Sales Analysis

A "Paired Sales Analysis" is when two properties that sell are identical except for one feature- for example, one has a swimming pool- and, the difference in sale price can be attributed to the difference. For instance, if one property without the pool sells for $100,000 and the other property with the pool sells for $105,000, then the pool contributes $5,000 to value.

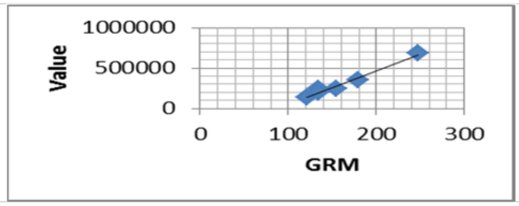
This is a wonderfully common appraisal tool; however, in real world applications, the indicated value contribution is not always as neat and tidy as the example provided above. This appraisal tool was taken into consideration for each case study, but the strengths and weaknesses of its applicability vary depending on what specific data was available for each area. The relevance of this method will be discussed individually in each case study.

PART 4: Case Studies

Having discussed the basics of PV systems, we can now turn to the case studies themselves. The case studies include 30 detached single-family homes. Each case study will be discussed individually, followed by a summary of the entire study.

Case Number	Property Location	Page Number
1	**Broomfield, Subdivision "A"**	**107**
2	**Broomfield, Subdivision "A"**	**115**
3	**Broomfield, Subdivision "A"**	**124**
4	**Broomfield, Subdivision "B"**	**132**
5	**Broomfield, Subdivision "C"**	**140**
6	**Broomfield, Subdivision "D"**	**148**
7	**Arvada, Subdivision "A"**	**157**
8	**Arvada, Subdivision "A"**	**165**
9	**Arvada, Subdivision "B"**	**173**
10	**Arvada, Subdivision "C"**	**180**
11	**Arvada, Subdivision "C"**	**186**
12	**Westminster, Subdivision "A"**	**192**
13	**Westminster, Subdivision "A"**	**198**
14	**Westminster, Subdivision "A"**	**203**
15	**Westminster, Subdivision "A"**	**208**
16	**Westminster, Subdivision "A"**	**213**
17	**Westminster, Subdivision "A"**	**218**
18	**Wheat Ridge, Market Area "A"**	**223**
19	**Wheat Ridge, Market Area "A"**	**230**
20	**Wheat Ridge, Market Area "A"**	**237**
21	**Wheat Ridge, Market Area "A"**	**241**
22	**Denver, Subdivision "A"**	**248**
23	**Denver, Subdivision "A"**	**255**
24	**Denver, Subdivision "A"**	**261**
25	**Denver, Subdivision "B"**	**267**
26	**Denver, Subdivision "C"**	**270**
27	**Denver, Subdivision "D"**	**273**
28	**Denver, Market Area "E"**	**279**
29	**Denver, Subdivision "F"**	**285**
30	**Denver, Subdivision "G"**	**288**

Broomfield, Subdivision “A”: Case Study 1

SUBDIVISION A			
Subdivision location:	Broomfield, CO	**Price range of homes sold[88]:**	$345,000 to $550,000 Median: $363,500 Mode: no mode
Number of detached homes:	Around 500	**Age range of homes:**	2001 to 2009
Percentage of Rentals:	16%	**Gross Rent Multiplier chart for subdivision (includes townhomes):**	
Quality of Construction:	Average to Very Good	**Type of homes:**	Tract homes, mostly 2-story on standard 5,000 to 19,000 sq.ft. lots
Number of homes sold in 6 months[89]:	14	**Range of above-grade square footages:**	1800 – 4600
Number of PV permits[90]:	19	**Number of homes that sold after they had PV installed:**	3 in the last year. None prior to that.
Range of kWs installed:	2.8-8.6	**Range of cost for PV systems over a three year period:**	$21,000 to $60,000 (before incentives)
Median kW amount installed:	6.02	**Median gross cost of PV systems:**	$30,000 (before incentives)

GENERAL PROPERTY INFORMATION: Case Study 1			
Purchase Date:	January, 2013	**Sales Price of house:**	$350,000
Age of home:	10 years	**Above-grade sq.ft. of home:**	2183
Total days on market[91]:	27	**Average Days on Market for subdivision[92]:**	36
Gross Rent Multiplier for similar home:	177 to 178		
Other green and/or energy efficient features: none known			

[88] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[89] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[90] Figures are for 2009, 2010, 2011 and 2012.
[91] For this report, “Days on Market” is defined as the number of days between the list date and the date of contract.
[92] Information is based on sales that sold in the six months proper to the closing date of the subject property.

MARKET CONDITIONS AT TIME OF SALE for Case Study 1 :	STABLE

This property went under contract in December, 2012. At that time, this market area was very balanced and stable and was just hinting that values would be increasing. The significant lack of inventory was not yet notable (as it would be a few months later). Thus, in this time period, the buyer and seller had equal negotiating powers and values were stable.

PHOTOVOLTAIC SYSTEM For Case Study 1

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Listing Agent
kW	2.8 kW	Permit
Date of Permit	August,2007	Permit
Manufacture of panels	Sharp	Permit
Warranty on panels	25 Years	Permit
Manufacturer of Inverter	Fronius	Permit
Warranty on Inverter	10 Years	Permit
Type	Fixed	Permit, Observation
Tilt	22.6	Observation
Energy Production per panel	175 watts	Permit
Energy Production Estimate (for 1 year)	4027 kWh	PV Value
Location	Roof	Permit, Observation
Age of panels	5 years	Permit
Inverter type	Wall mount	Permit, Observation
Age of Inverter	5 years	Permit
Original gross cost	$19,963	Permit
Azimuth	157	Solmetric Roof Azimuth tool

Real Estate Agent comments:

Listing Agent: PV did help sell the home and may have given extra value. Listing agent could not estimate the value contribution. Buyers liked the idea of solar but were "a little scared of it" and did not understand the system (how it works/maintenance). Agent did not work to educate buyers about the system.
Buyer's Agent: No feedback given

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #1

DATA SOURCES

Attempts were made to contact or collect all of the following data sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 1:

✓	Listing Agent	✓	Permit
	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis	✓	Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 1's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
✓	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis[93]

A paired sales analysis takes place when very similar properties that sold recently are "paired" to other sales. The difference in sale price between the properties is then attributed to the feature the other property does not have[94].

	Subject	Comp 1	Comp 2
Sale Date	January, 2013	December, 2012	August, 2012
Sale Price	$350,000	$347,000	$345,000
Market Conditions	Stable	Stable	Stable
Days to Sale	27	52	37
Square Feet	2183	2144	2225
Photovoltaic	Yes	No	No

The three properties noted above are highly identical to one another (see footnote below). All three listing agents were able to verify the sales. The paired sales analysis indicates that the subject's PV system had a contributory value of between $3000 and $5000 for a 2.9 kW system.

As of January 2013, a value indication using the Paired Sales Analysis is:
$1,070 to $1,780 (rounded) per kW
for a 2.8 kW, 5-year old system with 20 years remaining of useful life.

The above paired sales are much better than is typically found. Thus, the quality and reliability of these paired sales is excellent.

[93] Items not noted on the paired sales grid that are essentially identical are: conditions of sale, financing, market conditions, garage count, above grade bathroom count, builder, quality of construction, lot sizes, location, views, finished basements and general basement square footage.
[94] I.E. two identical properties have one difference: one has an air conditioning unit, and the other does not. The property with the AC sells for $100,000. The property without the AC sells for $105,000. Thus, the AC is worth $5000.

B. Cost Approach (Using Local Builder Costs)

Using the replacement cost[95] appraisal method, current builder costs[96] were extracted using building permit information for the City of Broomfield:

Date of Permit	Subdivision	Total system Cost	kWs	Cost per kW
11/5/2012	ANTHEM	$6,325	2.3	$2,750
11/20/2012	ASPEN CRK	$29,520	4.84	$6,099
11/21/2012	BRM CC	$29,500	7.5	$3,933
11/21/2012	MCKAY LND	$29,900	7.99	$3,742
11/27/2012	BRM HEIGHTS	$23,760	7.92	$3,000
11/27/2012	WILLOW RUN	$29,800	6.213	$4,796
12/4/2012	BRANDYWINE	$8,640	2.88	$3,000
12/7/2012	GRNW PK	$20,160	6.72	$3,000
12/7/2012	WESTLAKE VILLAGE	$12,480	4.16	$3,000
12/7/2012	ASPEN CRK	$19,300	4.9	$3,939
12/11/2012	BRANDYWINE	$16,560	5.52	$3,000
12/11/2012	BRM HEIGHTS	$17,280	5.76	$3,000
12/11/2012	HIGHLAND PK SOUTH	$25,920	8.64	$3,000
12/17/2012	RIDGEVIEW HEIGHTS	$21,000	6	$3,500
12/17/2012	ASPEN CRK	$28,565	7.59	$3,764
12/20/2012	BLAND	$26,361	7.105	$3,710

Current local costs average $3,577 (rounded to $3,500) per kW. Therefore, a current cost estimate of $3,500 per kW is reasonable.

Depreciation is based on the systems actual age (as of January 2013), compared to its useful life:

Straight-line age/life method	
Age of system:	5 years
Useful life[97]:	25 years[98]
5/25 = 20% depreciated	

[95] There are two ways to estimate the cost to replace an item: the replacement cost or the reproduction cost. Replacement cost uses cost figures of a feature that is of *like utility*, reproduction costs use cost figures for the *exact*, specific item. Residential appraisers most typically use the replacement cost.
[96] Reported builder costs do not include any rebates or incentives, rather, they are gross costs.
[97] Useful life: The period of time over which a structure or a component of a property may reasonably be expected to perform the function for which it was designed.
[98] The subject property's PV system is 5 years and has a 25 year warranty. Total useful life is based on the life of the warranty.

Since the subject property has 2.8 kWs, the following calculations can be made:

2.8kW X $3,500 per kW =	$9,800
$9,800 less 20% depreciation =	$7,840 (rounded to $7,800) = Cost Today
Cost today =	$7,800
$1000 X 2.8kW for functional obsolescence* =	-$2,800
	=$5,000

(* Functional obsolescence figures were developed after all data for the 30 case studies was complete. The cost approach was consistently higher than all other indicators of market value. Thus, the figure used for functional obsolescence was derived based on the average difference between all other indicators and the cost approach figures.)

In conclusion, based on actual local costs, the indicated value by the cost approach, as of January 2013 is $5,000 for a 2.8 kW system.

As of January 2013 the value indication using the Cost Approach is:
$1,780 per kW
for a 2.8 kW, 5-year old system with 20 years remaining of useful life.

The quality and quantity of the cost data are excellent, and therefore, the cost estimate is a reasonable indicator of market value.

C. Income Approach (Using a Gross Rent Multiplier[99])

Only one rental property (of a similar quality single-family home) was found. The property was nearly identical to the subject property and had an advertised rental rate of $1,950 per month. A reasonable GRM for this property is between 177 and 178 based on the sale prices of Comps 1 and 2 that were used in the paired sales analysis.

By calculating the subject's average monthly energy produced, the GRM can be used to estimate the value contribution of these savings.

1) Subject's yearly energy production is estimated[100] at 3940 kWh
2) Current utility rates are $0.11 per kWh
3) 3940 kWh X $0.11 = $433.40/12 = $36.11 per month

[99] A "Gross Rent Multiplier" is a figure that is arrived at by dividing the sales price (or value) of a home by its rental amount.
[100] The estimated savings rate is based on the probable number of kWh's the system will generate in a year (per PV Value®) and using current, local utility rates.

4) $36.11 X (GRM of 177) = **$6,391** (for a 2.8 kW system)
5) $36.11 X (GRM of 178) = **$6,427** (for a 2.8 kW system)

These figures are then reduced to a per kW estimate:

> As of January, 2013, the value indicated using the income approach is:
> **$2,280 to $2,300 (rounded) per kW**
> for a 2.8 kW, 5-year old system with 20 years remaining of useful life.

D. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 20 years. The system is already five years old, so the remaining useful life is only 20 years). The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80023	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	2800	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	200			Inverter cost	$1,221.28
Module Degradation rate	0.5	Net Yield Rate (Custom)[101]	3.70	Utility Escalation rate	1.95	System Warranty/Years	25
Tilt	22.6	Discount Rate(low)	4.32			Actual Age/Years	5
Azimuth	157	Discount rate (average)	5.57			Remaining Energy/Years	20
KWh Produced/Year	4027	Discount rate (high)	6.82				

**Note:* *XXXX = User Input* *XXXX = User Input Override* *XXXX = Calculated Value*

Using the above data points, the following figures were generated from PV Value:

Value of the energy produced this year
$435.56

Present value estimate of accumulated energy production for Next 20 years	
Low	$4,336.41
Average	$4,884.17
High	$5,523.96

As per the above data, the indicated value by the income approach is between $4,300 and $5,500 (both figures are rounded) for a 20 year period.

[101] Interest rate is from Interest Rate Chart contained in the addenda of this report.

As of January 2013, the value indicated by the Income Approach is:
$1,540 to $1,970 (rounded) per kW
for a 2.8 kW, 5-year old system with 20 years remaining of useful life.
The value indication using the average discount rate is
$1,740 per kW.

This data is considered to be very reliable since all details about the subject's PV system were known. Thus, the quality and quantity of the value conclusion are considered to be excellent. Given that this value indicator is in such close range of the paired sales analysis, this value indication deserves consideration.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The marketing of the PV system was not a major focus point for the listing agent. The listing agent did not spend significant time educating potential buyers about the system.
- The buyer's agent stated that the buyer liked the system but was leery of maintaining and operating the system.
- Marketing time was 10 to 25 days quicker compared to two comparable homes (and compared to the average days on market for the entire subdivision); values were stable during this time period.

The PV system did appeal to the market and had a positive impact on marketability and market value.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
$1,070 to $1,780 per kW	$1,780 per kW	$1,540 to $1,970 per kW (PV Value) $1,750 per kW (average)
		$2,280 to $2,300 per kW (GRM)

The paired sales analysis is the best indicator of market value because the paired sales data is very strong.

The cost approach has reliable and current cost figures. Therefore, the value indication by the cost approach is reliable and reflective of the market.

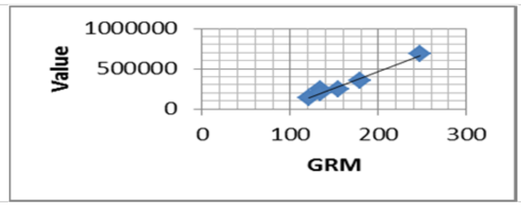
The income approach value indication generated using PV Value is also very reliable given that all data needed to utilize the tool was known and/or market-derived. The data is very strong and the findings reflect those found in using the paired sales analysis.

The income approach value indication using a GRM falls outside the value indications by the other approaches and, therefore, deserves the least amount of consideration. Since there are so few rentals in this area, the data set used to develop the GRM was not sufficient to produce a reasonably reliable GRM.

In conclusion, given that all three approaches share a common value indication of either \$1,750 or \$1,780 per kW, a reasonable value conclusion is \$1,750 and \$1,780 (rounded to the nearest 100th).

As of January 2013, the final value conclusion is: **\$1,800 per kW** for a 2.8 kW, 5-year old system with 20 years remaining of useful life and with a location in Broomfield, Co, Subdivision "A."
The marketing time was 27 days: 9 days faster than the subdivision average of 36 days.

Broomfield, Subdivision "A": Case Study 2

SUBDIVISION A			
Subdivision location:	Broomfield, CO	**Price range of homes sold[102]:**	$346,750 to $550,000 Median: $395,000 Mode: no mode
Number of detached homes:	Around 500	**Age range of homes:**	2001 to 2009
Percentage of Rentals:	16%	**Gross Rent Multiplier chart for subdivision (includes townhomes):**	
Quality of Construction:	Average to Very Good	**Type of homes:**	Tract homes, mostly 2-story on standard 5,000 to 19,000 sq.ft. lots
Number of homes sold in 6 months[103]:	11	**Range of above-grade square footages:**	1800 – 4600
Number of PV permits[104]:	19	**Number of homes that sold after they had PV installed:**	3 in the last year. None prior to that.
Range of kWs installed:	2.8-8.6	**Range of cost for PV systems over a three year period:**	$21,000 to $60,000 (before incentives)
Median kW amount installed:	6.02	**Median gross cost of PV systems:**	$30,000 (before incentives)

GENERAL PROPERTY INFORMATION: Case Study 2			
Purchase Date:	March, 2013	**Sales Price of house:**	$445,000
Age of home:	7 years	**Above-grade sq.ft. of home:**	2661
Total days on market[105]:	27	**Average Days on Market for subdivision[106]:**	28
Gross Rent Multiplier for similar home:	200		
Other green and/or energy efficient features: none known			

[102] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[103] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[104] Figures are for 2009, 2010, 2011 and 2012.
[105] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[106] Information is based on sales that sold in the six months proper to the closing date of the subject property.

MARKET CONDITIONS AT TIME OF SALE for Case Study 2 :	INCREASING
Inventory was clearly down at this point and multiple offers were starting to become common. This was a new seller's market with values slightly increasing at a rate of 0.8% per month for the three months prior to this sale. Prior to January 2013, the market was stable.	

PHOTOVOLTAIC SYSTEM For Case Study 2

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Listing Agent
kW	5.6 kW	Listing Agent, Permit
Date of Permit	April, 2009	Permit
Manufacturer of panels	bp Solar	Permit
Warranty on panels	25 Years	Permit
Manufacturer of Inverter	Sunny Boy	Permit
Warranty on Inverter	5 or 10 Years	Permit
Type	Fixed	Permit, Observation
Tilt	22.6	Observation
Energy Production per panel	200 watts	Permit
Energy Production Estimate (for 1 year)	7875 kWh	PV Value
Location	Roof	Permit, Observation
Age of panels	4 years	Permit
Inverter type	Wall mount	Permit, Observation
Age of Inverter	4 years	Permit
Original gross cost	$30,360	Permit
Azimuth	195	Solmetric Roof Azimuth tool

Real Estate Agent comments:

Listing Agent: Agent did not spend time to educate the buyers about the system, however, the listing agent felt the PV was a big positive and added $10,000-$15,000 to the value. Agent felt the buyers were savvy about the system. There was no impact on marketing time.
Buyer's Agent: Buyers didn't understand the system and were leery about signing a contract with Xcel. Value added was probably around $5,000, though the sellers thought it was worth up to $20,000 (which was NOT reasonable in the buyers' minds). It was an obstacle to overcome the seller's idea of how much value the PV system contributed.

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #2

DATA SOURCES

Attempts were made to contact or gather all of the following sources. The sources that are marked with a check are for which information was successfully obtained for Case Study 2:

✓	Listing Agent	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis	✓	Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 2's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
✓	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis[107]

A paired sales analysis takes place when very similar properties that sold recently are "paired" to other sales. The difference in sale price between the properties is then attributed to the feature the other property does not have.

	Comp 1	Comp 2	Comp 3
Sale Date	January, 2013	December, 2012	August, 2012
Sale Price	$350,000	$347,000	$345,000
Market Conditions	Stable	Stable	Stable
Days to Sale	27	52	37
Square Feet	2183	2144	2225
Photovoltaic	Yes: 2.8 kW	No	No
Age of PV System	5 years	n/a	n/a

These are the same sales used for a paired sales analysis in Case Study 1. These sales are still applicable to Case Study 2, even though Case Study 2 features a more expensive home. As noted earlier in this study, the market does not show a preference for installing PV systems on any particular age home or any particular value range of home. Additionally, the actual cost and income associated with PV systems have no relation to the *value* of the home on which they are installed. Therefore, given that this paired sale is from the same identical subdivision as Case Study 2, this is a relevant and applicable data set.

The three properties noted above are highly identical to one another (see footnote below). All three listing agents were able to verify the sales. The paired sales analysis indicates that Comp 1's PV system had a contributory value of between $3000 and $5000 for a 2.8 kW system and sold between 10 and 25 days faster than Comps 2 and 3. This is a value indication of $1,070 to $1,780 per kW for a five-year old system.

[107] Items not noted on the paired sales grid that are essentially identical are: conditions of sale, financing, market conditions, garage count, above grade bathroom count, builder, quality of construction, lot sizes, location, views, finished basements and general basement square footage.

However, these sales are from late 2012 and early 2013. Values have increased 0.8% per month between (early) January 2013 and (late) March 2013. Therefore, this value can be increased to reflect changes in market conditions:

($3,000 to $5,000) X (.8% X 3) = $3,070 to $5,120 total value for a 2.8 kW system.

Therefore, as of March 2013, the contributory value of a five- year old 2.8 kW system is $1,100 to $1,830 per kW.

Since the subject property has a four-year old system, the value conclusion for the subject property is 4% higher (based on the fact that it has 4% less depreciation than this property):

[$1,100 X 1.04 = $1,140 per kW] to [$1,830 X 1.04 = $1,900 per kW]

The figures generated above, indicate a total value for the subject's 5.6 kW system at between $6,400 and $10,600 (both figures are rounded).

Thus, the following figures are the most reasonable conclusion:

As of March 2013, a value indication using the Paired Sales Analysis is:
$1,140 to $1,900 (rounded) per kW
for a 5.6 kW, 4-year old system with 21 years remaining useful life.

B. Cost Approach (Using Local Builder Costs)

Using the replacement cost appraisal method, current builder costs were extracted using building permit information for the City of Broomfield:

Date of Permit	Subdivision	Total system Cost	kWs	Cost per kW
11/21/2012	BRM CC	$29,500	7.5	$3,933
11/21/2012	MCKAY LND	$29,900	7.99	$3,742
11/27/2012	BRM HEIGHTS	$23,760	7.92	$3,000
11/27/2012	WILLOW RUN	$29,800	6.213	$4,796
12/4/2012	BRANDYWINE	$8,640	2.88	$3,000
12/7/2012	GRNW PK	$20,160	6.72	$3,000
12/7/2012	WESTLAKE VILLAGE	$12,480	4.16	$3,000
12/7/2012	ASPEN CRK	$19,300	4.9	$3,939
12/11/2012	BRANDYWINE	$16,560	5.52	$3,000
12/11/2012	BRM HEIGHTS	$17,280	5.76	$3,000

12/11/2012	HIGHLAND PK SOUTH	$25,920	8.64	$3,000
12/17/2012	RIDGEVIEW HEIGHTS	$21,000	6	$3,500
12/17/2012	ASPEN CRK	$28,565	7.59	$3,764
12/20/2012	BLAND	$26,361	7.105	$3,710

Current local costs average $3,577 (rounded to $3,500) per kW. Therefore, a current cost estimate of $3,500 per kW is reasonable.

Depreciation is based on the systems actual age (as of March, 2013), compared to its useful life:

Straight-line age/life method	
Age of system:	4 years
Useful life:	25 years[108]
4/25 = 16% depreciated	

Since the subject property has a 5.6 kW system, the following calculations can be made:

5.6kW X $3,500 =	$19,600
$19,600 less 16% depreciation =	$16,464 (rounded to $16,500) = Cost Today
Cost today=	$16,500
$1000 X 5.6 kW for functional obsolescence=	-$5,600
	= $10,900

In conclusion, based on actual builder costs, the indicated value by the cost approach, as of March 2013 is $10,900 for a 5.6 kW system.

As of March 2013 a value indication using the Cost Approach is:
$1,950 (rounded) per kW
for a 5.6 kW, 4-year old system with 21 years remaining of useful life.

The quality and quantity of the cost data are excellent; therefore, the cost estimate is a reasonable indicator of market value.

[108] The subject property's PV system is 4 years and has a 25 year warranty. Total useful life is based on the life of the warranty.

C. Income Approach (Using Gross Rent Multiplier)

A suitable, comparable rental property was not found, however, a reasonable GRM could be developed based on general area rental data. Given the GRM chart for this subdivision, a reasonable GRM for the subject property is 200.

By calculating the subject's average estimated monthly savings, the GRM can be used to estimate the value contribution of these savings.

1) Subject's yearly energy production is estimated[109] at 7875 kWh
2) Current utility rates are $0.11 per kWh
3) 7875 kWh X $0.11 = $866.25/12 = $72.18 per month
4) $72.18 X (GRM of 200) = **$14,436** (for a 5.6 kW system)

These figures are then reduced to a per kW estimate:

As of March, 2013, a value indication using the income approach is: **$2,600 (rounded) per kW** for a 5.6 kW, 4-year old system with 21 years remaining of useful life.

[109] The estimated savings rate is based on the probable number of kWh's the system will generate in a year (per PV Value®) and using current, local utility rates.

D. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 21 years. The system is already 4 years old; thus, the remaining useful life is only 21 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80023	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	55
System Size in Watts	5600	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	200			Inverter cost	$1,653.12
Module Degradation rate	0.5	Net Yield Rate (Custom)[110]	3.82	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	22.6	Discount Rate(low)	4.32			Actual Age/Years	4
Azimuth	195	Discount rate (average)	5.82			Remaining Energy/Years	21
KWh Produced/Year	7875	Discount rate (high)	6.82				

**Note:* *XXXX* *= User Input* *XXXX* *= User Input Override* *XXXX* *= Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$856.13

Present value estimate of accumulated energy production for remaining 21 years	
Low	$9,522.69
Average	$10,426.85
High	$11,455.13

As per the above data, the indicated value by the income approach is between $9,500 and $11,500 (both figures are rounded).

As of March 2013 a value indication using the income approach is:
$1,670 to $2,050 (rounded) per kW
for a 5.6 kW, 4-year old system with 21 years remaining useful life.
The value indication using the average discount rate is:
$1,860 per kW.

This data is considered to be very reliable since all details about the subject's PV system were known. Thus, the quality and quantity of the value conclusion are considered to be excellent.

[110] Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The listing agent and the buyer's agent gave conflicting information about the buyer. However, the buyer's agents' statements are considered more reliable and are given more consideration (with regard to the buyer). Thus, it seems the buyers were not highly knowledgeable about the system, though there is reason to doubt this conclusion (for reasons noted below).
- Buyer's agent felt the system contributed at least $5,000 to value, and nowhere near the $20,000 that the sellers were hoping to receive. The listing agent felt the PV system generated $10,000 to $15,000 extra, though this seems unlikely given the selling agent's feedback and data generated from the paired sales analysis.
- Marketing time was the same as other properties. However, this appears to be due to the severe lack of inventory overall (and not just of homes with PV systems).

Therefore, the PV system did appeal to the market somewhat and was a positive feature. Both agents agreed the system added value. Based on the agents' comments, a reasonable conclusion to draw is that the system added between $5,000 and $10,000 to the value, with more emphasis on the lower end of the value range. This clearly indicates that this PV system (to the buyers) was a superadequacy.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
$1,140 to $1,900 per kW	$1,950 per kW	$1,640 to $2,050 per kW (PV Value) $1,860 per kW (average)
		$2,600 per kW (GRM)

The paired sales analysis, despite consisting of homes of lower value than the subject property, is still very applicable since all of the sales are from the same immediate subdivision (and builder). The data included in the paired sales analysis is very strong and is therefore given a good deal of consideration in the reconciliation.

The cost approach has reliable and current cost figures. Therefore, the value indication by the cost approach is reliable and reflective of the market.

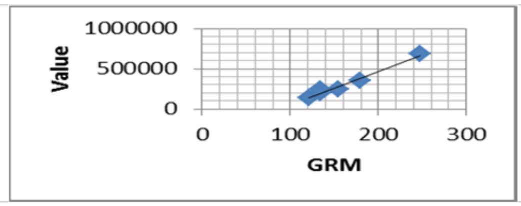
The income approach value indication generated using PV Value is also very reliable given that all data needed to adequately utilize the tool was either known or market-derived. The data is very strong and the findings reflect those found using the paired sales analysis and the cost approach.

The income approach using the GRM was outside the other value indicators and therefore deserves the least amount of consideration in the reconciliation. It is exceedingly rare for properties in this price range to be rented; therefore, the data set available to develop the GRM was too small to be reliable.

In conclusion, given that all three approaches to value share a very narrow indication range of $1,860 to $1,950 per kW, a reasonable conclusion of value for this PV system is:

As of March 2013, the value is: **$1,900 per kW** for a 5.5 kW, 4-year old system with 21 years of remaining useful life and a location in Broomfield, Co, Subdivision "A"
PV System did not affect marketing time.

Broomfield, Subdivision “A”: Case Study 3

SUBDIVISION A			
Subdivision location:	Broomfield, CO	**Price range of homes sold[111]:**	$345,000 to $550,000 Median: $369,000 Mode: no mode
Number of detached homes:	Around 500	**Age range of homes:**	2001 to 2009
Percentage of Rentals:	16%	**Gross Rent Multiplier chart for subdivision (includes townhomes):**	
Quality of Construction:	Average to Very Good	**Type of homes:**	Tract homes, mostly 2-story on standard 5,000 to 19,000 sq.ft. lots
Number of homes sold in 6 months[112]:	13	**Range of above-grade square footages:**	1800 – 4600
Number of PV permits[113]:	19	**Number of homes that sold after they had PV installed:**	3 in the last year. None prior to that.
Range of kWs installed:	2.8-8.6	**Range of cost for PV systems over a three year period:**	$21,000 to $60,000 (before incentives)
Median kW amount installed:	6.02	**Median gross cost of PV systems:**	$30,000 (before incentives)

GENERAL PROPERTY INFORMATION: Case Study 3			
Purchase Date:	December, 2012	**Sales Price of house:**	$450,000
Age of home:	9 years	**Above-grade sq.ft. of home:**	3002
Total days on market[114]:	11	**Average Days on Market for subdivision[115]:**	49
Gross Rent Multiplier for similar home:	200		
Other green and/or energy efficient features: none known			

[111] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[112] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[113] Figures are for 2009, 2010, 2011 and 2012.
[114] For this report, “Days on Market” is defined as the number of days between the list date and the date of contract.
[115] Information is based on sales that sold in the six months proper to the closing date of the subject property.

MARKET CONDITIONS AT TIME OF SALE for Case Study 3 :	STABLE
This property went under contract in October 2012. At that time, this market area was balanced and stable. The significant lack of inventory was not yet notable (as it would be a few months later). Thus, in this time period, the buyer and seller had equal negotiating powers and values were stable.	

PHOTOVOLTAIC SYSTEM For Case Study 3

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Listing Agent
kW	3.96 kW	Permit
Date of Permit	March, 2008	Permit
Manufacturer of panels	Day 4 Energy	Permit
Warranty on panels	25 Years	(assumed)
Manufacturer of Inverter	Fronius	Permit
Warranty on Inverter	5 or 10 Years	Permit
Type	Fixed	Permit, Observation
Tilt	22.6	Observation
Energy Production per panel	165 watts	Permit
Energy Production Estimate (for 1 year)	5432	PV Value
Location	Roof	Permit, Observation
Age of panels	4 years	Permit
Inverter type	Wall mount	Permit, Observation
Age of Inverter	4 years	Permit
Original gross cost	$9,103	Permit
Azimuth	205	Solmetric Roof Azimuth tool

Real Estate Agent comments:

Listing Agent: Buyers were scared of the PV system until the sellers gave them some information about it. Listing agent thinks it cost the sellers $20,000 (gross) and $6,000 net when they bought it. It did not sell faster because of PV. It did not sell for more because of PV.
Buyer's Agent: Buyers thought it was "Nice to have it." Buyers stuck to their offer regardless of benefits of PV. PV added no value for these buyers (these buyers did not understand the system).

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #3

DATA SOURCES

Attempts were made to contract or gather all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 3:

✓	Listing Agent	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis	✓	Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 3's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
✓	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis[116]

	Subject	Comp 2
Sale Date	December, 2012	June, 2012
Sale Price	$450,000	$435,000
Market Conditions:	Stable	Stable
Days to Sale	11	18
Square Feet	3002	2970
Basement Sq.Ft.	768	1486
View	Fronts to park/median	Residential
Bathrooms	3 full, 1 half	2 full, 1 half
Photovoltaic	Yes: 3.96 kW	No
Age of PV System	4 years	n/a

The properties noted above are very similar to the subject property (see footnote below). The higher bathroom count of the subject property offsets the larger basement square footage of Comp 1. Both sales were verified. As per interior photos available on MLS, there were no noted differences in upgrades, finish features or overall condition. The only notable difference is the view of the subject property. A $15,000 value for this view is reasonable (based on one paired sale from 2011).

Given the differences between the two properties (including the lack of good support for the view adjustment), this paired sale is minimally reliable.

Thus, the above data concludes what both the listing agent and selling agent thought:

As of December 2012, a value indication using the Paired Sales Analysis is: **$0** for a 3.96 kW, 4-year old system with 21 years remaining useful life.

[116] Items not noted on the paired sales grid that are essentially identical are: conditions of sale, financing, market conditions, garage count, builder, quality of construction, lot sizes, and unfinished basements.

B. Cost Approach (Using Local Builder Costs)

Using the replacement cost appraisal method, current builder costs were extracted using building permit information for the City of Broomfield:

Date of Permit	Subdivision	Total system Cost	kWs	Cost per kW
11/21/2012	BRM CC	$29,500	7.5	$3,933
11/21/2012	MCKAY LND	$29,900	7.99	$3,742
11/27/2012	BRM HEIGHTS	$23,760	7.92	$3,000
11/27/2012	WILLOW RUN	$29,800	6.213	$4,796
12/4/2012	BRANDYWINE	$8,640	2.88	$3,000
12/7/2012	GRNW PK	$20,160	6.72	$3,000
12/7/2012	WESTLAKE VILLAGE	$12,480	4.16	$3,000
12/7/2012	ASPEN CRK	$19,300	4.9	$3,939
12/11/2012	BRANDYWINE	$16,560	5.52	$3,000
12/11/2012	BRM HEIGHTS	$17,280	5.76	$3,000
12/11/2012	HIGHLAND PK SOUTH	$25,920	8.64	$3,000
12/17/2012	RIDGEVIEW HEIGHTS	$21,000	6	$3,500
12/17/2012	ASPEN CRK	$28,565	7.59	$3,764
12/20/2012	BLAND	$26,361	7.105	$3,710

Current local costs average $3,577(rounded to $3,500) per kW. Therefore, a current cost estimate of $3,500 per kW is reasonable.

Depreciation is based on the system's actual age (as of March, 2013), compared to its useful life:

Straight-line age/life method	
Age of system:	4 years
Useful life:	25 years[117]
4/25 = 16% depreciated	

[117] The manufacture for these solar panels has gone out of business (and they sold their assets to another company). It was not known how long the warranty was for, however, is assumed to be 25 years since that is typical for the market. Total useful life is based on this estimated warranty life.

Since the subject property has a 3.96 kW system, the following calculations can be made:

3.96 kW X $3,500 =	$13,860
$13,860 less 16% depreciation =	$11,642 (rounded to $11,600) = Cost today
Cost today =	$11,600
$1000 X 3.96kW for functional obsolescence=	-$3,960
	$7,600 (rounded)

In conclusion, based on actual local costs, the indicated value by the cost approach, as of December 2012, is $7,600 for a 3.96 kW system.

As of December, 2012 a value indication using the Cost Approach is:
$1,920 (rounded) per kW
for a 3.96 kW, 4-year old system with 21 years remaining of useful life.

In this instance, the cost approach data is considered to be very reliable since actual, current, local costs were available. Therefore, the quality and quantity of the cost data is considered to be excellent.

C. Income Approach (using a Gross Rent Multiplier)

A suitable, comparable rental property was not found; however, a reasonable GRM could be developed based on general area rental data. Given the GRM chart for this subdivision, a reasonable GRM for the subject property is 200.

By calculating the subject's average estimated monthly savings, the GRM can be used to estimate the value contribution of these savings.

1) Subject's yearly energy production is estimated[118] at 5432 kWh
2) Current utility rates are $0.11 per kWh
3) 5432 kWh X $0.11 = $597.52/12 = $49.79 per month
4) $49.79 X (GRM of 200) = **$9,958** (for a 3.96 kW system)

These figures are then reduced to a per kW estimate:

As of December 2012, a value indication using the income approach is:
$2,520 (rounded) per kW
for a 3.96 kW, 4-year old system with 21 years remaining of useful life.

[118] The estimated savings rate is based on the probable number of kWh's the system will generate in a year (per PV Value®) and using current, local utility rates.

D. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 21 years. The system is already four years old; thus, the remaining useful life is only 21 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		**Discount Rate Calculation**		**Electricity Rate Inputs**		**Operation & Maintenance Inputs**	
Zip Code	80023	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	3960	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$1670.59
Module Degradation rate	0.5	Net Yield Rate (Custom)[119]	3.62	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	22.6	Discount Rate(low)	4.12			Actual Age/Years	4
Azimuth	205	Discount rate (average)	5.37			Remaining Energy/Years	21
KWh Produced/Year	5432	Discount rate (high)	6.62				

*Note: *XXXX* = User Input   *XXXX* = User Input Override   *XXXX* = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$590.51

Present value estimate of accumulated energy production for remaining 21 years	
Low	$6,156.37
Average	$6,969.27
High	$7,925.88

As per the above data, the indicated value by the income approach is between $6,200 and $7,900 (both figures are rounded).

As of December 2012, a value indication using the income approach is:
$1,560 to $2,000 (rounded) per kW
for a 3.96 kW, 4-year old system with 21 years remaining useful life.
The value indication using the average discount rate is
$1,770 per kW.

This data is considered to be very reliable since all details about the subject's PV system were known. Thus, the quality and quantity of the value conclusion are considered to be excellent. This value indication is above the value indication using the paired sales analysis.

[119] Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- A paired sales analysis supported the listing agent's and selling agent's statements that this property did not sell for more because of the PV system.
- The listing agent did not feel the property sold faster or for more because of the PV system (however, market data clearly indicates otherwise).
- The listing agent did not actively market the specifics of the PV system.
- The only comment in the MLS with regard to the PV system was one word: "Solar." No details were given about the system, and when interviewed, neither the listing agent nor the selling agent knew any of the details about the system.

Therefore, the homebuyers did not show much interest in the PV system, nor were they given any education about the system by the listing agent. No party felt the home sold for more because of the PV system. The only positive comment either party made (during the interview) was that the PV system was "nice to have."

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
$0	$1,920 per kW	$2,520 per kW (GRM)
		$1,560 to $2,000 per kW (PV Value) $1,770 per kW(average)

The listing agent, selling agent and one weak paired sale indicate the PV system did not contribute value to the sale of the subject property. As per the buyer's agent, the buyers had no understanding or interest in the potential system and were steadfast in refusing to pay for the system.

Since the listing agent did not know the details of the system, did not actively market the system and did not work to educate the buyers about the system, the buyers ultimately gave it no value. Even though Case Study 1 and Case Study 2 (which are located in the same subdivision as this property) had good paired sale data indicating this market area was willing to pay for a PV system, this property sold without that additional value. It is reasonable to conclude that the PV system could have contributed value if the agent had worked to educate the buyers.

In other words, given that these buyers had no interest in paying a premium for the PV system and the sellers were willing to accept an offer that did not include a premium, this PV system did not contribute any value to the sale of the home.

Since there is proof (from Case Study 1 and Case Study 2) that PV systems add value in this neighborhood, the conclusion was made that this buyer was not knowledgeable about the system and therefore, did not meet the definition of market value. This was not a market value transaction. In conclusion, because Case Study 3 did not meet the definition of market value, any value conclusion reached for this property is not considered to applicable or relevant to this study.

As of December 2012, the value is: **not applicable** for a 3.96 kW, 4-year old system with 21 years of remaining useful life and a location in Broomfield, Co, Subdivision "A"
Marketing time was 11 days vs. the 49 days which was the average for other homes in the subdivision at this time period.

Broomfield, Subdivision "B": Case Study 4

SUBDIVISION B			
Subdivision location:	Broomfield, CO	**Price range of homes sold[120]:**	$225,000 to $1,025,000 Median: $445,250 Mode: $420,000
Number of detached homes:	Around 560	**Age range of homes:**	1998 to 2013
Percentage of Rentals:	7%	**Gross Rent Multiplier information:**	One rental was found for $2900 for a very similar home. $615,000/$2900 = 212
Quality of Construction:	Average to Excellent	**Type of homes:**	Mostly tract homes (some custom), mostly 2-story on standard 5,000 to 15,000 sq.ft. lots
Number of homes sold in 6 months[121]:	56	**Range of above-grade square footages:**	1900 – 4600
Number of PV permits[122]:	1	**Number of homes that sold after they had PV installed:**	1 in the last year. None prior to that.
Range of kWs installed:	4.1	**Range of cost for PV systems over a three year period:**	$23,222 (before incentives)
Median kW amount installed:	4.1	**Median gross cost of PV systems:**	$23,222 (before incentives)

GENERAL PROPERTY INFORMATION: Case Study 4			
Purchase Date:	April, 2013	**Sales Price of house:**	$615,000
Age of home:	5 years	**Above-grade sq.ft. of home:**	4217
Total days on market[123]:	156	**Average Days on Market for competing homes in the subdivision[124]:**	108 (this only includes three sales, thus it is not a very reliable indicator).
Gross Rent Multiplier for similar home:	212		
Other green and/or energy efficient features: none known			

[120] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[121] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[122] Figures are for 2009, 2010, 2011 and 2012
[123] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[124] Information is based on sales that sold in the six months proper to the closing date of the subject property.

MARKET CONDITIONS AT TIME OF SALE for Case Study 4 :	STABLE
This price point (i.e. over $550,000) was stable during this time period, while the rest of the market was experiencing increasing values.	

PHOTOVOLTAIC SYSTEM For Case Study 4

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Selling Agent
kW	4.1 kW	Permit
Date of Permit	Aug, 2008	Permit
Manufacturer of panels	Kyocera	Permit
Warranty on panels	20 Years	Permit
Manufacturer of Inverter	Fronius	Permit
Warranty on Inverter	5 or 10 Years	Permit
Type	Fixed	Permit, Observation
Tilt	18.43	Observation
Energy Production per panel	205 watts	Permit
Energy Production Estimate (for 1 year)	5788	PV Value
Location	Roof	Permit, Observation
Age of panels	5 years	Permit
Inverter type	Wall mount	Permit
Age of Inverter	5 years	Permit
Original gross cost	$23,222	Permit
Azimuth	193	Solmetric Roof Azimuth tool

Real Estate Agent comments:

Listing Agent: No feedback given.
Buyer's Agent: Buyers thought the PV was a "cool add on". It was a nice bonus, and they liked to have it. They never would have [paid the actual cost of the system] to have it. It did not contribute any major value, it was just an extra feature that was nice to have.

DETERMINING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #4

DATA SOURCES

Attempts were made to contact or gather all of the following sources . The sources that are marked with a check are those for which information was successfully obtained for Case Study 4:

	Listing Agent	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis	✓	Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to help determine the contribution value (if any) of Case Study 4's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
✓	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis

	Subject	Comp 1
Sale Date	April, 2013	November, 2012
Sale Price	$615,000	$643,000
Market Conditions	Stable	Stable
Days to Sale	156	372
Square Feet	4022	4022
View	Residential	Golf Course
Photovoltaic	Yes: 4.1 kW	No
Age of PV System	5 years	n/a

The subject property and Comp 1 are the identical model of home. Comp 1, however, has a golf course view. Both properties have unfinished basements, three car garages and extremely similar overall interior finish features. There is a total of a $28,000 value difference between these two properties. The gap of $28,000 on Comp 1 represents the superior view and the PV system of the subject property.

There were no reasonable paired sales in this price range to show the precise value of the golf course view. There were paired sales from a lower price range, but ultimately, that data did not translate to the higher valued homes.

Past paired sales data (from three to five years ago) suggests that the golf course view had a value of between $15,000 and $20,000; however, that data is too old to be relevant given that the market conditions were so different in that time period.

Therefore, the exact value contribution of the PV system is not discernible.

The following is the reasonable conclusion:

As of April 2013, a value indication using the Paired Sales Analysis is:
Inconclusive, but likely more than $0
for a 4.1 kW, 5-year old system with 15 years remaining useful life.

B. Cost Approach (Using Local Builder Costs)

Using the replacement cost appraisal method, current builder costs were extracted using building permit information for the City of Broomfield:

Date of Permit	Subdivision	Total system Cost	kWs	Cost per kW
11/21/2012	BRM CC	$29,500	7.5	$3,933
11/21/2012	MCKAY LND	$29,900	7.99	$3,742
11/27/2012	BRM HEIGHTS	$23,760	7.92	$3,000
11/27/2012	WILLOW RUN	$29,800	6.213	$4,796
12/4/2012	BRANDYWINE	$8,640	2.88	$3,000
12/7/2012	GRNW PK	$20,160	6.72	$3,000
12/7/2012	WESTLAKE VILLAGE	$12,480	4.16	$3,000
12/7/2012	ASPEN CRK	$19,300	4.9	$3,939
12/11/2012	BRANDYWINE	$16,560	5.52	$3,000
12/11/2012	BRM HEIGHTS	$17,280	5.76	$3,000
12/11/2012	HIGHLAND PK SOUTH	$25,920	8.64	$3,000
12/17/2012	RIDGEVIEW HEIGHTS	$21,000	6	$3,500
12/17/2012	ASPEN CRK	$28,565	7.59	$3,764
12/20/2012	BLAND	$26,361	7.105	$3,710

Current local costs average $3,577 (rounded to $3,500) per kW. Therefore, a current cost estimate of $3,500 per kW is reasonable.

Depreciation is based on the systems actual age (as of April 2013), compared to its useful life:

Straight-line age/life method	
Age of system:	5 years
Useful life:	20 years[125]
5/20 = 25% depreciated	

Since the subject property has a 4.1 kW system, the following calculations can be made:

4.1 kW X $3,500=	$14,350
$14,350 less 25% depreciation =	$10,762 (rounded to $10,800)= Cost Today
Cost Today =	$10,800
$1000 X 4.1 kW for functional obsolescence=	-$4,100
	$6,700

[125] The subject property's PV system is 5 years and has a 20 year warranty. Total useful life is based on the life of the warranty.

Thus, as per actual local builder costs, the indicated value by the cost approach, as of April 2013, is $6,700 for a 4.1 kW system.

As of April 2013, a value indication by the cost approach is:
$1,630 (rounded) per kW
for a 4.1 kW, 5-year old system with 15 years of remaining useful life.

In this instance, the cost approach data is considered to be very reliable since actual, current, local costs were available. Therefore, the quality and quantity of the cost data are considered to be excellent.

C. Income Approach (Using a Gross Rent Multiplier)

One rental property was found of a similar property. The property had an *advertised* rental rate of $2900. Given the subject's sale price of $615,000, the indicated GRM is 212.

By calculating the subject's average estimated monthly savings, the GRM can be used to estimate the value contribution of these savings.

5) Subject's yearly energy production is estimated[126] at 5788 kWh
6) Current utility rates are $0.11 per kWh
7) 5788 kWh X $0.11 = $636.68/12 = $53.05 per month
8) $53.05 X (GRM of 212) = **$11,248** (for a 4.1 kW system)

These figures are then reduced to a per kW estimate:

As of April 2013, the value indicated using the income approach is:
$2,740 (rounded)
per kW for a 4.1 kW, 5 year old system with 15 years remaining of useful life.

Given that the GRM is generated using data from one property that is merely advertised for rent (and not actually rented), the GRM is very weak and therefore, is given no consideration in the reconciliation of values.

[126] The estimated savings rate is based on the probable number of kWh's the system will generate in a year (per PV Value®) and using current, local utility rates.

D. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 15 years. The system is already five years old, thus, the remaining useful life is only 15 years, as the warranty period on this product is only 20 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		**Discount Rate Calculation**		**Electricity Rate Inputs**		**Operation & Maintenance Inputs**	
Zip Code	80023	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	55
System Size in Watts	4100	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	1755			Inverter cost	$1,787.66
Module Degradation rate	0.5	Net Yield Rate (Custom)[127]	3.59	Utility Escalation rate	2.21	System Warranty/Years	20
Tilt	18.4	Discount Rate(low)	4.09			Actual Age/Years	5
Azimuth	193	Discount rate (average)	5.34			Remaining Energy/Years	15
KWh Produced/Year	5788	Discount rate (high)	6.59				

**Note: XXXX = User Input   XXXX = User Input Override   XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$625.95

Present value estimate of accumulated energy production for remaining 15 years	
Low	$5,060.20
Average	$5,585.70
High	$6,179.148

As per the above data, the indicated value by the income approach is between $5,100 and $6,200 (both figures are rounded) for a 4.1 kW system.

As of April 2013, a value indication using the income approach is:
$1,240 to $1,500 (rounded) per kW
for a 4.1 kW, 5-year old system with 15 years remaining of useful life.

This data is considered to be very reliable since all details about the subject's PV system were known. Thus, the quality and quantity of the value conclusion are considered to be excellent.

127 Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The listing agent did not provide feedback.
- The selling agent indicated that the buyers did like the system and that it was not a "major value" feature. The PV system was a "nice bonus" and a good "add on."
- There are extremely few PV systems in this subdivision.

The PV system did appeal to the market and was a positive feature. The selling agent did not specifically indicate one way or the other what the exact value to the PV system was, only that the buyers thought it was "cool" and that they "would not pay" the retail price to purchase one. This supports the conclusion that PV systems are a superadequacy in this market area.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
Inconclusive, but more than $0	$1,630 per kW	$2,740 per kW (GRM)
		$1,240 to $1,500 per kW (PV Value)

The paired sales analysis and the buyer's agent indicate that the PV system has a positive value, but an exact dollar figure could not be developed with available area sales.

The cost approach is applicable, as the buyers themselves made reference to the cost and the fact that they would not pay the cost to have the system installed, but liked having the system. Therefore, the PV system was a superadequacy and the cost approach is applicable to buyers in this market area.

The income approach using the PV Value tool is applicable in this market area and a reflection of buyers' actions (this conclusion can be drawn from the fact that the buyers thought it did add value, but not "major value", to the property).

The income approach using the GRM gave a value indication that was outside of other value indicators and therefore, was not given any consideration.

In conclusion, the final value estimate is based mainly on the figure generated using the paired sales analysis:

As of April 2013, the value is: **$1,500 to $1,630 per kW** for a 4.1 kW, 5-year old system with 15 years remaining of useful life and with a location in Broomfield, Co, Subdivision "B"
Data regarding the marketing time was inconclusive.

Broomfield, Subdivision “C”: Case Study 5

SUBDIVISION C			
Subdivision location:	Broomfield, CO	**Price range of homes sold[128]:**	$275,000 to $615,000 Median: $409,330 Tri-Model: $352,000, $435,000 and $505,000
Number of detached homes:	Over 1000	**Age range of homes:**	2005 to 2013
Percentage of Rentals:	9%	**Gross Rent Multiplier chart for subdivision:**	Not able to retroactively locate rental data from 2011.
Quality of Construction:	Average to Excellent	**Type of homes:**	Mostly tract homes. Mostly 2-story on standard 5,000 to 15,000 sq.ft. lots
Number of homes sold in 6 months[129]:	66	**Range of above-grade square footages:**	1200 – 4500
Number of PV permits[130]:	3	**Number of homes that sold after they had PV installed:**	1 in 2011 None prior to that.
Range of kWs installed:	1.38- 4.76	**Range of cost for PV systems over a three year period:**	$2,700 to $32,000 (before incentives)
Median kW amount installed:	2.7	**Median gross cost of PV systems:**	$14,300 (before incentives)

GENERAL PROPERTY INFORMATION: Case Study 5			
Purchase Date:	August, 2011	**Sales Price of house:**	$410,000
Age of home:	5 years	**Above-grade sq.ft. of home:**	2518
Total days on market[131]:	23	**Average Days on Market for subdivision[132]:**	90
Gross Rent Multiplier for similar home:	205		
Other green and/or energy efficient features: none known			

MARKET CONDITIONS AT TIME OF SALE for Case Study 5 :	STABLE
Values were stable after a period of decline. While the greater market area was experiencing some short-sales and REO properties, they were not noted in this subdivision. This area was stable with no indication of increasing (or decreasing) value trends.	

[128] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[129] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[130] Figures are for 2009, 2010, 2011 and 2012.
[131] For this report, “Days on Market” is defined as the number of days between the list date and the date of contract.
[132] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 5			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	MLS listing
	kW	2.1 kW	Permit
	Date of Permit	July, 2008	Permit
	Manufacturer of panels	Sun Power	Permit
	Warranty on panels	25 Years	Permit
	Manufacturer of Inverter	Sun Power	Permit
	Warranty on Inverter	10 Years	Permit
	Type	Fixed	Permit, Observation
	Tilt	18.43	Observation
	Energy Production per panel	210 watts	Permit
	Energy Production Estimate (for 1 year)	3011	PV Value
	Location	Roof	Permit, Observation
	Age of panels	3 years	Permit
	Inverter type	Wall mount	Permit
	Age of Inverter	3 years	Permit
	Original gross cost	$18,900	Permit
	Azimuth	180	Solmetric Roof Azimuth tool
Realtor comments:	*Listing Agent*: Did not call back. *Buyer's Agent:* The buyer's agent is not disclosed on MLS listing, thus, the agent is unknown and could not be contacted.		

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #5

DATA SOURCES

Attempts were made to contact or gather all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 5:

	Listing Agent	✓	Permit
	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
✓	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis	✓	Area rental data (current data from 2013, not from 2011)

APPRAISAL METHODS

The appraisal methods noted below were used to help determine the contribution value (if any) of Case Study 5's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
✓	Income Approach (Using a Gross Rent Multiplier)

Paired Sales Analysis[133]

A paired sales analysis occurs when very similar properties that were sold recently are "paired" to other sales. The difference in sale price between the properties is then attributed to the feature the other property does not have.

	Subject	Comp 1	Comp 2
Sale Date	August, 2011	May, 2010	January, 2011
Sale Price	$410,000	$394,000	$440,000
Market Conditions	Stable	Stable	Stable
Days to Sale	23	34	178
Square Feet	2518	2518	2518
Photovoltaic	Yes: 2.1 kW	No	No
Age of PV System	3 years	n/a	n/a
Relevant Prior Sale	03/13/2006 for $397,510	09/22/2006 for $377,240	08/24/2006 for $403,840

The listing agent was not able to be contacted and the selling agent was not listed on the MLS. Thus, the sale of the subject property was not able to be verified. The above paired sales analysis suggests that the home with the PV system sold for less than the other homes, given the prior sales in 2006 at the time of new construction. However, there is reason to suspect this property sold with motivating circumstances (based on comments in MLS). However, since this cannot be verified, the paired sale noted above is considered to be inconclusive.

Thus, the following figure is the most reasonable conclusion:

As of August 2011, a value indication using the Paired Sales Analysis is:
INCONCLUSIVE
for a 2.1 kW, 3-year old system with 22 years remaining useful life.

[133] Items not noted on the paired sales grid that are essentially identical are: conditions of sale, financing, market conditions, garage count, above grade bathroom count, builder, quality of construction, lot sizes, location, views, finished basements and general basement square footage.

B. Cost Approach (Using Local Builder Costs)

Using the replacement cost appraisal method, current builder costs were extracted using building permit information for the City of Broomfield:

Date of Permit	Subdivision	Total system Cost	kWs	Cost per kW
10/22/2010	ANTHEM	32385	4.76	$6,803
01/17/2013	ANTHEM	12587	2.4	$5,244
03/12/2013	ANTHEM	6600	1.38	$4,782

This property was purchased in 2011. As noted in the dates above, there is no cost data as of August 2011; however, the costs in 2010 were near $6,800 per kW and in 2013, they averaged $5,000 per kW. In conclusion, the average costs were between $5,200 per kW and $6,800 per kW in 2011.

Therefore, it is reasonable to use a cost of $5,900 per kW for this market area, ssince the property closed in August 2011. Also, note that this figure of $5,900 is higher than the market average because these homes have tile roofs- which results in higher installation costs.

The subject property has a 2.1 kW system; therefore, the following calculations can be made:

2.1 kW X $5,900 =$12,390

Depreciation is based on the systems actual age (as of August, 2011), compared to its useful life:

Straight-line age/life method	
Age of system:	3 years
Useful life:	25 years[134]
3/25 = 12% depreciated	

$12,390 less depreciation = $10,903 = Cost Today

Cost Today = = $10,903
$1000 X 2.1 kW for functional obsolescence = $2,100
=$8,800 (rounded)

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $8,800.

[134] The subject property's PV system is 3 years and has a 25 year warranty. Total useful life is based on the life of the warranty.

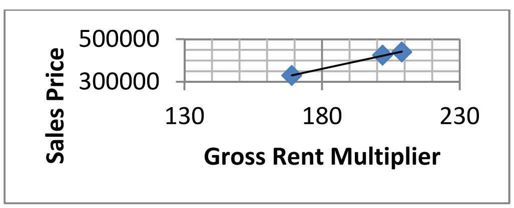
As per actual builder costs, the indicated value by the cost approach is $8,800 for a 2.1 kW system.

As of August 2011, a value indication using the cost approach is:
$4,190 (rounded) per kW
for a 2.1 kW, 3-year old system with 22 years remaining useful life. This is for a property with a concrete tile roof.

In this instance, the cost approach data is considered to have minor relevance. The cost to install PV systems is higher on properties with concrete tile roofs than on properties with composition roofs. There is no evidence that the market is willing to pay for this added expense, which is likely one of the main reasons there are so few homes in this subdivision with PV systems. Therefore, while the system has normal functional obsolescence for the market area (i.e. it costs more to install than it is worth), this property has additional functional obsolescence for the *additional* cost associated with installing the PV system on a concrete tile roof.

C. Income Approach (Using Gross Rent Multiplier)

The subject property sold in 2011, so no relevant rental data from 2011 was found. Rental rates have been fairly stable from 2011 to 2013, and therefore current rental data is considered to be a reliable indicator of the area GRM in 2011. Current rental data (from 2013) is as follows:



The GRM for the neighborhood ranges from 169 to 210. The most similar properties are those with a GRM near 210. Thus, 210 is the most relevant GRM.

By calculating the subject's average estimated monthly savings, the GRM can be used to estimate the value contribution of these savings.

1) Subject's yearly energy production is estimated[135] at 3011 kWh
2) Utility rates were just under $0.11 per kWh, however, $0.11 is used for this study
3) 3011 kWh X $0.11 = $331.21/12 = $27.60 per month
4) $27.60 X (GRM of 210) = **$5,796** (for a 2.1 kW system)

These figures are then reduced to a per kW estimate:

[135] The estimated savings rate is based on the probable number of kWh's the system will generate in a year (per PV Value®) and using local utility rates.

As of August 2011, the value indicated using the income approach is:
$2,760 (rounded) per kW
for a 2.1 kW, 3-year old system with 22 years remaining of useful life.

D. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 22 years. The system is already three years old, thus, the remaining useful life is only 22 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		**Discount Rate Calculation**		**Electricity Rate Inputs**		**Operation & Maintenance Inputs**	
Zip Code	80023	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	2100	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$757.48
Module Degradation rate	0.5	Net Yield Rate (Custom)[136]	4.54	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	18.4	Discount Rate(low)	5.04			Actual Age/Years	3
Azimuth	180	Discount rate (average)	6.29			Remaining Energy/Years	22
KWh Produced/Year	3011	Discount rate (high)	7.54				

**Note: XXXX = User Input XXXX = User Input Override XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$329.00

Present value estimate of accumulated energy production for remaining 22 years	
Low	$3,408.13
Average	$3,837.75
High	$4,344.54

According to the above data, the indicated value by the income approach is between $3,400 and $4,300 (both figures are rounded) for a 2.1 kW system.

As of August 2011, a value indication using the income approach is:
$1,620 to $2,050 (rounded) per kW
for a 2.1 kW, 3-year old system with 22 years remaining of useful life.
The value indication using the average discount rate is
$1,810 (rounded) per kW.

[136] Interest rate is from Interest Rate Chart contained in the addenda.

In this circumstance, this data is considered relevant. While the listing agent was not able to be personally reached, the listing agent did provide extensive written comments in the MLS listing regarding the subject's PV system. The listing agent specifically made reference to savings being "50% per month" and to a "cost benefit" analysis that could be provided to any potential buyers. This is an indication that the buyer was educated as to the economic benefits of the system (though, this could not be directly verified). Therefore, this value indicator is given consideration in the reconciliation of values.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The buyer's agent did not provide feedback. The listing agent also did not provide any feedback, but did include extensive information in the MLS regarding the PV system and its income benefits.
- Since the MLS listing had extensive comments regarding the benefits of the PV system, this is evidence that the listing agent did actively market the system and attempt to educate the buyers as to the income potential of the system.
- PV systems are more expensive in this subdivision than normal because of their concrete tile roofs.

A paired sales analysis was inconclusive; though it was possible Case Study 5 was a motivated sale with atypical selling circumstances. None of this, however, could be verified by a party involved in the sales transaction.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
Inconclusive	$4,190 per kW	$2,760 per kW (GRM)
		$1,620 to $2,050 per kW (PV Value)

The paired sales analysis proved inconclusive. Neither the listing agent nor the selling agent was able to be contacted. It was not clear how to interpret the data due to lack of feedback from anyone involved in the transaction.

The cost approach data is not given any consideration in the final reconciliation. The subject property is located in an area that has very few PV systems. Also, costs are higher to install PV systems in this subdivision because the homes have concrete tile roofs.

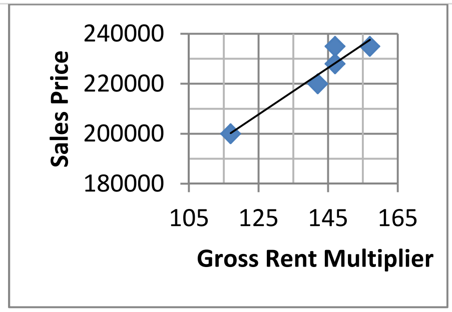
The value indication using the GRM is outside of all other value indicators and therefore, is given no consideration in the reconciliation.

The value indication from the income approach (using the PV Value tool) had a value indicator of between $1,620 and $2,050 per kW. The lower end of this value range is consistent with other market data for the Broomfield market area.

In conclusion, the final value estimate is based solely on the income approach

As of August 2011, the value is: **$1,620 per kW** for a 2.1 kW, 3-year old system with 22 years remaining of useful life and with a location in Broomfield, Co, Subdivision "C"
Marketing time was 23 days: 67 days less than the market average of 90 days.

Broomfield, Subdivision "D": Case Study 6

SUBDIVISION D			
Subdivision location:	Broomfield, CO	**Price range of homes sold[137]:**	$130,000 to $308,000 Median: $215,000 Mode: $230,000
Number of detached homes:	Over 1000	**Age range of homes:**	1956 to 1979
Percentage of Rentals:	28%	**Gross Rent Multiplier chart for subdivision:**	
Quality of Construction:	Fair to Average	**Type of homes:**	Tract homes. Mostly brick ranch homes on standard 5,000 to 12,000 sq.ft. lots
Number of homes sold in 6 months[138]:	29	**Range of above-grade square footages:**	1000 – 2500
Number of PV permits[139]:	18	**Number of homes that sold after they had PV installed:**	1 in 2011 None prior to that.
Range of kWs installed:	2.22-8.93	**Range of cost for PV systems over a three year period:**	$13,700 to $43,200 (before incentives)
Median kW amount installed:	5.52	**Median gross cost of PV systems:**	$23,000 (before incentives)

GENERAL PROPERTY INFORMATION: Case Study 6			
Purchase Date:	May, 2013	**Sales Price of house:**	$245,000
Age of home:	56 years	**Above-grade sq.ft. of home:**	1160
Total days on market[140]:	4 (Note: 5 offers were received on this property)	**Average Days on Market for subdivision[141]:**	51
Gross Rent Multiplier for similar home:	170		
Other green and/or energy efficient features: none known			

[137] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[138] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[139] Figures are for 2009, 2010, 2011 and 2012
[140] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[141] Information is based on sales that sold in the six months proper to the closing date of the subject property.

MARKET CONDITIONS AT TIME OF SALE for Case Study 6 :	INCREASING

This property went under contract in April 2013 during which the market was overheated. Supply was significantly below demand and it was common for properties to receive multiple offers. Every buyer was "desperate to buy", as this listing agent stated. Values had been increasing at 0.8% per month since January 2013.

PHOTOVOLTAIC SYSTEM For Case Study 6

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Listing Agent, Selling Agene
kW	6.75 kW	Permit, MLS listing
Date of Permit	August, 2011	Permit
Manufacturer of panels	Phono Solar	Permit
Warranty on panels	25 Years	Permit
Manufacturer of Inverter	Enphase Micro	Permit
Warranty on Inverter	15 Years	Permit
Type	Fixed	Permit, Observation
Tilt	18.43	Observation
Energy Production per panel	225 watts	Permit
Energy Production Estimate (for 1 year)	7776	PV Value
Location	Roof	Permit, Observation
Age of panels	2 years	Permit
Inverter type	Wall mount	Permit
Age of Inverter	2 years	Permit
Original gross cost	$14,280[142]	Permit
Azimuth	92	Solmetric Roof Azimuth tool

Real Estate Agent comments:

Listing Agent: The average utility bills were $7 per month. Everyone liked the system. It was hard to tell how it impacted value since there was a bidding war immediately upon the home being listed for sale.

Buyer's Agent: The buyers felt ok paying more for the house because the PV system would reduce their utility bills to almost zero [i.e. the lack of utility bills allowed them to have a higher mortgage]. Buyers were "very positive" about the "big" PV system.

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #6

DATA SOURCES

Attempts were made to contact or gather all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 6:

✓	Listing Agent	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
✓	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis	✓	Area rental data

[142] This fee is for materials only. The homeowner installed the PV system himself.

APPRAISAL METHODS

The appraisal methods noted below were used to help determine the contribution value (if any) of Case Study 6's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using Rental Property comparable)
✓	Income Approach (Using PV Value)
✓	Income Approach (Using a Gross Rent Multiplier)
✓	Income Approach (Mortgage Savings)

A. Paired Sales Analysis

	Subject	Comp 1	Comp 1 Adjustments	Comp 2	Comp 2 Adjustments
Sale Price	$245,000	$242,500		$262,000	
Sale Date	May, 2013	March, 2013	+4,000	February 2013	+4000
Sale Confirmed	Listing Agent Selling Agent	Listing Agent		Listing Agent	
Days to Sale	3	4	0	4	0
Square Feet	1160	1258	-3,920	1272	-4,480
Photovoltaic	Yes	No	0	No	0
Notable Feature	Extensively Remodeled	Extensively Remodeled	0	Major Gut and Remodel	-20000
Other	3 bed/1 bath up, 1 Garage	2 bed/2 bath up, 1 Garage	-5000 0	2 bed/2 bath up, 1 Garage	-5000 0
	=$245,000		=$237,580		=$236,520

In this area, reasonable square footage adjustments are: $40 per square foot above grade, $7 per square foot basement square footage, and $14 per square foot for basement finish area. A 3 bed/1 bath home has a slightly lower market appeal than a 2 bed/2 bath home (per real estate agent feedback on both the above comps). Time adjustments are based on changes in median home prices for this market area and type of homes, as well as according to feedback both agents gave regarding market conditions (both agents specifically indicated they would get about $4,000 more today).

Based on the above information, a reasonable value contribution of the PV system ranges from $7,420 to $8,480 for a 6.75 kW system.

Thus, the following figure is the most reasonable conclusion:

As of May 2013, a value indication using the Paired Sales Analysis is:
$1,100 to $1,260 (rounded) per kW
for a 6.7 kW, 2-year old system with 23 years remaining useful life.

B. Cost Approach (Using Local Builder Costs)

Current builder costs were extracted using building permit information for the City of Broomfield:

Date of Permit	Subdivision	Total system Cost	kWs	Cost per kW
07/08/2009	BRM HEIGHTS	35957	5.07	$7,683
12/31/2009	BRM HEIGHTS	13700	3.136	$4,368
09/01/2010	BRM HEIGHTS	23000	5	$4,600
03/01/2011	BRM HEIGHTS	29269	5.52	$5,302
03/29/2011	BRM HEIGHTS	32661	5.64	$5,790
04/18/2011	BRM HEIGHTS	19740	5.64	$3,500
07/27/2011	BRM HEIGHTS	31200	5.52	$3,858
08/22/2011	BRM HEIGHTS	13280	2.22	$5,981
05/04/2012	BRM HEIGHTS	33575	5.88	$5,710
05/17/2012	BRM HEIGHTS	33468	8.93	$3,747
06/05/2012	BRM HEIGHTS	17821	3.96	$4,500

Most current permits average $4,600 per kW; however, this data is nearly one year old, and given that prices in all other areas have dropped to $3,500 per kW, $3,500 per kW is a reasonable cost estimate.

The subject property has a 6.7 kW system, thus:

6.7 kW X $3,500 per kW = $23,450.

Depreciation is based on the system's actual age (as of August 2013), compared to its useful life:

Straight-line age/life method	
Age of system:	2 years
Useful life:	25 years[143]
2/25 = 8% depreciated	

$23,450 less depreciation = $21,574, rounded to $22,000 = Cost Today

Cost Today = = $22,000
$1000 X 6.7 kW for functional obsolescence =$6,700
= $15,300

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $15,300.
This figure is then used to draw the following conclusion:

[143] The subject property's PV system is 2 years and has a 25 year warranty. Total useful life is based on the life of the warranty.

As of May 2013 a value indication using the cost approach is:
$2,280 (rounded) per kW
for a 6.7 kW, 2-year old system with 23 years remaining useful life.

C. Income Approach (Using a Gross Rent Multiplier)

More than 28% of the properties in this subdivision are rented. Thus, there is ample rental data available for comparison and a GRM is a reasonable indicator of market value in this subdivision. As noted in the GRM chart provided earlier, a GRM for the subject property is 170.

By calculating the subject's average estimated monthly savings, the GRM can be used to estimate the value contribution of these savings.

1) Subject's yearly energy production is estimated[144] at 7776 kWh
2) Current utility rates are $0.11 per kWh
3) 7776 kWh X $0.11 = $855.36/12 = $71.28 per month
4) $71.28 X (GRM of 170) = **$12,117** (for a 6.75 kW system)

These figures are then reduced to a per kW estimate:

As of May 2013, the value indicated using the income approach is:
$1,800 (rounded)
per kW for a 6.7 kW, 2-year old system with 23 years remaining of useful life.

Rental income is a factor that nearly 30% of potential buyers take into account when buying in this neighborhood. Also, there is ample rental information available. For this reason, the income approach is given consideration in the reconciliation of values. Also, the selling agent indicated the utility savings were taken into consideration by the buyers; therefore, the GRM is a reasonable method to determine the value contribution of the subject's PV system.

[144] The estimated savings rate is based on the probable number of kWh's the system will generate in a year (per PV Value®) and using local utility rates.

D. Income Approach (Rental Property)

The subject property sold for $245,000 with a PV system. A paired sales analysis was found by comparing a property leased with a PV system, with one that was leased without a PV system. This paired sales analysis come from a subdivision that is contiguous to the subject's subdivision. The contiguous subdivision features homes in the same price points, but most of the homes were built in the early 1970s, not the late 1950s. Regardless, the two subdivisions are similar to one another.

	Rental 1	Rental 2
Rent price	$1695	$1650
Purchase Date	January 2013 $235,000	n/a
Rental Date	January 2013	May 2013
Style	Ranch	Two Story
Square Feet	1290	1308
Photovoltaic	Yes[145]	No
Notable Feature	Extensively Remodeled	Newer home, similar finish
Other	3 bed/2 bath up, 2 Garage	3 bed/2 bath up, 2 Garage

The owner of Rental 1 (a real estate agent and investor), felt Rental 1 rented for $45 higher than market, which is supported by the above paired sale. The buyer could not be sure if it rented for higher due to the PV system or not.

The owner's management company was, however, also surprised it was able to get such a high rent (i.e. $45 per month above current rates) for Rental 1. This additional $45 was paid for a property with a 4.56 kW system. Thus, the property rented for $10 more per month, per kW. Since the subject property has a 6.7 kW system, a reasonable conclusion is that the subject property's PV panels would command $67 more per month based on this rental information.

Given a GRM of 170, the $67 in extra rent indicates a possible value of $11,390 for a PV system of this size.

As of May 2013, the value indicated using the income approach is:
$1,700 (rounded) per kW
for a 6.7 kW, 2 year old system with 23 years remaining of useful life.

[145] These solar panels were leased. The lease was paid off at the time of purchase of the house. The sale price of this property was $10,000 below the market value (per the buyer) due to a drainage issue.

E. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 23 years. The system is already two years old; thus, the remaining useful life is only 23 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80020	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	55
System Size in Watts	6700	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$1,897.08
Module Degradation rate	0.5	Net Yield Rate (Custom)[146]	3.59	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	18.4	Discount Rate(low)	4.09			Actual Age/Years	2
Azimuth	92	Discount rate (average)	5.34			Remaining Energy/Years	23
KWh Produced/Year	7719	Discount rate (high)	6.59				

**Note:* *XXXX = User Input* *XXXX = User Input Override* *XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$854.05

Present value estimate of accumulated energy production for remaining 23 years	
Low	$10,041.72
Average	$11,398.00
High	$13,016.78

As per the above data, the indicated value by the income approach is between $10,000 and $13,000 (both figures are rounded) for a 6.7 kW system.

As of May 2013, a value indication using the income approach is:
$1,500 to $1,940 (rounded) per kW
for a 6.7 kW, 2-year old system with 23 years remaining of useful life.

In this circumstance, this data is considered very relevant. The selling agent indicated directly that the buyers took into consideration the income this PV system would generate. This data is therefore a reflection of how these buyers took into consideration the value contribution of the PV system.

[146] Interest rate is from Interest Rate Chart contained in the addenda.

F. Income Approach (Mortgage)

When deciding to purchase the subject property, these buyers took the income of the PV system into direct consideration when purchasing the home. They reasoned that they felt comfortable having a higher mortgage in exchange for virtually no energy bills.

Based on the kWhs this 6.75 kW PV system is capable of producing (an average of $71.17 in savings per month), the buyers were able to spend an additional $70.00 (rounded) per month on their mortgage knowing they would not spend that $70.00 on utility bills every month. This $70.00 translates into the following additional value the homebuyers could finance at today's lending rate of 3.59%:

$15,500 for a 6.75 kW system

When translated into a value per kW, the following figures are generated:

As of May 2013, a value indication using the income approach is:
$2,300 (rounded) per kW
for a 6.7 kW, 2-year old system with 23 years remaining of useful life.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The selling agent was emphatic that the PV system added value to the property and the buyers very much took into consideration the income the PV system would generate.
- The house went under contract in four days with five offers.
- The listing agent stated that everyone loved the PV system.

In this circumstance, the income of the PV system played a role in the sale price of the home.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
$1,100 to $1,260 per kW	$2,280 per kW	$1,800 per kW (GRM)
		$1,700 per kW (Rental Comparable)
		$1,500 to $1,940 per kW (PV Value)
		$2,300 per kW (Mortgage)

The paired sales analysis, given the large number of adjustments that were made to the sales, is weak and is therefore given minimal consideration in the reconciliation.

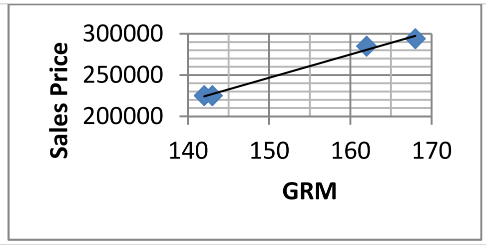
The cost approach data is given full consideration as the cost approach is a direct reflection of how buyers perceive the value of the PV system in this market area.

The income approach value using a GRM is given the majority of the consideration. This was the best indicator of market value and it is a strong indication. The data generated using the GRM is relevant and taken into consideration. The data generated using PV Value mirrors the conclusion reached using the GRM. The mortgage information is at the high end of the range and is given no weight since no other indicators have this high of a value conclusion.

In conclusion, the final value estimate is based mainly on the figures generated from the income approach. The majority of the income approach data points to the $1,700 to $1,800 value range. Thus, this is the final value conclusion:

As of May 2013, the value is: **$1,700 to $1,800 per kW** for a 6.75 kW, 2-year old system with 23 years remaining of useful life and with a location in Broomfield, Co, Subdivision “D”
Marketing time was 4 days: 47 days less than the market average of 51 days.

Arvada, Subdivision "A": Case Study 7

SUBDIVISION A			
Subdivision location:	Arvada, CO	**Price range of homes sold[147]:**	$183,500 to $344,500 Median: $251,000 Mode: $279,000
Number of detached homes:	840	**Age range of homes:**	1952 to 1984
Percentage of Rentals:	14%	**Gross Rent Multiplier chart for subdivision:**	
Quality of Construction:	Average to Good	**Type of homes:**	Mostly tract homes built in the 1970's on standard 5,000 to 15,000 sq.ft. lots
Number of homes sold in 6 months[148]:	16	**Range of above-grade square footages:**	700 – 2200
Number of PV permits[149]:	12	**Number of homes that sold after they had PV installed:**	1 in 2012 None prior to that.
Range of kWs installed:	2.53- 9.98	**Range of cost for PV systems over a three year period:**	$7,280 to $43,200 (before incentives)
Median kW amount installed:	5.76	**Median gross cost of PV systems:**	$20,160(before incentives)

GENERAL PROPERTY INFORMATION: Case Study 7			
Purchase Date:	August, 2012	**Sales Price of house:**	$291,000
Age of home:	30 years	**Above-grade sq.ft. of home:**	1539
Total days on market[150]:	22	**Average Days on Market for subdivision[151]:**	45
Gross Rent Multiplier for similar home:	168		
Other green and/or energy efficient features: Energy efficient furnace, tankless hot water heater			

[147] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[148] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[149] Figures are for 2009, 2010, 2011 and 2012.
[150] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[151] Information is based on sales that sold in the six months proper to the closing date of the subject property.

Case Study 7

MARKET CONDITIONS AT TIME OF SALE for Case Study 7 :	STABLE
Seasonally, this market had been stable for the two years prior to the closing date of the subject property. Marketing times were under two months and properties were selling at 98% to list price. Supply and demand were in balance.	

PHOTOVOLTAIC SYSTEM For Case Study 7

	Category	Details	Source
Details of the subject's PV system:	Ownership	Owned	Listing Agent, Selling agent
	kW	4.76 kW	Permit
	Date of Permit	May, 2008	Permit
	Manufacturer of panels		(unknown)
	Warranty on panels	25 Years	(assumed)
	Manufacturer of Inverter		(unknown)
	Warranty on Inverter	10 Years	(assumed)
	Type	Fixed, tilted	Observation
	Tilt	45.00	Observation
	Energy Production per panel		(unknown)
	Energy Production Estimate (for 1 year)	6955	PV Value
	Location	Roof	Observation
	Age of panels	4 years	Permit
	Inverter type	Wall mount	(assumed)
	Age of Inverter	4 years	(assumed)
	Original gross cost	$60,000[152] $37,242	Listing Agent Permit
	Azimuth	182	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Listing Agent*: Added $20,000-$25,000 to value. Agent had to work very diligently to educate the buyers and agent had to be very proactive. Every potential buyer liked the system. Buyers see a "great amount of value in solar systems that are owned." *Buyer's Agent:* Buyers were elderly and extremely nervous about the system. It took a lot of work to get them to educate them to the point that they "grew to understand the system." The buyers were on a fixed income. The buyers like the low utility bills but had no interest in paying for having the lower utility bills. They did not think they added value, it was not a "big" deal.		

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #7

DATA SOURCES

Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 7:

✓	Listing Agent	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research

[152] This figure seems very unlikely since there are only 10 panels with a system size of 4.76 kW. If the PV system was $60,000, which would have been a cost of $12,605 per kW, which is extremely high and not reflective of any actual costs from 2008 (when they bought the panels).

✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis	✓	Area rental data (current data from 2013, not from 2012)

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 7's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
✓	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis[153]

A paired sales analysis occurs when very similar properties that were sold recently are "paired" to other sales. The difference in sale price between the properties is then attributed to the feature the other property does not have.

	Subject	Comp 1
Sale Date	August, 2012	April, 2012
Sale Price	$291,000	$290,000
Market Conditions	Stable	Stable
Days to Sale	22	7
Square Feet	1539	1510
View	Park	Park
Photovoltaic	Yes: 4.76 kW	No
Age of PV System	4 years	n/a

These PV panels were a bit unusual in that they did not lie flat against the roof. Rather, they were tilted at a 45-degree angle off the roof. The selling agent stated that the reason the couple bought this house was the park view. The PV panels, to them, were a detriment at first. Once the buyers understood the system, they decided it was a neutral feature to them. The above paired sale shows the panels did not add value.

Thus, the following figure is the most reasonable conclusion:

As of August, 2012, a value indication using the Paired Sales Analysis is:
$0
for a 4.76 kW, 4 year old system with 21 years remaining useful life.

[153] All other features are similar: style, year of construction, garage count, updating, condition, bed and bath count and selling circumstances.

B. Cost Approach (Using Local Builder Costs)

Using the replacement cost appraisal method, current builder costs were extracted using building permit information for the City of Arvada:

Date of Permit	Subdivision	Total system Cost	kWs	Cost per kW
08/02/2012	Ralston Valley	$21,521	5.39	$3,992
08/03/2012	Ralston Valley	$18,720	6.24	$3,000
08/30/2012	Ralston Valley	$35,000	9.98	$3,507

Based on the above permit data, a reasonable current cost estimate for a PV system in this area is $3,500 per kW.

The subject property has a 4.76 kW system. Therefore, the following calculations can be made:

4.76 kW X $3,500 =$16,660

Depreciation is based on the system's actual age (as of August 2012), compared to its useful life:

Straight-line age/life method	
Age of system:	4 years
Useful life:	25 years[154]
4/25 = 16% depreciated	

$16,600 less depreciation = $13,944 = Cost Today

Cost Today =	=$13,944
$1000 X 4.76kw for functional obsolescence	=-$4,760
	= $9,200 (rounded)

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $9,200.

As per actual builder costs, the indicated value by the cost approach is $9,200 for a four-year old 4.76 kW system. Given that the current costs to replace the subjects system is $9,200, it is unlikely that the

[154] The subject property's PV system is 4 years and is assumed to have a 25 year warranty. Total useful life is based on the life of the warranty. If the estimated warranty period is incorrect, this could alter the conclusions and opinions reached in this report.

listing agent's conclusion that these panels added "$20,000 to $25,000" to the value of the home is correct. Thus, the listing agent's statement is given no consideration.

As of August 2012 a value indication using the cost approach is: **$1,930 (rounded) per kW** for a 4.76 kW, 4-year old system with 21 years remaining useful life.

In this instance, the cost approach data is considered to have no relevance. The elderly buyers only came to accept the PV panels after an initial negative reaction to them. Thus, the selling agent believes the buyers did not see value in the panels and, as a result, the actual cost of the panels was of no relevance.

C. Income Approach (Using a Gross Rent Multiplier)

The subject property sold in 2012, so no relevant rental data from 2012 was found. Rental rates have been fairly stable from late 2012 to mid-2013, as a result, current rental data is considered to be a reliable indicator of the area GRM in 2012.

The GRM for a like-quality house is 168.

By calculating the subject's average estimated monthly savings, the GRM can be used to estimate the value contribution of these savings.

1) Subject's yearly energy production is estimated[155] at 6955 kWh
2) Utility rates were $0.11 in late 2012
3) 6955 kWh X $0.11 = $765.05/12 = $63.75 per month
4) $63.75 X (GRM of 168) = **$10,710** (for a 4.76 kW system)

These figures are then reduced to a per kW estimate:

As of August 2012, the value indicated using the income approach is: **$2,250 (rounded) per kW** for a 4.76 kW, 4 year old system with 21 years remaining of useful life.

It was interesting to note that the selling agent did state that the buyers liked the fact that they would save on their utility bills. Clearly, there was an interest in the income this system would be able to generate. Yet, he also stated that the fear of the technology was a major obstacle and prevented the buyers from seeing any actual contributory value in the system.

[155] The estimated savings rate is based on the probable number of kWh's the system will generate in a year (per PV Value®) and using local utility rates.

D. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 21 years. The system is already four-4 years old, thus, the remaining useful life is only 21 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80004	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	4760	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$1952.34
Module Degradation rate	0.5	Net Yield Rate (Custom)[156]	3.89	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	45.0	Discount Rate(low)	4.39			Actual Age/Years	4
Azimuth	182	Discount rate (average)	5.64			Remaining Energy/Years	21
KWh Produced/Year	6955	Discount rate (high)	6.89				

**Note: XXXX = User Input XXXX = User Input Override XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$756.06

Present value estimate of accumulated energy production for remaining 21 years	
Low	$7,864.95
Average	$8,870.50
High	$10,052.42

As per the above data, the indicated value by the income approach is between $7,900 and $10,100 (both figures are rounded) for a 4.76 kW system.

As of August 2012, a value indication using the income approach is:
$1,660 to $2,120 (rounded) per kW
for a 4.76 kW, 4-year old system with 21 years remaining of useful life.

Again, this data is considered relevant. The buyer liked the idea of saving on utility bills but saw no value in paying for this feature.

156 Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV system:

- The listing agent's assessment regarding the value contribution of the PV system does not reflect market data.
- Both agents stated that it was a large obstacle to educate the buyers about the system. At first it was considered a negative, and then, after education, they grew to accept the system. They never felt it was a positive.
- A paired sales analysis shows the PV system had no contributory value.
- The panels were unsightly as they did not lay flat on the roof.

There was one additional factor that may have been a factor in the buyer's eyes: these panels were installed at an angle that was tilted away from the roof (i.e. they did not lay flat). As a result, they looked very much like the old hot water solar panels that the market area was adverse to. This unusual setpup was part of the reason the panels, at first, were a negative to the buyers.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
$0	$1,930 per kW	$2,250 per kW (GRM)
		$1,660 to $2,120 per kW (PV Value)

The paired sales analysis included on strong paired sale. This paired sale, combined with the buyers' agent's comments, supports the conclusion that the system added no value to the property.

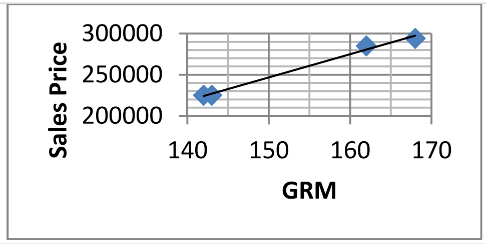
The cost approach data is given no consideration in the final reconciliation. The buyers, at first, saw the panels as a negative feature (and eventually grew to merely accept them). The buyers never considered the actual cost of the system as relevant. The cost approach was not a reflection of actions of the buyers for this sale.

The income approach to value is given consideration. The buyers liked the idea of very low utility bills but had no interest in paying a premium for this feature.

In conclusion, even after being educated about the system and learning the income potential of the system, the buyers had no interest in paying a premium to have the PV system. The final value estimate is based on the paired sales analysis and the lack of relevance of the cost approach and the income approach:

As of August 2012, the value is: **$0** for a 4.76 kW, 4-year old system with 21 years remaining of useful life and with a location in Arvada, Co, Subdivision “A”
Marketing time was 22 days: 23 days less than the market average of 45 days.

Arvada, Subdivision "A": Case Study 8

SUBDIVISION A			
Subdivision location:	Arvada, CO	**Price range of homes sold[157] in market area:**	$159,900 to $684,000 Median: $258,750 (3% increase over 6 mths) Tri-Model: $275,000, $310,000 and $315,000
Number of detached homes in subdivision:	840	**Age range of homes:**	1952 to 1984 (the subjects small infill sub-area consists of 22 homes built between 1995 and 1996)
Percentage of Rentals:	14%	**Gross Rent Multiplier chart for market area:**	
Quality of Construction:	Average to Good	**Type of homes:**	Mostly tract homes built in the 1970's on standard 5,000 to 15,000 sq.ft. lots
Number of homes sold in 6 months[158]:	58	**Range of above-grade square footages:**	700 – 2200
Number of PV permits[159]:	12	**Number of homes that sold after they had PV installed:**	1 in 2013 1 in 2012.
Range of kWs installed:	2.53- 9.98	**Range of cost for PV systems over a three year period:**	$7,280 to $43,200 (before incentives)
Median kW amount installed:	5.76	**Median gross cost of PV systems:**	$20,160(before incentives)

GENERAL PROPERTY INFORMATION: Case Study 8			
Purchase Date:	March, 2013	**Sales Price of house:**	$310,000
Age of home:	17 years	**Above-grade sq.ft. of home:**	1707
Total days on market[160]:	100	**Average Days on Market for subdivision[161]:**	45
Gross Rent Multiplier for similar home:	175		
Other green and/or energy efficient features: None noted			

[157] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[158] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[159] Figures are for 2009, 2010, 2011 and 2012.
[160] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[161] Information is based on sales that sold in the six months proper to the closing date of the subject property.

MARKET CONDITIONS AT TIME OF SALE for Case Study 8 :	INCREASING

Values increased 0.5% per month over the prior six months. Inventory was down and sale-to-list price ratios rose to 99% (which is abnormally high). Multiple offers were common. The number of sales increased nearly four-fold compared to six months prior.

PHOTOVOLTAIC SYSTEM For Case Study 8

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Listing Agent, Selling agent
kW	5.72	(assumed based on costs in 2007 of $6,500 per kW)
Date of Permit	August, 2007	Permit
Manufacturer of panels		(unknown)
Warranty on panels	25 Years	(assumed)
Manufacturer of Inverter		(unknown)
Warranty on Inverter	10 Years	(assumed)
Type	Fixed	Observation
Tilt	22.60	Observation
Energy Production per panel		(unknown)
Energy Production Estimate (for 1 year)	8159	(assumed)
Location	Roof	Observation
Age of panels	6 years	Permit
Inverter type	Wall mount	(assumed)
Age of Inverter	6 years	(assumed)
Original gross cost	$37,227	Permit
Azimuth	197	Solmetric Roof Azimuth tool

Real Estate Agent comments:

Listing Agent and Buyer's agent were one and the same: In the MLS, the agent stated "Solar panels are owned and have many years left on the warranty. Solar panels make for huge savings on electric bill." The agent did not know the size of the system. The panels were "of interest to the buyers because Green is in." Most buyers did not understand the systems or care to know their potential. They did add some value. Once buyers spoke to the owners and gained knowledge about the savings, they were excited. It did not, however, help with marketing.

Other note:

The permit data was incomplete; thus, many features of the PV system had to be assumed or deducted from other indicators. This is a limitation of this case study. If these assumptions are incorrect, they could alter the conclusions and opinions reached in this report.

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #8

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 8:

✓	Listing Agent		Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis	✓	Area rental data (current data from 2013, not from 2012)

APPRAISAL METHODS

The appraisal methods noted below were used to help determine the contribution value (if any) of Case Study 8's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
✓	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis[162]

	Subject	Comp 1	Adjustments
Sale Date	March, 2013	August, 2012	
Sale Price	$310,000	$316,669	
Market Conditions		Increased 0.5% per month over the last 6 months	+7900
Days to Sale	100	14	
Square Feet	1707	1752	
Updating	Minimal	Yes	-25000
View	Residential	Residential	
Photovoltaic	Yes: 5.72 kW	No	
Age of PV System	4 years	n/a	
			=$299,569

The overall value difference, for PV, is approximately $10,431 for a 5.72 kW PV system.

As of March 2013, a value indication using the Paired Sales Analysis is:
$1,820 per KW
for a 5.72 kW, 6 year old system with 19 years remaining useful life.

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[162] All other features are similar: style, year of construction, garage count, basement size, finished basement area, builder, location, bed and bath count and selling circumstances.

The one weakness to this value indicator is that the size of the system is not 100% verifiable. Also, the adjustment for updating could reasonably be just slightly higher, or just slightly lower. This is taken into consideration in the reconciliation.

B. Cost Approach (Using Local Builder Costs)

Using the replacement cost appraisal method, current builder costs were extracted using building permit information for the City of Arvada (Note: These costs are from the same immediate market area as there were no recent permits in the subject's, small 22-home infill subdivision).

Date of Permit	Subdivision	Total system Cost	kWs	Cost per kW
08/02/2012	Ralston Valley	$21,521	5.39	$3,992
08/03/2012	Ralston Valley	$18,720	6.24	$3,000
08/30/2012	Ralston Valley	$35,000	9.98	$3,507

Based on the above permit data, a reasonable current cost estimate for a PV system in this area is $3,500 per kW.

The subject property has what is assumed to be a 5.72 kW system; therefore, the following calculations can be made:

5.72 kW X $3,500 =$20,020

Depreciation is based on the system's actual age (as of March 2013), compared to its useful life:

Straight-line age/life method	
Age of system:	6 years
Useful life:	19 years[163]
6/25 = 24% depreciated	

$20,020 less depreciation = $15,215 = Cost Today

Cost today =	=$15,215
$1000 X 5.72kW for functional obsolescence=	-$5,720
	=$9,500 (rounded)

[163] The subject property's PV system is 6 years and is assumed to have a 25 year warranty. Total useful life is based on the life of the warranty. If the estimated warranty period is incorrect, this could alter the conclusions and opinions reached in this report.

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $9,500.

As of March 2013 a value indication using the cost approach is: **$1,660 (rounded) per kW** for a 5.72 kW, 6-year old system with 19 years remaining useful life.

C. Income Approach (Using Gross Rent Multiplier)

The GRM for a like-quality house is 175.

By calculating the subject's average estimated monthly savings, the GRM can be used to estimate the value contribution of these savings.

1) Subject's yearly energy production is estimated[164] at 8159 kWh
2) Utility rates were $0.11 in early 2012
3) 8159 kWh X $0.11 = $897.49/12 = $74.79 per month
4) $74.79 X (GRM of 175) = **$13,088** (for a 5.72 kW system)

These figures are then reduced to a per kW estimate:

As of March 2013, the value indicated using the income approach is: **$2,300 (rounded) per kW** for a 5.72 kW, 6-year old system with 19 years remaining of useful life.

[164] The estimated savings rate is based on the probable number of kWh's the system will generate in a year (per PV Value®) and using local utility rates.

D. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 19 years. The system is already six years old; thus, the remaining useful life is only 19 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80004	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	55
System Size in Watts	5720	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$1931.50
Module Degradation rate	0.5	Net Yield Rate (Custom)[165]	3.82	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	22.6	Discount Rate(low)	4.32			Actual Age/Years	6
Azimuth	197	Discount rate (average)	5.57			Remaining Energy/Years	19
KWh Produced/Year	8159	Discount rate (high)	6.82				

**Note:* *XXXX* = *User Input* *XXXX* = *User Input Override* *XXXX* = *Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$877.91

Present value estimate of accumulated energy production for remaining 19 years	
Low	$8,946.57
Average	$9,969.20
High	$11,155.54

As per the above data, the indicated value by the income approach is between $8,900 and $11,200 (both figures are rounded) for a 5.72 kW system.

As of March 2013, a value indication using the income approach is:
$1,560 to $1,960 (rounded) per kW
for a 5.72 kW, 6-year old system with 19 years remaining of useful life.

According to feedback received from the listing agent (who was also the buyer's agent), the buyers were excited about the saving potential once they were educated about the system. Therefore, the income approach is considered to be relevant. The one weakness, however, is that the precise size of the PV system is not known exactly (but is probably correct at 5.72kWs). Thus, this value indicator may be slightly low or slightly high. This is taken into consideration in the reconciliation.

[165] Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The listing agent commented that these buyers were excited about the potential savings of the PV system and that the system at most added "a small increase to the home value."
- This statement is verified by a paired sales analysis and data indicated by the PV Value valuation tool.

The weakness to this case study is that the exact size of the PV system is not known, as the permit was lacking relevant information and the agent did not know the size of the system. However, it was reasonable to conclude the system size was 5.72 kW based on its known cost in 2007, and the fact that systems typically cost about $6,500 per kW in the year 2007. If the assumption that the subject's system is 5.72 kWs in size is incorrect, this could alter the opinions and conclusions reached for this case study.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
$1,820 per kW	$1,660 per kW	$2,300 per kW (GRM)
		$1,560 to $1,960 per kW (PV Value)

The paired sales analysis was conclusive; however, the weakness in this approach is that the exact size of the PV system is not 100% verifiable.

The cost approach data was developed using actual builder costs from the subject's immediate neighborhood; therefore, the cost data is considered to be strong and relevant.

The income approach to value is given consideration. The value indication from the GRM is not relevant in this circumstance, as it is outside of all of all other value indicators. However, the value indication from the PV Value tool is considered to be an accurate reflection of the market. These buyers were specifically interested in the potential utility savings the system offered.

The greatest consideration is given to the cost approach, followed by the paired sales analysis, then by the value indication from PV Value.

In conclusion, the final value estimate is noted below.

As of March 2013, the value is: **$1,660 to $1,820 per kW** for a 5.72 kW, 6-year old system with 19 years remaining of useful life and with a location in Arvada, Co, Subdivision "A"
Marketing time was not less than the market area. PV had no impact on marketing time.

Arvada, Subdivision "B": Case Study 9

SUBDIVISION B			
Subdivision location:	Arvada, CO	**Price range of homes sold[166] in market area:**	$305,000 to $515,000 Median: $418,000 Bi-Model: $423,000 and $435,000
Number of detached homes in subdivision:	614	**Age range of homes:**	2002 to 2009
Percentage of Rentals:	7%	**Gross Rent Multiplier chart for market area:**	No rental data found
Quality of Construction:	Good to Very Good	**Type of homes:**	Tract homes from the 1970s on standard 5,000 to 15,000 sq.ft. lots
Number of homes sold in 6 months[167]:	58	**Range of above-grade square footages:**	1500 – 3500
Number of PV permits[168]:	Unknown (permits are not labeled by subdivision)	**Number of homes that sold after they had PV installed:**	1 in the year 2012
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 9			
Purchase Date:	June, 2012	**Sales Price of house:**	$460,000
Age of home:	5 years	**Above-grade sq.ft. of home:**	2850
Total days on market[169]:	32	**Average Days on Market for subdivision[170]:**	61
Gross Rent Multiplier for similar home:	No relevant rental data found		
Other green and/or energy efficient features: None noted			

MARKET CONDITIONS AT TIME OF SALE for Case Study 9 :	STABLE
The market had just stabilized (after a long period of slow decline). The number of sales per 6-month-sales-period was increasing, and the number of days on market was decreasing (from 72 to 61). Thus, values were stabilized.	

166 Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
167 Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
168 Figures are for 2009, 2010, 2011 and 2012.
169 For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
170 Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 9			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Listing Agent, Selling agent
	kW	7.13	Permit
	Date of Permit	January, 2009	Permit
	Manufacturer of panels		(unknown)
	Warranty on panels	25 Years	(assumed)
	Manufacturer of Inverter		(unknown)
	Warranty on Inverter	10 Years	(assumed)
	Type	Fixed	Observation
	Tilt	22.60	Observation
	Energy Production per panel		(unknown)
	Energy Production Estimate (for 1 year)	9979	PV Value
	Location	Roof	Observation
	Age of panels	3 years	Permit
	Inverter type	Wall mount	(assumed)
	Age of Inverter	3 years	(assumed)
	Original gross cost	$37,400	Permit
	Azimuth	204	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Listing Agent:* This property had extremely low utility bills and everyone was very excited about them. The agent actively marketed the system. The agent left the utility bills out for people to see. The PV system did add value and, was a positive for marketing, and as a result, the home sold very quickly. *Buyer's Agent:* The buyer's agent was willing to contact the homebuyers to see if they would provide feedback. However, in the end, it was not possible to obtain additional information from the homebuyer. The Buyer's agent provided no specific feedback.		

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #9

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 9:

✓	Listing Agent	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
✓	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis		Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to help determine the contribution value (if any) of Case Study 9's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis[171]

A paired sales analysis occurs when very similar properties that were sold recently are "paired" to other sales. The difference in sale price between the properties is then attributed to the feature the other property does not have.

	Subject	Comp 1	Comp 2
Sale Date	June, 2012	October, 2011	June, 2012
Sale Price	$460,000	$434,000	$435,000
Days to Sale	32	69	3
Square Feet	2850	2850	2850
View	Greenbelt/City	Park	Park
Photovoltaic	Yes: 7.13 kW	No	No
Age of PV System	3 years	n/a	n/a

These three homes are all the same model. All three homes have views; however, the subject's view is just superior to the view of Comp 1 and Comp 2. According to a conversation with two area agents, the greenbelt/city view was considered to have a contributory value of $15,000. This was the only available support for this adjustment, which is considered to be a weak point in this particular paired sale. The net value difference between the subject property and Comp 1 and Comp 2 is $11,000 to $12,000 for a 7.13 kW PV system. Given that this value indication is right in line with other market indicators, it appears the agent's estimate of value for the greenbelt view is reasonable.

As of June 2012, a value indication using the Paired Sales Analysis is:
$1,540 to $1,690 per kW
for a 7.13 kW, 3-year old system with 22 years remaining useful life.

This paired sales data is considered to be moderately reliable (only because there is no exact data to prove the greenbelt adjustment, other than the comments from the two area agents), and is given some consideration in the reconciliation of values.

[171] All other features are similar: builder, garage size, quality of construction, location, basement square footage, upgrades, condition and sales conditions.

B. Cost Approach (Using Local Builder Costs)

Using the replacement cost appraisal method, current builder costs were extracted using building permit information for the City of Arvada (Note: These costs are from the same immediate market area as there were no recent permits in the subject's small 22-home infill subdivision).

Address	Date of Permit	kWs	Total Cost	Cost per kW
5358 OWENS ST	15-Jun-12	9.81	54900	$5,596
13733 W 78TH PL	15-Jun-12	9.8	57376	$5,855
7970 W 70TH DR	15-Jun-12	9.8	57000	$5,816

Based on the above permit data, a reasonable current cost estimate for a PV system in this area is $5,600 per kW. The subject property has a 7.13 kW system:

7.13 kW X $5,600 =$39,928

Depreciation is based on the system's actual age (as of June 2012), compared to its useful life:

Straight-line age/life method	
Age of system:	3 years
Useful life:	25 years[172]
3/25 = 12% depreciated	

$39,928 less depreciation = $35,136 = Cost Today

Cost Today = =$35,136
$1000 X 7.13kW for functional obsolescence= - $7,130
$28,000 (rounded)

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $28,000.

[172] The subject property's PV system is 3 years and is assumed to have a 25 year warranty. Total useful life is based on the life of the warranty. If the estimated warranty period is incorrect, this could alter the conclusions and opinions reached in this report.

As of June 2012, a value indication using the cost approach is:
$3,920 (rounded) per kW
for a 7.13 kW, 3 year old system with 22 years remaining useful life.

These costs are, for an unknown reason, much higher than costs in other nearby, market areas. The properties used for cost data have standard composition roofs. Further investigation did not yield a reasonable explanation for these high costs (relative to the rest of the market). Therefore, this data is not considered accurate and the cost approach is not considered in the reconciliation of values.

C. Income Approach (Using PV Value)

The PV Value tool was used to determine the present value of the energy that will be produced by the subject's PV system over the next 22 years. The system is already three years old; thus, the remaining useful life is only 22 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		**Discount Rate Calculation**		**Electricity Rate Inputs**		**Operation & Maintenance Inputs**	
Zip Code	80005	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	55
System Size in Watts	7130	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$2007.15
Module Degradation rate	0.5	Net Yield Rate (Custom)[173]	3.99	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	22.6	Discount Rate(low)	4.49			Actual Age/Years	3
Azimuth	204	Discount rate (average)	5.74			Remaining Energy/Years	12
KWh Produced/Year	9979	Discount rate (high)	6.99				

**Note: XXXX = User Input   XXXX = User Input Override   XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$1,090.36

Present value estimate of accumulated energy production for remaining 22 years	
Low	$12,396.63
Average	$13,926.71
High	$15,736.325

173 Interest rate is from Interest Rate Chart contained in the addenda.

As per the above data, the indicated value by the income approach is between $12,400 and $15,700 for a 7.13 kW system.

As of June 2012, a value indication using the income approach is:
$1,740 to $2,200 (rounded) per kW
for a 7.13 kW, 3-year old system with 22 years remaining of useful life.

The selling agent very clearly indicated that utility savings were very much taken into consideration by buyers in this market, and that the PV system did add value to the home. Therefore, the income approach is considered to be an accurate reflection of buyers in this market area.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The listing agent commented that these buyers were excited about the potential savings of the PV system and that the system most added an "increase to the home value."
- This statement is verified by a paired sales analysis and data indicated by the PV Value valuation tool.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
$1,540 to $1,690 per kW	$3,920 per kW	$1,740 to $2,200 per kW (PV Value)

The paired sales analysis was conclusive, but had one adjustment with weak market support. Therefore, the paired sales analysis is given less consideration than the value indication by the income approach.

The cost approach data is given no consideration in the final reconciliation. The cost approach does not take into consideration rebates and incentives. Also, in 2012, costs were very prohibitive.

The income approach to value is given the greatest consideration. The value indication from the PV Value tool is considered to be an accurate reflection of the market. These buyers were specifically interested in the potential utility savings the system offered.

The low end of the value indication of the income approach is given the greatest amount of weight, followed by the upper end of value indication by the paired sales analysis.

In conclusion, the final value estimate is between $1,690 and $1,740 (with both figures rounded to the nearest 100th, therefore a final conclusion of $1,700 per kW is reasonable.

As of June 2012, the value is: **$1,700 per kW** for a 7.13 kW, 3-year old system with 22 years remaining of useful life and with a location in Arvada, Co, Subdivision "B"
The marketing time was faster: (32 days, versus the subdivision average of 61 days).

Arvada, Subdivision "C": Case Study 10

SUBDIVISION C			
Subdivision location:	Arvada, CO	**Price range of homes sold in market area:**	Not available. This is a new subdivision and most sales are either not yet recorded in public records, or are not recorded at all in MLS. The builders advertise prices from the "low $300's to the $500's".
Number of detached homes in subdivision:	560 estimated lots (most homes are not yet built)	**Age range of homes:**	2012 to present
Percentage of Rentals:	n/a	**Gross Rent Multiplier chart for market area:**	Insufficient data.
Quality of Construction:	Good to Very Good	**Type of homes:**	Tract homes. New construction area. This neighborhood's focus is homes that are sustainable, green and energy-efficient.
Number of homes sold in 6 months:	Unknown	**Range of above-grade square footages:**	Estimated 1500 to 4800
Number of PV permits:	Most	**Number of homes that sold after they had PV installed:**	Many of the homes are sold with PV systems (standard).
Range of kWs installed:	1.38 to 2.1 (standard). As of yet, no party has opted to upgrade the standard system size.	**Range of cost for PV systems over a three year period:**	$5,000 to $6,000. Only one builder in this subdivision offers *owned* PV systems as a standard feature. Two other builders offer only pre-paid lease PV systems.
Median kW amount installed:	1.38	**Median gross cost of PV systems:**	$5,500

GENERAL PROPERTY INFORMATION: Case Study 10			
Purchase Date:	February, 2013	**Sales Price of house:**	$466,976
Age of home:	New	**Above-grade sq.ft. of home:**	2409
Total days on market[174]:	154 (for new construction)	**Average Days on Market for subdivision:**	Data not available
Gross Rent Multiplier for similar home:	n/a.		
Other green and/or energy efficient features: Energy Star-qualified. Sustainability neighborhood.			

[174] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.

MARKET CONDITIONS AT TIME OF SALE for Case Study 10 :	INCREASING

Because the subject's neighborhood consists of only new homes, there is no historic data to trend values. Thus, the market trends for the larger market area were researched. The greater market area shows values have been increasing at a rate of 0.5% per month over the last six months.

PHOTOVOLTAIC SYSTEM For Case Study 10

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Builder
kW	1.38	Permit, Builder
Date of Permit	January, 2013	Permit
Manufacturer of panels	Sunpower	Builder flyer
Warranty on panels	25 Years	Internet information
Manufacturer of Inverter		(unknown)
Warranty on Inverter	10 Years	(assumed)
Type	Fixed	Observation of model home
Tilt	22.60	(assumed)
Energy Production per panel	230	Builder flyer
Energy Production Estimate (for 1 year)	2020	PV Value
Location	Roof	Observation
Age of panels	New	Builder
Inverter type	Wall mount	Observation
Age of Inverter	New	
Original gross cost	$6,600	Permit
Azimuth	180	(assumed)

Real Estate Agent comments:

Builder: The builder's representative was only able to providethe general feedback that buyers were excited to have a PV system included as a standard feature. The PV system does help marketability.
Buyer's Agent: The selling agent was a "non-MLS" participant, thus, it was not possible to know specifically who the selling agent was.

NOTE:

As part of its marketing material, this builder does offer to homebuyers, a flyer that shows the monetary benefits of owning a PV system. The flyer, however, did not use the correct cost/savings figures (nor a correct analysis method) to arrive at a cost/benefit conclusion. It was typical in the course of this study to run across marketing materials with incorrect figures. Therefore, this is not a reflection of this specific builder but rather, a comment about why it is necessary for market participants to become familiar with the PV Value tool to correctly understand the monetary benefits of a PV system.

PBI

Because this is a new home built in 2013, it is probable that this property is receiving PBIs. Based on the date of the permit, a reasonable assumption is that these payments are for $0.11 per kWh for the next 10 years.

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #10

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 10:

✓	Builder	✓	Permit
	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing

	Utility Records	✓	Assessor's property records
✓	Builder's flyer	✓	Market conditions research (for the general area only)
✓	PV Value	✓	Subdivision Analysis

APPRAISAL METHODS

The appraisal methods noted below were used to help determine the contribution value (if any) of Case Study 10's PV system:

	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

No paired sales were available as this is a newly developing subdivision and the sales are not recorded on the MLS system. Also, the subdivision is so new that this builder had only had, to date, just two closed sales (i.e. this property and the property used for Case Study 11).

A. Cost Approach (Using Local Builder Costs)

Using the replacement cost appraisal method, current builder costs were extracted using building permit information for the City of Arvada.

Address	Date of Permit	kWs	Cost	Cost per kW
9302 NOBLE WAY	16-Jan-13	2	$6,500	$3,250
9848 W 74TH PL	9-Jan-13	8.64	$25,920	$3,000
6997 COLE CT	8-Jan-13	5.76	$17,280	$3,000
9114 ELLIS WAY	2-Jan-13	6.37	$23,399	$3,673

Based on the above permit data, a reasonable current cost estimate for a PV system in this area is $3,200 per kW.

The subject property has what is assumed to be a 1.38 kW system; therefore, the following calculations can be made:

1.38 kW X $3,200 =$4,416

The system is new, so there is no depreciation. However, the market is indicating that PV systems are a superadequacy, and so an adjustment to the cost data must be made for functional obsolescence.

$4,416 less ($1000 X 1.38kW for functional obsolescence) = $3,036

Thus, a fine value estimate conclusion of $3,036 is supportable for a 1.38 kW system.

As of February 2013 a value indication using the cost approach is:
$2,200 per kW
for a 1.38 kW, new system with 25 years remaining useful life.

B. Income Approach (Using PV Value)

The PV Value tool was used to determine the present value of the energy that will be produced by the subject's PV system over the next 25 years. The system is new, and so the remaining useful life is 25 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		**Discount Rate Calculation**		**Electricity Rate Inputs**		**Operation & Maintenance Inputs**	
Zip Code	80007	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	1380	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$458.37
Module Degradation rate	0.5	Net Yield Rate (Custom)[175]	3.83	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	22.6	Discount Rate(low)	4.33			Actual Age/Years	0
Azimuth	180	Discount rate (average)	5.58			Remaining Energy/Years	25
KWh Produced/Year	2020	Discount rate (high)	6.83				

**Note: XXXX = User Input XXXX = User Input Override XXXX = Calculated Value*

Using the above figures, the following calculations were generated for a 1.38 kW system:

Value of the energy produced this year
$224.11

Present value estimate of accumulated energy production for remaining 25 years	
Low	$2,741.90
Average	$3,125.63
High	$3,588.83

These value estimates are only for the *present value of the future energy* and do not include the income to be generated from the PBI[176]. Thus, a separate calculation was run (following the steps outlined earlier in how to use PV Value to calculate PBIs) and the final value figures generated were as follows for a 1.38 kW system:

175 Interest rate is from Interest Rate Chart contained in the addenda.

176 During the course of this study, it was never possible to confirm the PBI's associated with properties. Thus, based on the permit data, assumptions had to be made in regards to IF a property had PBI's and how much they were for. If these assumptions are incorrect, they could alter the opinions and conclusions reached in this report.

Present Value Estimate of PBIs for the next 10 years	
Low	$1,802.14
Average	$1,750.23
High	$1,700.87

When these PBI figures are added to the future energy production figures, the value range (using rounded numbers) is $4,600 to $5,300 for a 1.38 kW system. However, while this market typically places value on the income generated from PV systems, this market area has yet to provide any indication that it understands that PBIs even exist (and can contribute to value). Thus, the only figures used from the income approach are those based on the present value of the future energy production.

As of February 2013, a value indication using the income approach is:
$1,990 to $2,600 (rounded) per kW
for a 1.38 kW, new system with 25 years remaining of useful life.

Summary and Conclusions

Market Perception/reaction to the Subject's PV System:

- The builder's representative was not highly familiar with the PV system and the marketing material was inaccurate.
- Minimal information was available for this sale.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
n/a	$2,200 per kW	$1,990 to $2,600 per kW (PV Value)

The cost figures and the income figures are very similar to one another. Both the income approach and the cost approach are applicable. The cost approach is applicable because this is new construction and actual cost figures are available. The income approach is applicable because this market showed evidence of placing value on the income to be produced by the PV system. There was no data available to develop a paired sales analysis.

In conclusion, the final value estimate is:

As of February 2013, the value is: **$1,990 to $2,200 per kW** for a 1.38 kW, new system with 25 years remaining of useful life and with a location in Arvada, Co, Subdivision "C"
PV had a positive impact on marketability, per the builder.

Arvada, Subdivision "C": Case Study 11

SUBDIVISION C			
Subdivision location:	Arvada, CO	**Price range of homes sold in market area:**	Not available. This is a new subdivision and most sales are either not yet recorded in public records, or are not recorded at all in MLS. The builders advertise prices from the "low $300's to the $500's".
Number of detached homes in subdivision:	560 estimated lots (most homes are not yet built)	**Age range of homes:**	2012 to present
Percentage of Rentals:	n/a	**Gross Rent Multiplier chart for market area:**	Of the few homes that are closed, none are known to be rentals.
Quality of Construction:	Good to Very Good	**Type of homes:**	Tract homes. New construction. This neighborhood's focus is homes that are sustainable, green and energy-efficient.
Number of homes sold in 6 months:	Unknown	**Range of above-grade square footages:**	Estimated 1500 to 4800
Number of PV permits:	Most	**Number of homes that sold after they had PV installed:**	Many of the homes are sold with PV systems (standard).
Range of kWs installed:	1.38 to 2.1 (standard). As of yet, no party has opted to upgrade the standard system size.	**Range of cost for PV systems over a three year period:**	$5,000 to $6,000. Only one builder in this subdivision offers *owned* PV systems as a standard feature. Two other builders offer only pre-paid lease PV systems.
Median kW amount installed:	1.38	**Median gross cost of PV systems:**	$5,500

GENERAL PROPERTY INFORMATION: Case Study 11			
Purchase Date:	March, 2013	**Sales Price of house:**	$480,000
Age of home:	New	**Above-grade sq.ft. of home:**	1707
Total days on market[177]:	218 (new construction)	**Average Days on Market for subdivision:**	Not available
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: Energy Star qualified, sustainable neighborhood			

[177] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.

MARKET CONDITIONS AT TIME OF SALE for Case Study 11 :	INCREASING
Values increased 0.5% per month over the prior six months. Inventory was down and sale-to-list price ratios rose to 99% (which is abnormally high). Multiple offers were common. The number of sales increased nearly four-fold compared to six months prior.	

PHOTOVOLTAIC SYSTEM For Case Study 11

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Builder
kW	1.38	Permit, Builder
Date of Permit	December,2012	Permit
Manufacturer of panels	Sunpower	Permit
Warranty on panels	25 Years	Permit
Manufacturer of Inverter	Sunpower	Permit
Warranty on Inverter	10 Years	Permit
Type	Fixed	Observation of model home
Tilt	22.60	(assumed)
Energy Production per panel	230	Builder flyer
Energy Production Estimate (for 1 year)	2020	PV Value
Location	Roof	Observation
Age of panels	New	Builder
Inverter type	Wall mount	Observation
Age of Inverter	New	
Original gross cost	$5,000	Permit
Azimuth	180	(assumed)

Real Estate Agent comments:

Builder: The builder's representative was only able to provide general feedback that buyers were excited to have a PV system included as a standard feature. The PV system does help marketability.
Buyer's Agent: The buyers liked the PV, however, it was not the reason they bought the house.

NOTE:

As part of its marketing material, this builder does offer to homebuyers, a flyer that shows the monetary benefits of owning a PV system. The flyer, however, did not use the correct cost/savings figures (nor a correct analysis method) to arrive at a cost/benefit conclusion. It was typical in the course of this study to run across marketing materials with incorrect figures. This is not a reflection of this specific builder but rather a comment on why it is necessary for market participants to become familiar with the PV Value tool to correctly understand the monetary benefits of a PV system.

PBI

Because this is a new home built in 2013, it is probable this property is receiving PBIs. Based on the date of the permit, a reasonable assumption is that these payments are for $0.11 per kWh for the next 10 years.

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #11

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 11:

✓	Builder	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records

	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
	Paired Sales Analysis		

APPRAISAL METHODS

The appraisal methods noted below were used to help determine the contribution value (if any) of Case Study 11's PV system:

	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

Like Case Study 10, there was no data available to develop a paired sales analysis.

A. Cost Approach (Using Local Builder Costs)

Using the Replacement Cost appraisal method, current builder costs were extracted using building permit information for the City of Arvada.

Address	Date of Permit	kWs	Cost	Cost per kW
9302 NOBLE WAY	16-Jan-13	2	$6,500	$3,250
9848 W 74TH PL	9-Jan-13	8.64	$25,920	$3,000
6997 COLE CT	8-Jan-13	5.76	$17,280	$3,000
9114 ELLIS WAY	2-Jan-13	6.37	$23,399	$3,673

Based on the above permit data, a reasonable current cost estimate for a PV system in this area is $3,200 per kW.

The subject property has what is assumed to be a 1.38 kW system, therefore, the following calculations can be made:

1.38 kW X $3,200 =$4,416

The system is new, so there is no depreciation. However, the market is indicating that PV systems are a superadequacy, and so an adjustment to the cost data must be made for functional obsolescence (which will be adjusted below).

$4,416 less ($1000 X 1.38kW for functional obsolescence) = $3,036

The builder's actual costs (per the permit data) were $5,000 (or, $3,623 per kW). This is in-line with the cost figures noted above; however, area costs are relied upon in lieu of the builder's reported cost.

As of February 2013, a value indication using the cost approach is:
$2,200 per kW
for a 1.38 kW, new system with 25 years remaining useful life.
This does not include rebates and incentives.

B. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 25 years. The system is new, so the remaining useful life is 25 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		**Discount Rate Calculation**		**Electricity Rate Inputs**		**Operation & Maintenance Inputs**	
Zip Code	80007	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	1380	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$492.20
Module Degradation rate	0.5	Net Yield Rate (Custom)[178]	3.83	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	22.6	Discount Rate(low)	4.33			Actual Age/Years	0
Azimuth	180	Discount rate (average)	5.58			Remaining Energy/Years	25
KWh Produced/Year	2020	Discount rate (high)	6.83				

**Note: XXXX = User Input XXXX = User Input Override XXXX = Calculated Value*

Using the above figures, the following calculations were generated for a 1.38 kW system:

Value of the energy produced this year
$224.11

Present value estimate of accumulated energy production for remaining 25 years	
Low	$2,741.90
Average	$3,125.63
High	$3,588.83

These value estimates are only for the present value of the future energy and do not include the income to be generated from the PBIs[179]. Thus, a separate calculation was run (following the steps outlined

[178] Interest rate is from Interest Rate Chart contained in the addenda.

[179] During the course of this study, it was never possible to confirm the PBI's associated with properties. Thus, based on the permit data, assumptions had to be made in regards to IF a property had PBI's and how much they were for. If these assumptions are incorrect, they could alter the opinions and conclusions reached in this report.

earlier on how to use PV Value to calculate PBIs) and the final value figures generated were as follows for a 1.38 kW system:

Present Value Estimate of PBIs for the next 10 years	
Low	$1,802.14
Average	$1,750.23
High	$1,700.87

When these figures are added to the other figures, the value range (using rounded numbers) is $4,600 to $5,300 for a 1.38 kW system. However, while this market typically places value on the income generated from PV systems, this market area has yet to provide any indication that it understands that PBIs even exist (and can contribute to value). Thus, the only figures used from the income approach are those based on the present value of the future energy production. The market does not yet recognize the PBI payments.

As of February 2013, a value indication using the income approach is:
$1,990 to $2,600 (rounded) per kW
for a 1.38 kW, new system with 25 years remaining of useful life.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The builder's representative was not highly familiar with the PV system and the marketing material was inaccurate.
- The selling agent stated that the buyers "liked the PV," but that was the only feedback she received. The PV was not a part of the reason they bought the house.
- Minimal information was available for this sale.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
n/a	$2,200 per kW	$1,990 to $2,600 per kW (PV Value)

Both the income approach and the cost approach are applicable. The cost approach is applicable because this is new construction and actual cost figures are available. The income approach is applicable because this market showed evidence of placing value on the income to be produced by the PV system. There was no data available to develop a paired sales analysis.

The cost figures and the income figures are very similar to one another.

As of February 2013, the value is:
$1,990 to $2,200 per kW
for a 1.38 kW, new system with 25 years remaining of useful life and with a location in Arvada, Co, Subdivision "C"

PV had a positive impact on marketability, per the builder and buyer's agent.

This case study provides similar data and information noted in Case Study 10, even though this is a different home. The only essential differences are that for this case study, the buyer's agent was able to provide feedback, and the actual builder costs for this PV system were slightly lower than for the PV system noted in Case Study 10.

Westminster, Subdivision “A”: Case Study 12

SUBDIVISION A			
Subdivision location:	Westminster, CO	**Price range of homes sold[180]:**	$315,500 to $645,000 Median: $416,704 Mode: $405,000
Number of detached homes:	Near 500	**Age range of homes:**	2002 to 2013
Percentage of Rentals:	8%	**Gross Rent Multiplier chart for subdivision:**	Not enough data. While there are rental properties: they all appear to be townhomes.
Quality of Construction:	Average to Very Good	**Type of homes:**	Tract homes. Mostly 2-story, new urbanism homes on small city lots with back alleys. Pedestrian friendly.
Number of homes sold in 6 months[181]:	13	**Range of above-grade square footages:**	1200 – 4600
Number of PV permits[182]:	15	**Number of homes that sold after they had PV installed:**	6
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 12			
Purchase Date:	March, 2012	**Sales Price of house:**	$408,074
Age of home:	New	**Above-grade sq.ft. of home:**	1945
Total days on market[183]:	182 (new construction)	**Average Days on Market for subdivision[184]:**	110
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: Assumed, but not known.			

MARKET CONDITIONS AT TIME OF SALE for Case Study 12 :	STABLE
Values were perfectly stable. Supply and demand were in balance, and the number of sales per six-month period was in balance. Bank sales and REO sales represented only 10% of all transactions.	

[180] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[181] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[182] Figures are for 2009, 2010, 2011 and 2012
[183] For this report, “Days on Market” is defined as the number of days between the list date and the date of contract.
[184] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 12			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Listing Agent
	kW	3.0 kW	Permit, MLS listing
	Date of Permit	August, 2011	Permit
	Manufacturer of panels	Perlight	Permit
	Warranty on panels	25 Years	Permit
	Manufacturer of Inverter	Frontius	Permit
	Warranty on Inverter	10 Years	Assumed
	Type	Fixed	Permit, Observation
	Tilt	36.37	Observation
	Energy Production per panel	250	Permit
	Energy Production Estimate (for 1 year)	3713	PV Value
	Location	Roof	Permit, Observation
	Age of panels	0 years	Permit
	Inverter type	Wall mount	Permit
	Age of Inverter	0 years	Permit
	Original gross cost	$10,998	Permit
	Azimuth	235	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Builder (Listing Agent)*: Agent did not provide any feedback. As per the MLS listing, 3.0 kW PV systems were included as standard features on these homes. *Buyer's Agent:* Agent did not provide any feedback.		

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #12

DATA SOURCES

Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 12:

	Listing Agent	✓	Permit
	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
✓	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis		
	Other: Builder		Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to help determine the contribution value (if any) of Case Study 12's PV system:

	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

There were no paired sales available for analysis. This is a new urbanism development; as a result, every home is notably different from one another and paired sales for PV systems are rare to typically non-existent.

A. Cost Approach (Using Local Builder Costs)

Current builder costs were extracted using building permit information for the City of Westminster:

Address	Date of Permit	Total system Cost	kWs	Cost per kW
11 Paramount Pkwy	10/7/2011	$28,309	4.6	$6,154
3520 Owens St	12/6/2011	$29,984	5.76	$5,205
4560 Upham St	5/1/2012	$40,900	7.68	$5,325
4265 Dudley St	5/7/2012	$31,387	6.75	$4,649
4455 Yarrow St	2/15/2012	$30,000	7.5	$4,000

The actual builder costs (for the PV system belonging to Case Study 12) are:

Address	Date of Permit	Total system Cost	kWs	Cost per kW
Subject Property (Case Study 12)	08/30/2011	$10,998	3.0	$3,666

While the majority of the PV systems in the greater area were selling for $4,000 per kW (in early February), the actual builder costs were only $3,666 per kW.

Depreciation is based on the system's actual age (as of August, 2013), compared to its useful life:

Straight-line age/life method	
Age of system:	0 years
Useful life:	25 years[185]
0/25 = 0% depreciated	

$10,998 less depreciation = $10,998

In reconciling the actual builder costs and the most recent local permit data, both indicate that costs are between the narrow range of $3,666 and $4,000 per kW. Since these figures are relatively similar, the

[185] The subject property's PV system is 0 years and has a 25 year warranty. Total useful life is based on the life of the warranty.

choice was made to use the actual builder costs. The builder costs were reasonable in this case study because all specifications about this PV system were able to be confirmed, whereas that was not the case for Case Studies 10 and 11. Therefore, a cost estimate of $11,000 is reasonable for the subject's PV system.

This figure does not include functional obsolescence, which needs to be added to the figures:
$11,000 less ($1000 X 3.0kW for functional obsolescence) = $8,000

As of March 2012, a value indication using the cost approach is:
$2,670 (rounded) per kW
for a 3.0 kW, new system with 25 years remaining useful life.

The cost approach is relevant given that this property is new construction and the exact costs of this system, as of the effective date of this case study, are known.

B. Income Approach (Using PV Value)

The PV Value® tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 25 years. The system is new, so the remaining useful life is 25 years.The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80031	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	3000	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$936.19
Module Degradation rate	0.5	Net Yield Rate (Custom)[186]	4.27	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	36.4	Discount Rate(low)	4.77			Actual Age/Years	0
Azimuth	235	Discount rate (average)	6.02			Remaining Energy/Years	20
KWh Produced/Year	3713	Discount rate (high)	7.27				

**Note:* XXXX *= User Input* XXXX *= User Input Override* XXXX *= Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$411.93

Present value estimate of accumulated energy production for remaining 25 years	
Low	$4,727.00
Average	$5,388.26
High	$6,184.41

[186] Interest rate is from Interest Rate Chart contained in the addenda.

As per the above data, the indicated value by the income approach is between $4,700 and $6,200 (both figures are rounded) for a 3.0 kW system.

As of March, 2012, a value indication using the income approach is:
$1,600 to $2,070 (rounded) per KW
per kW for a 3.0 kW, new system with 25 years remaining of useful life.

In this circumstance, this data is considered relevant. A weakness in this data is that neither the listing agent nor the buyer's agent was able to provide any feedback. However, given that this is a new urbanism type of neighborhood, and PV systems were just beginning to be a popular feature tool during this time period and in this market area, the conclusion was that the PV systems were part of the appeal of this home. Therefore, the cost approach is a valid approach to value for the subject property.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- This builder's representative was not able to provide any information or feedback, nor was the listing agent.
- There was not enough rental data to generate a reliable GRM.
- An adequate paired sale was not found, thus, no data was available regarding the possible value contribution of a PV system.

Given the extreme lack of data, the only conclusion that can be drawn is based on feedback received from other area builders. For new construction, area builders reported that people are very excited when a PV system is included as a standard feature on the home. For this reason, the conclusion was drawn that the PV system was appealing to this market segment and contributed to the value. This conclusion is reasonable given that many of the homes in this subdivision have PV systems.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
n/a	$2,670 per kW	$1,990 to $2,600 per kW (PV Value)

The paired sales analysis is not applicable due to a lack of data.

The cost approach data is applicable and relevant. The exact builder costs were known and PV systems are very common in this subdivision. Thus, the value indication of $2,670 per kW is given strong consideration in the reconciliation of values.

The income approach is also a very relevant approach. The value indicated by the income approach is a figure that is similar to the actual monetary cost of the PV system (after accounting for superadequacies).

Thus, a value conclusion of $2,000 is reasonable (it is the high end of the PV Value range and near the low end of the cost value indicator).

Since this is a "new urbanism" neighborhood and PV is noted on many of the homes, it is reasonable to conclude the PV system add values to the property. Based mainly on the income approach data, a final value conclusion of $2,000 per kW is reasonable.

As of March 2012, the value is: **$2,000 per kW** for a 3.0 kW, new system with 25 years remaining of useful life and with a location in Westminster, Co, Subdivision "A"
Marketing time was not relevant, as this was new construction at the time of sale. New construction days-on-market reflect the time it takes to build the home, and therefore, the numbers do not reflect the days-on-market had the home been complete and ready to purchase.

Westminster, Subdivision "A": Case Study 13

SUBDIVISION A			
Subdivision location:	Westminster, CO	**Price range of homes sold[187]:**	$295,000 to $680,000 Median: $397,250 No Mode
Number of detached homes:	Near 500	**Age range of homes:**	2002 to 2013
Percentage of Rentals:	8%	**Gross Rent Multiplier chart for subdivision:**	Not enough data. While there are rental properties, they all appear to be townhomes.
Quality of Construction:	Average to Very Good	**Type of homes:**	Tract homes. Mostly 2-story, new urbanism homes on small city lots with back alleys. Pedestrian friendly.
Number of homes sold in 6 months[188]:	13	**Range of above-grade square footages:**	1200 – 4600
Number of PV permits[189]:	15	**Number of homes that sold after they had PV installed:**	6
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 13			
Purchase Date:	November, 2012	**Sales Price of house:**	$680,000
Age of home:	3	**Above-grade sq.ft. of home:**	3505
Total days on market[190]:	9	**Average Days on Market for subdivision[191]:**	93
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: Extensive green built features (windows, tankless hot water heater, furnace, 13 SEER AC, recycled cellulose fiber insulation, recycled countertops, R40 ceilings, R24 walls).			

MARKET CONDITIONS AT TIME OF SALE for Case Study 13 :	STABLE
Values were stable. Supply and demand were in balance, and the number of sales per six month period was in balance. Bank sales and REO sales represented only 10% of all transactions.	

[187] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[188] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[189] Figures are for 2009, 2010, 2011 and 2012
[190] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[191] Information is
based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 13			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Prior MLS listing
	kW	4.2 kW	MLS listing
	Date of Permit	Sept 2008	Permit
	Manufacturer of panels	Kyocera	Permit
	Warranty on panels	20 Years	Permit
	Manufacturer of Inverter	Frontius	Permit
	Warranty on Inverter	10 Years	Assumed
	Type	Fixed	Observation
	Tilt	45.00	Observation
	Energy Production per panel	205	Permit
	Energy Production Estimate (for 1 year)	6231	PV Value
	Location	Roof	Permit, Observation
	Age of panels	4 years	Permit
	Inverter type	Wall mount	Permit
	Age of Inverter	4 years	Permit
	Original gross cost	$38,400	Permit
	Azimuth	154	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Listing Agent*: Agent did not provide any feedback. As per the MLS listing, a 4.2 kW PV system was included on this custom home at the time of construction. *Buyer's Agent:* Agent did not provide any feedback.		

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #13

DATA SOURCES

Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 13:

	Listing Agent	✓	Permit
	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
✓	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis		Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 13's PV system:

	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

A. Cost Approach (Using Local Builder Costs)

Current builder costs were extracted using building permit information for the City of Westminster:

Address	Date of Permit	Total system Cost	kWs	Cost per kW
12497 Lipan Ct	11/08/2012	$21,600	7.2	$3,000
9749 Teller Ln	10/30/2012	$16,305	3.92	$4,159
6601 E 99th Ave	11/27/2012	$16,560	5.52	$3,000
8582 Dover Cir	11/27/2012	$23,760	7.92	$2,988
11760 Newton St	11/13/2012	$14,500	4.08	$3,553

Based on the above permit data, a reasonable conclusion to draw is that a current cost per kW is $3,500.

4.2 kW X $3,500 = $14,700

Depreciation is based on the system's actual age (as of November, 2012), compared to its useful life:

Straight-line age/life method	
Age of system:	4 years
Useful life:	20 years[192]
4/20 = 20% depreciated	

$14,700 less depreciation = $11,760

Therefore, a cost of $11,760 is reasonable. This, however, does not take into consideration functional obsolescence:

$11,760 less ($1000 X 4.2kW for functional obsolescence) = $7,560 for a 4.2 kW system

As of November 2012, a value indication using the cost approach is:
$1,800 (rounded) per kW
for a 4.2 kW, new system with 16 years remaining useful life.

The subject property is a six year-old tract home located in a "new urbanism" development. PV systems are very common in this area, and so the cost to install a PV system is a relevant factor to potential buyers. The cost approach is applicable and is given consideration in the reconciliation.

[192] The subject property's PV system is 4 years and has a 20 year warranty. Total useful life is based on the life of the warranty.

B. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 16 years. The system is four years old; thus, the remaining useful life is 16 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80031	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	4200	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$1764.46
Module Degradation rate	0.5	Net Yield Rate (Custom)[193]	3.66	Utility Escalation rate	2.13	System Warranty/Years	20
Tilt	45	Discount Rate(low)	4.16			Actual Age/Years	4
Azimuth	154	Discount rate (average)	5.41			Remaining Energy/Years	16
KWh Produced/Year	6231	Discount rate (high)	6.66				

**Note: XXXX = User Input XXXX = User Input Override XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$677.34

Present value estimate of accumulated energy production for remaining 16 years	
Low	$5,951.19
Average	$6,575.25
High	$7,284.82

As per the above data, the indicated value by the income approach is between $6,000 and $7,300 (both figures are rounded) for a 4.2 kW system.

As of November 2012, a value indication using the income approach is:
$1,480 to $1,740 (rounded) per kW
for a 4.2 kW, 4-year old system with 16 years remaining of useful life.

In this circumstance, this data is considered relevant. A weakness in this data is that neither the listing agent nor the buyer's agent was able to provide any feedback. However, given that this is a "new urbanism" type of neighborhood, and PV systems were just beginning to be a popular feature, the conclusion was that the PV systems were part of the appeal of this home.

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193 Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- This listing agent was not able to provide any information or feedback, nor was the buyer's agent.
- There was not enough rental data to generate a reliable GRM.
- An adequate paired sale was not found, and as a result, no data was available regarding possible value contribution of a PV system.

Given the lack of verification of data from the agents, the only conclusion that can be drawn is based on feedback received from other area builders. Area builders reported that people are very excited when a PV system is included as a standard feature on the home. For this reason, the conclusion was drawn that the PV system was appealing to this market segment.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
n/a	$1,800 per kW	$1,480 to $1,740 per kW (PV Value)

The cost approach data is applicable and relevant. PV systems are common in this area. The value indication of $1,800 per kW is given strong consideration in the reconciliation of values.

The income approach is also a very relevant approach. The value indicated by the income approach is a figure that is similar to the actual monetary cost of the PV system (after accounting for superadequacies).

Since this is a "new urbanism" neighborhood and PV is noted on many of the homes, it is reasonable to conclude the PV system adds value to the property.

Thus, the income approach and cost approach are given full consideration:

As of November 2012, the value is:
$1,740 to $1,800 per kW
for a 4.2 kW, 4-year old system with 16 years remaining of useful life and with a location in Westminster, Co, Subdivision "A"

Marketing time was 9 days: 84 days less than the market average of 93 days. This is also remarkable because the subject property was the highest priced sale in the neighborhood at the time.

Westminster, Subdivision "A": Case Study 14

SUBDIVISION A			
Subdivision location:	Westminster, CO	**Price range of homes sold[194]:**	$315,500 to $645,000 Median: $416,704 Mode: $405,000
Number of detached homes:	Near 500	**Age range of homes:**	2002 to 2013
Percentage of Rentals:	8%	**Gross Rent Multiplier chart for subdivision:**	Not enough data. While there are rental properties: they all appear to be townhomes.
Quality of Construction:	Average to Very Good	**Type of homes:**	Tract homes. Mostly 2-story, new urbanism homes on small city lots with back alleys. Pedestrian friendly.
Number of homes sold in 6 months[195]:	13	**Range of above-grade square footages:**	1200 – 4600
Number of PV permits[196]:	15	**Number of homes that sold after they had PV installed:**	6
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 14			
Purchase Date:	February, 2012	**Sales Price of house:**	$405,000
Age of home:	New	**Above-grade sq.ft. of home:**	1979
Total days on market[197]:	71 (new construction)	**Average Days on Market for subdivision:**	110 (this figure is not reliable in this circumstance as it includes new construction).
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: Assumed, but exact details not known.			

MARKET CONDITIONS AT TIME OF SALE for Case Study 14 :	STABLE
Values were perfectly stable. Supply and demand were in balance, and the number of sales per six month period was in balance. Bank sales and REO sales represented only 10% of all transactions.	

[194] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[195] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[196] Figures are for 2009, 2010, 2011 and 2012
[197] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.

PHOTOVOLTAIC SYSTEM For Case Study 14			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Selling Agent
	kW	3.0	Permit
	Date of Permit	August,2011	Permit
	Manufacturer of panels	Perlight	Permit
	Warranty on panels	25 Years	Permit
	Manufacturer of Inverter	Frontius	Permit
	Warranty on Inverter	10 Years	(assumed)
	Type	Fixed	Observation
	Tilt	33.69	Observation
	Energy Production per panel	250	Permit
	Energy Production Estimate (for 1 year)	3655	PV Value
	Location	Roof	Observation
	Age of panels	New	Permit
	Inverter type	Wall mount	(assumed)
	Age of Inverter	New	Permit
	Original gross cost	$10,998	Permit
	Azimuth	238	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Builder (Listing Agent):* Did not provide feedback. *Buyer's Agent:* Buyers would have bought the property anyway. PV was a "cherry on top" and was worth about as much as a "third stall in a three car garage". PV was not a major selling point. Minimal conversations were had about the PV system.		

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #14

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 14:

	Listing Agent	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
	Paired Sales Analysis		

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 14's PV system:

	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

A. Cost Approach (Using Local Builder Costs)

Current builder costs were extracted using building permit information for the City of Westminster:

Address	Date of Permit	Total system Cost	kWs	Cost per kW
11 Paramount Pkwy	10/7/2011	$28,309	4.6	$6,154
3520 Owens St	12/6/2011	$29,984	5.76	$5,205
4455 Yarrow St	2/15/2012	$30,000	7.5	$4,000

The actual builder costs (for the PV system belonging to Case Study 14) are:

Address	Date of Permit	Total system Cost	kWs	Cost per kW
Subject Property (Case Study 14)	08/2011	$10,998	3.0	$3,666

While the majority of PV systems in the greater are were selling for $4000 per kW (in early February, 2012), the actual builder costs were only $3,666 per kW.

Depreciation is based on the system's actual age (as of February 2012), compared to its useful life:

Straight-line age/life method	
Age of system:	0 years
Useful life:	25 years[198]
0/25 = 0% depreciated	

$10,998 less depreciation = $10,998

In reconciling the actual builder cost and the most recent local permit data, both indicate that costs are between the narrow ranges of $3,666 and $4,000 per kW. Since these figures are relatively similar, the choice was made to use the actual builder costs. The builder costs were reasonable in this case study because all specifications about this PV system were able to be confirmed, whereas that was not the case for Case Studies 10 and 11). Therefore, a cost of $11,000 is reasonable for the subject's PV system.

This figure does not include functional obsolescence, which needs to be added to the figures:

$11,000 less ($1000 X 3.0kW for functional obsolescence) = $8,000

[198] The subject property's PV system is 0 years and has a 25 year warranty. Total useful life is based on the life of the warranty.

As of February 2012 a value indication using the cost approach is:
$2,670 (rounded) per kW
for a 3.0 kW, new system with 25 years remaining useful life.
This cost estimate is prior to rebates and incentives.

The cost approach is relevant given that this property is new construction and the exact costs of this system, as of the effective date of this case study, are known.

B. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 25 years. The system is new, so the remaining useful life is 25 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80031	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	3000	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$945.51
Module Degradation rate	0.5	Net Yield Rate (Custom)[199]	4.20	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	33.7	Discount Rate(low)	4.70			Actual Age/Years	0
Azimuth	238	Discount rate (average)	5.95			Remaining Energy/Years	25
KWh Produced/Year	3655	Discount rate (high)	7.20				

**Note: XXXX = User Input XXXX = User Input Override XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$405.48

Present value estimate of accumulated energy production for remaining 25 years	
Low	$4,662.47
Average	$5,320.05
High	$6,112.11

As per the above data, the indicated value by the income approach is between $4,700 and $6,100 (both figures are rounded) for a 3.0 kW system.

As of February 2012 a value indication using the income approach is:
$1,570 to $2,030 (rounded) per kW
for a 3.0 kW, new system with 25 years remaining of useful life.

[199] Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The builder/listing agent did not provide any feedback. Since this builder provided no feedback for any of the new homes sold, it is not known how the PV system was marketed to potential buyers. Through other evidence gathered for this study, it was clear that active marketing and education about the PV systems have a positive impact on value.
- The buyer's agent stated that buyers liked the PV, but other than it being a "cherry on top," it was not something that was "that great." The selling agent stated that, at most , the PV system may be worth the same as a third car stall in a three car garage (which costs about $4,000 to $6,000 in this area).

There was a very slight indication that these buyers paid a little bit to have this PV system (the selling agent likened it to the value of the third stall of a three car garage). Also, the home is located in a "new urbanism" development where PV systems are very common.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
n/a	$2,670 per kW	$1,570 to $2,030 per kW (PV Value)

The value indicated by the income approach is applicable and is given the greatest amount of consideration. The value indicated by the income approach ($1,570 to $2,030) is directly supported by the selling agent's statement that the system contributed the same value as the third stall of a three car garage (i.e. $4,000 to $6,000); this can be translated into a per kW value of $1,330 to $2,000. The income approach has a value range of $1,570 to $2,030 per kW. This is considered a reliable figure.

The cost approach, while applicable, is outside of the value range of all other market indicators, therefore, it is not given any consideration.

As of February 2013, the value is:
$1,570 to $2,000 per kW
for a 3.0 kW, new system with 25 years remaining of useful life and with a location in Westminster, Co, Subdivision "A"

The PV system had a positive impact on the marketability of the home.

Westminster, Subdivision “A”: Case Study 15

SUBDIVISION A			
Subdivision location:	Westminster, CO	**Price range of homes sold[200]:**	$349,000 to $645,000 Median: $493,000 No Mode
Number of detached homes:	Near 500	**Age range of homes:**	2002 to 2013
Percentage of Rentals:	8%	**Gross Rent Multiplier chart for subdivision:**	Not enough data. While there are rental properties: they all appear to be townhomes.
Quality of Construction:	Average to Very Good	**Type of homes:**	Tract homes. Mostly 2-story, new urbanism homes on small city lots with back alleys. Pedestrian friendly.
Number of homes sold in 6 months[201]:	8	**Range of above-grade square footages:**	1200 – 4600
Number of PV permits[202]:	15	**Number of homes that sold after they had PV installed:**	6
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 15			
Purchase Date:	December, 2011	**Sales Price of house:**	$416,704
Age of home:	New	**Above-grade sq.ft. of home:**	2090
Total days on market[203]:	190 (new construction)	**Average Days on Market for subdivision[204]:**	90
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: Assumed, however, no details are disclosed.			

MARKET CONDITIONS AT TIME OF SALE for Case Study 15 :	STABLE
Values were stable. Supply and demand were in balance and, the number of sales per six-month period was in balance. Bank sales and REO sales represented only 10% of all transactions.	

[200] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[201] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[202] Figures are for 2009, 2010, 2011 and 2012
[203] For this report, “Days on Market” is defined as the number of days between the list date and the date of contract.
[204] Information is
based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 15			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Listing Agene
	kW	3.0 kW	Permit
	Date of Permit	Aug, 2011	Permit
	Manufacturer of panels	Perlight	Permit
	Warranty on panels	25 Years	Permit
	Manufacturer of Inverter	Frontius	Permit
	Warranty on Inverter	10 Years	Assumed
	Type	Fixed	Observation
	Tilt	45.00	Observation
	Energy Production per panel	250	Permit
	Energy Production Estimate (for 1 year)	4299	PV Value
	Location	Roof	Permit, Observation
	Age of panels	New	Permit
	Inverter type	Wall mount	Permit
	Age of Inverter	New	Permit
	Original gross cost	$10,998	Permit
	Azimuth	134	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Listing Agent*: Agent did not provide any feedback. *Buyer's Agent:* Agent does not remember the property but stated that the PV was "certainly not a negative."		

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #15

DATA SOURCES

Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 15:

	Listing Agent	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
✓	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
	Paired Sales Analysis		Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 15's PV system:

	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

A. Cost Approach (Using Local Builder Costs)

Current builder costs were extracted using building permit information for the City of Westminster:

Address	Date of Permit	Total system Cost	kWs	Cost per kW
6645 W 114th Ave	11/28/2011	$11,280	3.225	$3,475
7131 Irving St	12/13/2011	$19,347	5.98	$3,235
10589 Pierson Cir	12/13/2011	$16,400	4.7	$3,489
6449 W 97th Pl	12/08/2011	$32,775	7.02	$4,668
5792 W 109th Ave	11/27/2011	$39,500	8.64	$4,571

Based on the above permit data, a reasonable conclusion to draw is that a current cost per kW is $3,500.

3.0 kW X $3,500 = $10,500

There is no depreciation to take into consideration, as this is a new PV system. The above costs are directly in line with the builders exact costs of $10,998 (as was noted on the permit).

The actual builder costs are directly reflective of other area permit data, and therefore, the builders cost figures of $11,000 (i.e. $10,998 rounded) are reasonable cost figures for this case study.

The $11,000 cost figure, however, does not take into consideration functional obsolescence. Therefore:

$11,000 less ($1000 X 3.0kW for functional obsolescence) = $8,000 for a 3.0 kW system

As of December 2011, a value indication using the cost approach is:
$2,670 (rounded) per kW
for a 3.0 kW, new system with 25 years remaining useful life.
This cost estimate is prior to rebates and incentives.

B. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 25 years. The system is new, so the remaining useful life is 25 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80031	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	3000	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$933.55
Module Degradation rate	0.5	Net Yield Rate (Custom)[205]	4.29	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	45	Discount Rate(low)	4.79			Actual Age/Years	0
Azimuth	134	Discount rate (average)	6.04			Remaining Energy/Years	25
KWh Produced/Year	4299	Discount rate (high)	7.29				

**Note: XXXX = User Input   XXXX = User Input Override   XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$476.92

Present value estimate of accumulated energy production for remaining 25 years	
Low	$5,612.02
Average	$6,375.39
High	$7,294.37

As per the above data, the indicated value by the income approach is between $5,600 and $7,300 (both figures are rounded) for a 3.0 kW system.

As of December 2011, a value indication using the income approach is:
$1,870 to $2,430 (rounded) per kW
for a 3.0 kW, new system with 25 years remaining of useful life.

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205 Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The buyer's agents only comment was that "PV was not a negative."
- There was not enough rental data to generate a reliable GRM.
- An adequate paired sale was not found, and therefore, no data was available about the possible value contribution of a PV system.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
n/a	$2,670 per kW	$1,870 to $2,430 per kW (PV Value)

The value indicated by the income approach is applicable and is given the greatest amount of consideration. The value indicated by the income approach is $1,870 to $2,430. This is considered a reliable figure. PV systems are very common in this market area and buyers are very interested in utility savings.

The cost approach, while applicable, is outside of the value range of all other market indicators, and therefore, it is not given any consideration.

As of December 2011, the value is: **$1,870 to $2,430 per kW** for a 3.0 kW, new system with 25 years remaining of useful life and with a location in Westminster, Co, Subdivision "A"
Based on the selling agents comment, it is probable that PV had a positive impact on marketability

Westminster, Subdivision "A": Case Study 16

SUBDIVISION A			
Subdivision location:	Westminster, CO	**Price range of homes sold[206]:**	$300,000 to $680,000 Median: $435,150 No Mode
Number of detached homes:	Near 500	**Age range of homes:**	2002 to 2013
Percentage of Rentals:	8%	**Gross Rent Multiplier chart for subdivision:**	Not enough data. While there are rental properties: they all appear to be townhomes.
Quality of Construction:	Average to Very Good	**Type of homes:**	Tract homes. Mostly 2-story, new urbanism homes on small city lots with back alleys. Pedestrian friendly.
Number of homes sold in 6 months[207]:	16	**Range of above-grade square footages:**	1200 – 4600
Number of PV permits[208]:	15	**Number of homes that sold after they had PV installed:**	6
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 16			
Purchase Date:	April, 2013	**Sales Price of house:**	$417,000
Age of home:	3	**Above-grade sq.ft. of home:**	2244
Total days on market[209]:	13	**Average Days on Market for subdivision[210]:**	57
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: Assumed, however, specifics are not known			

MARKET CONDITIONS AT TIME OF SALE for Case Study 16 :	INCREASING
From approximately December 2012 to the present, values have been increasing. The exact rate of increase has been approximately 0.8% per month. Inventory is down considerably, which is putting upward pressure on sale prices.	

[206] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[207] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[208] Figures are for 2009, 2010, 2011 and 2012
[209] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[210] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 16			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Builder
	kW	2.7	Permit
	Date of Permit	April, 2010	Permit
	Manufacturer of panels	Canadian Solar	Permit
	Warranty on panels	25 Years	Permit
	Manufacturer of Inverter	Enphase Micro	Permit
	Warranty on Inverter	15 Years	Permit
	Type	Fixed	Observation
	Tilt	22.6	Observation
	Energy Production per panel	180	Permit
	Energy Production Estimate (for 1 year)	3906	PV Value
	Location	Roof	Observation
	Age of panels	New	Permit
	Inverter type	Microinverters	Permit
	Age of Inverter	New	Permit
	Original gross cost	$16,000	Permit
	Azimuth	138	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Listing Agent* (Provided extensive feedback): It was a "nice marketing tool." Everyone was excited about it. The installer was instrumental in answering potential buyer's questions about the system. The utility savings costs were measureable and important. This sale, however, had unusual circumstances. The seller had to reduce the contract by $13,000 to account for three unusual circumstances: The newer roof had a material failure (even though it was only three years old) and needed to be replaced. Thus, the roof would have to be replaced and the panels would need to be removed and reinstalled. Also, there was a problem with pigeons living under the panels, so a bird abatement program had to be paid for. Often, buyers are leery of having to sign a contract with Xcel, but if they receive good education, that fear is overcome and they actually become excited about the systems. Educating the buyer and providing documentation are key. In the end, this particular PV system did not add value because it had atypical repair costs. *Buyer's Agent:* The buyers were concerned about the maintenance issues.		

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #16

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 16:

✓	Listing Agent	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
	Paired Sales Analysis		Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 16's PV system:

	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

A. Cost Approach (Using Local Builder Costs)

Current builder costs were extracted using building permit information for the City of Westminster:

Address	Date of Permit	Total system Cost	kWs	Cost per kW
12497 Lipan Ct	11/08/2012	$21,600	7.2	$3,000
9749 Teller Ln	10/30/2012	$16,305	3.92	$4,159
6601 E 99th Ave	11/27/2012	$16,560	5.52	$3,000
8582 Dover Cir	11/27/2012	$23,760	7.92	$2,988

As per the two permits noted above, costs were only $3,000 per kW, which is below the greater market norm. However, these figures are used since they are derived directly from the market.

2.7 kW X $3,000 = $8,100

Depreciation is based on the system's actual age (as of April, 2013), compared to its useful life:

Straight-line age/life method	
Age of system:	3 years
Useful life:	25 years[211]
3/25 = 12% physical depreciation	

$8,100 less depreciation = $7,200
Less the $3000 cost to remove and replace the panels = $4,200
Less the $700 cost for bird abatement = $3,500
Less ($1000 X 2.7kW for functional obsolescence) = $800 total

The value of the entire 2.7 kW system, as-is, would be $800.

[211] The subject property's PV system is 0 years and has a 25 year warranty. Total useful life is based on the life of the warranty.

As of April 2013, a value indication using the cost approach is: **$300 per kW** for a 2.7 kW, 3-year old system with 22 years remaining useful life *and* *needed repairs.*

Given the unusual repair circumstances surrounding this property, the cost approach shows the PV system did not add any value to the property.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- While the listing agent stated that PV has a very positive impact on marketability, this property had the unusual circumstance of needing $13,000 in repairs to the roof and for bird abatement issues. Even so, the buyers were very much interested in the ability to save on their utility costs, so they are planning to have the roof repaired and re-install the PV system (though arguably, it is probable that their agreement with Xcel requires them to re-install the panels, this could not be verified, but is a possibility).
- The selling agent stated that the buyers liked the system, but the repair costs were an issue.

A reasonable conclusion to draw is that the income potential of the system was of interest to the buyers, but in its current state, it did not add value.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
n/a	$800 per kW	n/a

The cost approach data is given full consideration in the final reconciliation. This PV system had atypical repair issues which, essentially, reduced the as-is cost value to $800 for the entire 2.7 kW system. This cost figure is very low and given that the buyers were compensated for these repair issues, a reasonable conclusion can be drawn that as-is cost was the value added to the property.

As of April 2013, the value is: **$300 per kW** for a 2.7 kW, 3-year old system with 22 years remaining of useful life (and repair issues) and with a location in Westminster, Co, Subdivision "A"
Marketing time was 13 days: 44 days less the market area average of 57. The listing agent confirmed that PV is a positive marketing feature and attracts buyers.

As previously stated in this study, once a property was identified as having met the criteria to qualify as a case study (i.e. it was sold between January 2011 and May 2013, it was located in the market study area, it had a PV system that was owned, and it sold for between $200,000 and $680,000), the property was retained as a case study. If, as in the case noted above, further information was discovered along the way that indicated the sale had unusual circumstances, the property was not removed from the case study.

While this case study does not add significant information to the overall study, it does demonstrate that there are circumstances where a PV system (regardless of demand for PV systems in a particular market area), does not add value to a specific property because of extenuating circumstances.

This case study shows that appraisers do verify data and research market indicators when developing an opinion of market value, and do not just assume that PV systems add value in all situations (even if they are popular and in demand in a particular market area, as they are in this area).

Westminster, Subdivision "A": Case Study 17

SUBDIVISION A			
Subdivision location:	Westminster, CO	**Price range of homes sold[212]:**	$300,000 to $680,000 Median: $435,150 No Mode
Number of detached homes:	Near 500	**Age range of homes:**	2002 to 2013
Percentage of Rentals:	8%	**Gross Rent Multiplier chart for subdivision:**	Not enough data. While there are rental properties: they all appear to be townhomes.
Quality of Construction:	Average to Very Good	**Type of homes:**	Tract homes. Mostly 2-story, new urbanism homes on small city lots with back alleys. Pedestrian friendly.
Number of homes sold in 6 months[213]:	16	**Range of above-grade square footages:**	1200 – 4600
Number of PV permits[214]:	15	**Number of homes that sold after they had PV installed:**	6
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 17			
Purchase Date:	May, 2013	**Sales Price of house:**	$449,900
Age of home:	4	**Above-grade sq.ft. of home:**	2244
Total days on market[215]:	9	**Average Days on Market for subdivision[216]:**	57
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: Assumed. However, specifics are not known.			

MARKET CONDITIONS AT TIME OF SALE for Case Study 17 :	INCREASING
From approximately December 2012 to the present, values have been increasing. The exact rate of increase has been approximately 0.8% per month. Inventory is down considerably, which is putting upward pressure on sale prices.	

212 Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
213 Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
214 Figures are for 2009, 2010, 2011 and 2012
215 For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
216 Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 17			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Builder
	kW	3.6 kW	Permit
	Date of Permit	Sept, 2009	Permit
	Manufacturer of panels		(unknown)
	Warranty on panels	25 Years	(assumed)
	Manufacturer of Inverter		(unknown)
	Warranty on Inverter	10 Years	(assumed)
	Type	Fixed	Observation
	Tilt	22.6	Observation
	Energy Production per panel		(unknown)
	Energy Production Estimate (for 1 year)	4671	PV Value
	Location	Roof	Observation
	Age of panels	4 years	Permit
	Inverter type	Wall mounted	(assumed)
	Age of Inverter	4 years	Permit
	Original gross cost		(unknown)
	Azimuth	225	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Listing Agent:* Did not provide feedback *Buyer's Agent:* The buyers were excited about saving money on their utility costs. The utility savings were a plus. The PV system added value for sure (though the existence of PV did not make or break the deal).		

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #17

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 17:

	Listing Agent	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
	Paired Sales Analysis		Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to help determine the contribution value (if any) of Case Study 17's PV system:

	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

A. Cost Approach (Using Local Builder Costs)

Current builder costs were extracted using building permit information for the City of Westminster:

Address	Date of Permit	Total system Cost	kWs	Cost per kW
7483 Dale Ct	02/13/2013	$7,920	2.64	$3,000
9520 Pierce St	02/13/2013	$12,960	4.32	$3,000
5726 W 115th Pl	02/13/2013	$16,560	5.52	$3,000
11350 Quivas Way	03/11/2013	$30,345	8.67	$3,500

As per the two permits noted above, costs were only $3,000 per kW, which is below the market norm. However, these figures are used since they are derived directly from the market.

3.6 kW X $3,000 = $10,800

Depreciation is based on the system's actual age (as of May, 2013), compared to its useful life:

Straight-line age/life method	
Age of system:	4 years
Useful life:	25 years[217]
4/25 = 16% physical depreciation	

$10,800 less depreciation = $9,070 (rounded)

The value would be $9,070 for the entire 3.6 kW system. This, however, is prior to taking functional obsolescence into consideration:

$9,070 less ($1000 X 3.6kW for Functional Obsolescence) = $5,470 total value

As of May 2013, a value indication using the cost approach is:
$1,520 (rounded) per kW
for a 3.6 kW, 4-year old system with 21 years remaining useful life.

[217] The subject property's PV system is 4 years and has a 25 year warranty. Total useful life is based on the life of the warranty. The warranty life span is assumed. If this assumption is incorrect, this could alter the opinions and conclusions reached in this report.

B. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 21 years. The system is four years old, thus, the remaining useful life is 21 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80031	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	3600	Basis Points (high)	200	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	125			Inverter cost	$1605.34
Module Degradation rate	0.5	Net Yield Rate (Custom)[218]	3.59	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	22.6	Discount Rate(low)	4.09			Actual Age/Years	4
Azimuth	225	Discount rate (average)	4.84			Remaining Energy/Years	21
KWh Produced/Year	4671	Discount rate (high)	5.59				

**Note: XXXX = User Input XXXX = User Input Override XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$507.77

Present value estimate of accumulated energy production for remaining 21 years	
Low	$5,222.21
Average	$5,923.89
High	$6,749.73

As per the above data, the indicated value by the income approach is between $5,200 and $6,700 (both figures are rounded) for a 3.6 kW system.

As of May 2013, a value indication using the income approach is:
$1,450 to $1,860 (rounded) per kW
for a 3.6 kW, 4-year old system with 21 years remaining of useful life.

218 Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the subject's PV System:

- The selling agent indicated that the PV system had a positive impact on value. The selling agent also indicated that the buyers did take the utility savings into consideration when purchasing the property.
- The marketing time was only nine days.

A reasonable conclusion to draw is that the income potential of the system was of interest to the buyers. Also, given the selling agents comments, the PV system did add value to the property.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
n/a	$1,520 per kW	$1,450 to $1,860 per kW (PV Value)

The paired sales analysis is not applicable due to a lack of data.

The cost approach was data given consideration, as the data used to develop the cost approach is considered to be very reliable and indicative of the market. The value indication by the cost approach is reflective of the income approach value indication.

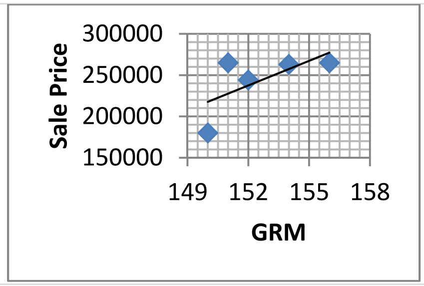
The value indicated by the income approach is given the greatest amount of consideration given the comments made by the buyer's agent. The agent indicated that the monthly savings on utility costs were of interest to the buyers, and therefore the income approach was considered relevant.

This property is located in a "new urbanism" development where a good majority of the homes have PV systems. Also, green features and energy efficient building is part of the appeal of this neighborhood. Therefore, the value indicated by the income approach is the most relevant. A value indication of between $1,450 and $1,860 per kW is reasonable.

As of May 2013, the value is:
$1,450 to $1,860 per kW
for a 3.6 kW, 4-year old system with 21 years remaining of useful life and with a location in Westminster, Co, Subdivision "A"

Marketing time was 9 days: 48 days less the market area average of 57. The buyer's agent confirmed that PV is a positive marketing feature.

Wheat Ridge Market Area[219] "A": Case Study 18

MARKET AREA A			
Subdivision location:	Wheat Ridge, CO	**Price range of homes sold[220]:**	$60,000 to $620,000 Median: $216,000 Mode: too many to be relevant
Number of detached homes:	Unknown. Densely populated 8 sq. mile area	**Age range of homes:**	Unknown. Most properties were built in the late 1950s and early 1960s. A mixed urban area.
Percentage of Rentals:	Unknown. Estimated near 30%.	**Gross Rent Multiplier chart for subdivision:**	
Quality of Construction:	Fair to Average	**Type of homes:**	Tract homes. Mostly brick ranch homes on standard 5,000 to 12,000 sq.ft. lots
Number of homes sold in 6 months:	79	**Range of above-grade square footages:**	1000 – 2500
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	4 in last 2 years.
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 18			
Purchase Date:	May, 2012	**Sales Price of house:**	$265,000
Age of home:	55 years	**Above-grade sq.ft. of home:**	1426
Total days on market[221]:	54	**Average Days on Market for subdivision[222]:**	76
Gross Rent Multiplier for similar home:	155		
Other green and/or energy efficient features: none known			

[219] The case studies that are not from Wheat Ridge, include market data taken from their exact subdivision. Wheat Ridge is not divided into subdivisions. Thus, a market area that is common to all four case studies from Wheat Ridge is used.
[220] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[221] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[222] Information is based on sales that sold in the six months proper to the closing date of the subject property.

Case Study 18

MARKET CONDITIONS AT TIME OF SALE for Case Study 18 :	STABLE
Seasonally, values were extremely stable. Supply and demand were in balance. 30% of all sales were REO properties, as the market was just starting to recover from heavy foreclosure rates.	

PHOTOVOLTAIC SYSTEM For Case Study 18

Details of the subject's PV system:

Category	Details-Array 1	Details-Array 2	Source
Ownership	Owned	Owned	Listing Agent
kW	2.3 kW	2.7 kW	Permit
Date of Permit	July, 2008	July, 2008	Permit
Manufacturer of panels	Kyocera	Kyocera	Permit
Warranty on panels	20 Years	20 Years	Permit
Manufacturer of Inverter	Xantrax	Xantrax	Permit
Warranty on Inverter	10 Years	10 Years	Permit
Type	Fixed	Fixed	Permit, Observation
Tilt	18.4	18.4	Observation
Energy Production per panel	205	205	Permit
Energy Production Estimate (for 1 year)	3131	3261	Permit
Location	Roof	Roof	Permit, Observation
Age of panels	4 years	4 years	Permit
Inverter type	Wall mount	Wall mount	Permit
Age of Inverter	4 years	4 years	Permit
Original gross cost	$17,951	$21,074	Permit
Azimuth	157	247	Solmetric Roof Azimuth tool

Real Estate Agent comments:

Listing Agent: It was necessary to educate the buyers: education was key. Many did not understand the system but liked the cost efficiency once they learned about it. Buyers were worried about perceived maintenance costs. The person who bought the house did not understand the system until it was explained to him. The agent actively marketed the PV system by disclosing the low utility rates the home has.
Buyer's Agent: Did not provide feedback.

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #18

DATA SOURCES

Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 18:

✓	Listing Agent	✓	Permit
	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
✓	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Market area Analysis
✓	Paired Sales Analysis	✓	Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 6's PV system:

✔	Sales Comparison (Paired Sales Analysis)
✔	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✔	Income Approach (Using PV Value)
✔	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis[223]

	Subject	Comp 1
Sale Price	$265,000	$265,000
Sale Date	May, 2012	Feb, 2012
Days to sale	54	88
Square feet	1995	2005
Photovoltaic	Yes	No
Notable feature	Moderate Updating	Extensively Remodeled
Other	4 bed/2 bath, 2 car Garage	4 bed/2 bath, 2 car Garage

This was the only reasonable paired sale found. While it does not indicate an exact value contribution of a PV system, it does indicate that the PV system did have positive value. Comp 1 had more remodeling and was sold for the same price as the subject property. This is not a value indicator, but it does indicate that PV had some contributory value.

Thus, the following is the most reasonable conclusion:

As of May 2012, a value indication using the Paired Sales Analysis is:
AN UNDETERMINED POSITIVE VALUE AMOUNT
for a 5.0 kW, 4 year old system with 16 years remaining useful life.

[223] Similar features of these two properties include a similar year of construction, style, lot size, view, location and quality of construction.

B. Cost Approach (Using Local Builder Costs)

Current builder costs were extracted using building permit information for the City of Wheat Ridge:

Date of Permit	Address	Total system Cost	kWs	Cost per kW
10/14/2011	2655 Quay St	$15,000	4.14	$3,623
05/01/2012	4560 Upham St	$40,900	7.68	$5,325
05/07/2012	4265 Dudley St	$31,387	6.75	$4,649
02/15/2012	4455 Yarrow St	$30,000	7.58	$3,957

During this time period, cost per kW was changing rapidly. The lowest price per kW was used for this cost approach since costs were generally declining during this time period. Thus, a cost of $4,000 per kW is reasonable.

The subject property has a 5.0 kW system, thus:

5.0 kW X $4,000 per kW = $20,000.

Depreciation is based on the system's actual age (as of May, 2012), compared to its useful life:

Straight-line age/life method	
Age of system:	4 years
Useful life:	20 years[224]
4/20% = 20% depreciated	

$20,000 less depreciation = $16,000

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $16,000. This, however, does not take into consideration functional obsolescence:

$16,000 less ($1000 X 5.0kW for functional obsolescence) = $11,000

This figure is then used to draw the following conclusion:

As of May 2012, a value indication using the cost approach is:
$2,200 (rounded) per kW
for a 5.0 kW, 4-year old system with 16 years remaining useful life.

[224] The subject property's PV system is 4 years and has a 20 year warranty. Total useful life is based on the life of the warranty.

C. Income Approach (Using a Gross Rent Multiplier)

An estimated 30% of the properties in this subdivision are rented. Thus, there is ample rental data available for comparison and a GRM is a reasonable indicator of market value in this subdivision. As per the GRM chart provided earlier, a GRM for the subject property is 155.

By calculating the subject's average estimated monthly savings, the GRM can be used to estimate the value contribution of these savings.

1) Subject's yearly energy production is estimated[225] at 6547 kWh
2) Current utility rates are $0.11 per kWh
3) 6547 kWh X $0.11 = $720.17/12 = $60.01 per month
4) $60.01 X (GRM of 155) = **$9,302** (for a 5.0 kW system)

These figures are then reduced to a per kW estimate:

As of May 2012, the value indicated using the income approach is: **$1,860 (rounded) per kW** for a 5.0 kW, 4-year old system with 16 years remaining of useful life.

Rental income is a factor nearly 30% of potential buyers take into account in this neighborhood. Also, there is ample rental information available. For this reason, the income approach is given consideration in the reconciliation of values. The buyer did not understand the system at first, but after education from the listing agent (who stated "education was key"), the buyer learned about the money saving capabilities of the system and liked them.

225 The estimated savings rate is based on the probable number of kWh's the system will generate in a year (per PV Value®) and using local utility rates.

D. Income Approach (Using PV Value)

The PV Value tool was used to determine the present value of the energy that will be produced by the subject's PV system over the next 16 years. The system is already four years old, so the remaining useful life is only 16 years. Because this system has two separate arrays, two PV Value calculations were run and added together in the following chart. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80031	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	5000	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$1472.94
Module Degradation rate	0.5	Net Yield Rate (Custom)[226]	4.09	Utility Escalation rate	2.13	System Warranty/Years	20
Tilt	18.4	Discount Rate(low)	4.59			Actual Age/Years	4
Azimuth	157	Discount rate (average)	5.84			Remaining Energy/Years	16
KWh Produced/Year	7440	Discount rate (high)	7.09				

**Note: XXXX = User Input XXXX = User Input Override XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$711.72

Present value estimate of accumulated energy oroduction for remaining 16 years	
Low	$7,504.70
Average	$8,218.24
High	$9,028.58

As per the above data, the indicated value by the income approach is between $7,500 and $9,000 (both figures are rounded) for a 5.0 kW system.

As of May 2012, a value indication using the income approach is:
$1,500 to $1,800 (rounded) per kW
for a 5.0 kW, 4-year old system with 16 years remaining of useful life.

In this circumstance, this data is considered very relevant. The buyer's agent indicated that he marketed the utility savings realized. This data is therefore given consideration in the final reconciliation and is a reflection of how this buyer considered the value contribution of the PV system.

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[226] Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The listing agent marketed the property by advertising the utility savings. The buyer had to be educated about the system, but once educated, he saw the value.
- The utility savings were important to the valuation of the home (per the listing agent).

In this circumstance, the income of the PV system played a role in the price of the home.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
Positive value contribution (exact value amount unknown)	$2,200 per kW	$1,860 per kW (GRM)
		$1,500 to $1,800 per kW (PV Value)

The paired sales analysis only indicates that a positive adjustment is warranted, however, it does not indicate how much that adjustment should be.

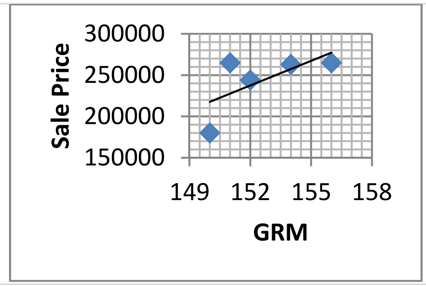
The cost approach data is applicable; however, since the listing agent indicated that the income was of greatest interest to the buyer, the income approach is given the greatest consideration.

The income approach value using a GRM is given consideration. This market area did take the utility savings into account. The value indicated by the PV Value is also given a great amount of consideration, as it very closely approximates the actual savings the seller realized per year. The agent actively marketed this home by advertising the savings amount. Therefore, the utility savings were an important feature in this transaction.

As of May 2012, the value is:
$1,500 to $1,860 per kW
for a 5.0 kW, 4-year old system with 16 years remaining of useful life and with a location in Wheat Ridge, market area "A"

Marketing time was 54 days: 22 days less than the market average of 76 days.

Wheat Ridge Market Area[227] "A": Case Study 19

MARKET AREA A			
Subdivision location:	Wheat Ridge, CO	**Price range of homes sold[228]:**	$60,000 to $620,000 Median: $220,000 Mode: too many to be relevant
Number of detached homes:	Unknown. Densely populated 8 sq. mile area	**Age range of homes:**	Unknown. Most properties were built in the late 1950s and early 1960s. A mixed urban area.
Percentage of Rentals:	Unknown. Estimated near 30%.	**Gross Rent Multiplier chart for subdivision:**	
Quality of Construction:	Fair to Average	**Type of homes:**	Tract homes. Mostly brick ranch homes on standard 5,000 to 12,000 sq.ft. lots
Number of homes sold in 6 months:	51	**Range of above-grade square footages:**	1000 – 2500
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	4 in last 2 years.
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 19			
Purchase Date:	June, 2012	**Sales Price of house:**	$289,000
Age of home:	60 years	**Above-grade sq.ft. of home:**	1690
Total days on market[229]:	21	**Average Days on Market for subdivision[230]:**	68
Gross Rent Multiplier for similar home:	155		
Other green and/or energy efficient features: none known			

[227] The case studies that are not from Wheat Ridge, include market data taken from their exact subdivision. Wheat Ridge is not divided into subdivisions. Thus, a market area that is common to all four case studies from Wheat Ridge is used.
[228] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[229] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[230] Information is based on sales that sold in the six months proper to the closing date of the subject property.

MARKET CONDITIONS AT TIME OF SALE for Case Study 19 :	STABLE
Seasonally, values were extremely stable. Supply and demand were in balance. 30% of all sales were REO properties, as the market was just starting to recover from heavy foreclosure rates.	

PHOTOVOLTAIC SYSTEM For Case Study 19

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Listing Agent
kW	3.36 kW	Permit
Date of Permit	December, 2009 2008	Permit
Manufacturer of panels	Amerisolar	Permit
Warranty on panels	25 Years	Permit
Manufacturer of Inverter	PV Powered 3000	Permit
Warranty on Inverter	10 Years	(assumed)
Type	Fixed	Permit, Observation
Tilt	18.4	Observation
Energy Production per panel	240	Permit
Energy Production Estimate (for 1 year)	4838	Permit
Location	Roof	Permit, Observation
Age of panels	3 years	Permit
Inverter type	Wall mount	Permit
Age of Inverter	3 years	Permit
Original gross cost	$15,000	Permit
Azimuth	143	Solmetric Roof Azimuth tool

Realtor Estate Agent comments:

Listing Agent: The PV system was of great importance to the buyers. The utility bills were small and this made the buyers "super happy." When the house was appraised for the sale, the appraiser developed the opinion that the system added somewhere between $5,000 and $6,000 to the property value (N*ote: the appraiser was not available for comment, so it is not known how the appraiser developed this opinion of contributory value or if it is a valid and supportable opinion.*)
Buyer's Agent: Buyers were very excited about the system, they were apprehensive about the maintenance costs until they were educated about them. The PV did impact the value positively, as these buyers were young and "loved green." The more energy efficiency features they could find, the better. PV was a selling feature that mattered to them.

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #19

DATA SOURCES

Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 19:

✓	Listing Agent	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
✓	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Market area Analysis
✓	Paired Sales Analysis	✓	Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 19's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
✓	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis[231]

	Comp 1	Comp 2
Sale Price	$265,000	$265,000
Sale Date	May, 2012	Feb, 2012
Days to sale	54	88
Square feet	1995	2005
Photovoltaic	Yes	No
Notable feature	Moderate Updating	Extensively Remodeled
Other	4 bed/2 bath, 2 car Garage	4 bed/2 bath, 2 car Garage

This is the same paired sale used for Case Study 18. The paired sale is applicable to this case study as well, as both Case Study 18 and Case Study 19 are from the same identical market area and were sold in the same price range. While this paired sale does not indicate an exact value contribution of a PV system, it does indicate that the PV system did have value. Comp 2 had more remodeling and was sold for the same price as Comp 1. Thus, this is not a value indicator, but it does indicate that the PV had some contributory value.

Thus, the following is the most reasonable conclusion:

As of June 2012, a value indication using the Paired Sales Analysis is:
AN UNDETERMINED POSITIVE VALUE AMOUNT
for a 3.36 kW, 3 year old system with 22 years remaining useful life.

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[231] Similar features of these two properties include a similar year of construction, style, lot size, view, location and quality of construction.

B. Cost Approach (Using Local Builder Costs)

Current builder costs were extracted using building permit information for the City of Wheat Ridge:

Date of Permit	Address	Total system Cost	kWs	Cost per kW
06/21/2012	4355 Newland St	$18,238	6.5	$2,805
07/12/2012	10 Morningside	$18,720	6.24	$3,000
05/07/2012	4265 Dudley St	$31,387	6.75	$4,649
02/15/2012	4455 Yarrow St	$30,000	7.58	$3,957

Based on this data and cost data from other markets, a per-kW cost of $3,500 is reasonable, that is also the average cost per kW of the above PV systems.

The subject property has a 3.360 kW system, thus:

3.36 kW X $3,500 per kW = $11,760

Depreciation is based on the system's actual age (as of June, 2012), compared to its useful life:

Straight-line age/life method	
Age of system:	3 years
Useful life:	25 years[232]
3/25% = 12% depreciated	

$11,760 less depreciation = $10,350

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $10,400 (rounded). This figure, however, does not include functional obsolescence. Therefore, functional obsolescence is taken into consideration:

$10,400 less ($1000 X 3.36kW for functional obsolescence) = $7,040 total value

This figure is then used to draw the following conclusion:

As of June 2012, a value indication using the cost approach is:
$2,100 (rounded) per kW
for a 3.36 kW, 3-year old system with 22 years remaining useful life.

C. Income Approach (Using a Gross Rent Multiplier)

[232] The subject property's PV system is 3 years old and has a 25 year warranty. Total useful life is based on the life of the warranty.

An estimated 30% of the properties in this subdivision are rented. Thus, there is ample rental data available for comparison and a GRM is a reasonable indicator of market value in this subdivision. As per the GRM chart provided earlier, a GRM for the subject property is 155.

By calculating the subject's average estimated monthly savings, the GRM can be used to estimate the value contribution of these savings.

1) Subject's yearly energy production is estimated[233] at 4838 kWh
2) Current utility rates are $0.11 per kWh
3) 4838 kWh X $0.11 = $532.18/12 = $44.34 per month
4) $44.34 X (GRM of 155) = **$6,873** (for a 3.36 kW system)

These figures are then reduced to a per kW estimate:

As of June 2012, the value indicated using the income approach is:
$2,050 (rounded) per kW
for a 3.36 kW, 3-year old system with 22 years remaining of useful life.

Rental income is a factor nearly 30% of potential buyers take into account in this neighborhood. Also, there is ample rental information available. For this reason, the income approach is given consideration in the reconciliation of values. The listing agent stated that the PV system and the utility savings per month were very important to these buyers. Therefore, this value indicator is taken into consideration.

[233] The estimated savings rate is based on the probable number of kWh's the system will generate in a year (per PV Value®) and using local utility rates.

E. Income Approach (Using PV Value)

The PV Value tool was used to determine the present value of the energy that will be produced by the subject's PV system over the next 22 years. The system is already three years old; thus, the remaining useful life is only 22 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80214	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	3360	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$1289.82
Module Degradation rate	0.5	Net Yield Rate (Custom)[234]	3.99	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	18.4	Discount Rate(low)	4.49			Actual Age/Years	3
Azimuth	143	Discount rate (average)	5.74			Remaining Energy/Years	22
KWh Produced/Year	4838	Discount rate (high)	6.99				

**Note: XXXX = User Input   XXXX = User Input Override   XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$528.66

Present value estimate of accumulated energy production for remaining 22 years	
Low	$5,693.79
Average	$6,435.64
High	$7,313.02

As per the above data, the indicated value by the income approach is between $5,700 and $7,300 (both figures are rounded) for a 3.36 kW system.

As of June 2012, a value indication using the income approach is:
$1,700 to $2,170 (rounded) per kW
for a 3.36 kW, 3-year old system with 22 years remaining of useful life.

In this circumstance, this data is considered very relevant. The buyer's agent indicated that the buyers said the utility savings per month were "of great importance" to them. This data is therefore given consideration in the final reconciliation and is a reflection of how this buyer considered the value contribution of the PV system.

[234] Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The listing agent indicated that the utility savings were very important to this buyer.
- The buyer's agent indicated that the utility savings were very important to the buyer.
- The home sold very quickly.

In this circumstance, the income of the PV system played a role in the price of the home.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
Positive value contribution (exact value amount unknown)	$2,100 per kW	$2,050 per kW (GRM)
		$1,700 to $2,170 per kW (PV Value)

The paired sales analysis only indicates that a positive adjustment is warranted, however, it does not indicate how much that adjustment should be.

The cost approach is applicable and reflective of the market area.

The income approach value using a GRM is given consideration. This market area did take the utility savings into account; therefore, the GRM is reflective of market actions. The value indicated by the PV Value is also given consideration, as the data utilized for this approach was very complete.

Given the above value indicators, and the fact that three value indicators are within the very tight range of $2,050 to $2,170, a final value indication of $2,100 per kW is reasonable.

As of June 2012, the value is:
$2,100 per kW
for a 3.36 kW, 3-year old system with 22 years remaining of useful life and with a location in Wheat Ridge, market area "A"

Marketing time was 21 days: 47 days less than the market average of 68 days.

Wheat Ridge Market Area[235] "A": Case Study 20

MARKET AREA A			
Subdivision location:	Wheat Ridge, CO	**Price range of homes sold[236]:**	$60,000 to $620,000 Median: $216,000 Mode: too many to be relevant
Number of detached homes:	Unknown. Densely populated 8 sq. mile area	**Age range of homes:**	Unknown. Most properties were built in the late 1950s' and early 1960s. A mixed urban area.
Percentage of Rentals:	Unknown. Estimated near 30%.	**Gross Rent Multiplier chart for subdivision:**	No rental data available for this price range.
Quality of Construction:	Fair to Average	**Type of homes:**	Tract homes. Mostly brick ranch homes on standard 5,000 to 12,000 sq.ft. lots
Number of homes sold in 6 months:	47	**Range of above-grade square footages:**	1000 – 3500
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	4 in last 2 years.
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 20			
Purchase Date:	April, 2012	**Sales Price of house:**	$620,000
Age of home:	5 years	**Above-grade sq.ft. of home:**	3251
Total days on market[237]:	12	**Average Days on Market for subdivision[238]:**	76
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: none known			

MARKET CONDITIONS AT TIME OF SALE for Case Study 19 :	STABLE
Seasonally, values were extremely stable. Supply and demand were in balance. 30% of all sales were REO properties, as the market was just starting to recover from heavy foreclosure rates.	

[235] The case studies that are not from Wheat Ridge, include market data taken from their exact subdivision. Wheat Ridge is not divided into subdivisions. Thus, a market area that is common to all four case studies from Wheat Ridge is used.
[236] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[237] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[238] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 20

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Listing Agent
kW	4.9 kW	Permit
Date of Permit	March, 2007	Permit
Manufacturer of panels	Solarworld	Permit
Warranty on panels	25 Years	(assumed)
Manufacturer of Inverter	Fronius	Permit
Warranty on Inverter	7 Years	Permit
Type	Fixed	Permit, Observation
Tilt	45	Observation
Energy Production per panel	175	Permit
Energy Production Estimate (for 1 year)		Permit
Location	Ground	Permit, Observation
Age of panels	5 years	Permit
Inverter type	Wall mount	Permit
Age of Inverter	5 years	Permit
Original gross cost		(unknown)
Azimuth	183	Solmetric Azimuth tool

Real Estate Agent comments:

Listing Agent: The PV system was not even mentioned by anyone. This house had other negative issues that impacted the value: the home lacked a basement because the water table was so high. It is not typical to lack a basement in this area. Also, the property backed to a lake, but did not have legal access to the lake. This was a huge negative.

Buyer's Agent: Did not provide feedback.

NOTE:

This system was installed in 2007, when PV systems were rarely noted in the market area. Also, this is an unusual system in that the array is mounted on the ground in the backyard and takes up nearly a third of the backyard. Thus, this system has inferior appeal because of its location on the ground.

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #20

DATA SOURCES

Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 20:

✓	Listing Agent	✓	Permit
	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
	PV Value	✓	Market area Analysis

COMMENTS

Per the listing agent's comments (and the comments of six other agents who have sold properties on this lake in the past), PV systems have no appeal in this particular market area. The location on/near the lake is such a huge overriding factor, that smaller individual features homes have (such as decks, basement finish, moderate updating, two-verses-three car garages), have no relevance to the value.

There are so few homes available in the Denver metro area with lake views that the lack of supply dictates that buyers do not distinguish value based on smaller features (such as PV systems). While the PV system does produce energy, this market area has literally no interest in that income.

In conclusion, this PV system has no relevance to the property value. Attempts were made to locate paired sales. However, true to the area agent's statements: no value difference could be found for any minor feature (such as a PV system) in the 10 sales that occurred on this lake in the past five years. The majority of the value was in the land.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

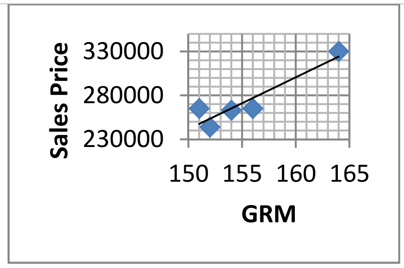
- The listing agent indicated that the PV system was of no relevance.
- Other area agents confirmed that PV systems are of no relevance in this market area.
- This is a unique home with unusual functional issues.
- The PV system was unique in that it was mounted on the ground (and took up a good portion of the backyard).
- This was the most expensive home to be sold in the last year in the defined market area. Lake views are extremely rare and, therefore when a home becomes available with a lake view, it tends to sell extremely quickly, regardless of the many individual features the home may or may not have.

For this particular property, the PV system was not relevant. PV systems are not common in this price range of home and in this market area. The listing agent indicated that the system was not a negative; rather, it was just a non-issue. Even so, he did include comments in the MLS regarding its existence and the home did sell extremely quickly (though, in his opinion, it was because of the lake and had nothing to do with the PV system).

PV Systems have no market appeal in this particular market area. This is for a 4.9 kW, 5-year old system with 20 years remaining of useful life and with a location in Wheat Ridge, market area "A"
The subject's very fast sale was not because to the PV system, thus, it is given no consideration.

Again, this case study was retained only because it met the original qualifications to be included as a case study. This particular property shows that there are circumstances in which a market area places no interest in the PV system simply because buyers so greatly desire another feature (in this case, a lake view, which rarely becomes available in this market area). The supply of lake view properties is so abnormally low that buyers rush to buy these properties, and they see little value in the individual features each home has in this area. Thus, even though the PV system produces electricity (and income), this market gave zero indication that income was relevant.

Wheat Ridge Market Area[239] "A": Case Study 21

MARKET AREA A			
Subdivision location:	Wheat Ridge, CO	**Price range of homes sold[240]:**	$50,699 to $620,000 Median: $216,000 Mode: too many to be relevant
Number of detached homes:	Unknown. Densely populated 8 sq. mile area	**Age range of homes:**	Unknown. Most properties were built in the late 1950s and early 1960s. A mixed urban area.
Percentage of Rentals:	Unknown. Estimated near 30%.	**Gross Rent Multiplier chart for subdivision:**	
Quality of Construction:	Fair to Average	**Type of homes:**	Tract homes. Mostly brick ranch homes on standard 5,000 to 12,000 sq.ft. lots
Number of homes sold in 6 months:	105	**Range of above-grade square footages:**	1000 – 2500
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	4 in last 2 years.
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 21			
Purchase Date:	June, 2012	**Sales Price of house:**	$315,000
Age of home:	109	**Above-grade sq.ft. of home:**	1120
Total days on market[241]:	21	**Average Days on Market for subdivision[242]:**	50
Gross Rent Multiplier for similar home:	164		
Other green and/or energy efficient features: none known			

[239] The case studies that are not from Wheat Ridge, include market data taken from their exact subdivision. Wheat Ridge is not divided into subdivisions. Thus, a market area that is common to all four case studies from Wheat Ridge is used.
[240] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[241] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[242] Information is based on sales that sold in the six months proper to the closing date of the subject property.

MARKET CONDITIONS AT TIME OF SALE for Case Study 21 :	STABLE

Seasonally, values were extremely stable. Supply and demand were in balance. 30% of all sales were REO properties, as the market was just starting to recover from heavy foreclosure rates. At this point, however, the number of sales began to dramatically increase and the days on market were beginning to decrease. This was nearing the tipping point of when values began to increase.

PHOTOVOLTAIC SYSTEM For Case Study 21

	Category	Details	Source
Details of the subject's PV system:	Ownership	Owned	Listing Agent
	kW	3.08 kW	Permit
	Date of Permit	April, 2009	Permit
	Manufacturer of panels	REC Solar	Permit
	Warranty on panels	25 Years	Permit
	Manufacturer of Inverter	Fronius	Permit
	Warranty on Inverter	10 Years	(assumed)
	Type	Fixed	Permit, Observation
	Tilt	18.4	Observation
	Energy Production per panel	220	Permit
	Energy Production Estimate (for 1 year)	4487	Permit
	Location	Roof	Permit, Observation
	Age of panels	3 years	Permit
	Inverter type	Wall mount	Permit
	Age of Inverter	3 years	Permit
	Original gross cost	$20,000	Permit
	Azimuth	189	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Listing Agent*: The agent thought the system did bring value, and was an "added benefit," (secondary to the quality of a recent $75,000 remodel project), but was not sure how much value it brought. *Buyer's Agent:* Did not provide feedback.		

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #21

DATA SOURCES

Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 21:

✓	Listing Agent	✓	Permit
	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
✓	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Market area Analysis
✓	Paired Sales Analysis	✓	Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 21's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
✓	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis

	Subject	Comp 1
Sale Price	$315,000	$305,000
Sale Date	October, 2012	October, 2012
Days to Sale	11	22
Square Feet	1120	1075
Basement	Full & Finished	Full & Finished
Other	Porch	Porch
Photovoltaic	Yes	No
Notable Feature	Major Remodel	Major Remodel
Other	2 bed/1 bath up 1 bed/1 bath down 2 car Garage	2 bed/1 bath up 1 bed/1 bath down 2 car Garage
Year of Construction	1904	1899
Lot Size	11,112 sq.ft.	6,752 sq.ft.

This paired sale indicates a value contribution of $10,000 to the property for the larger lot size and the PV system. Lot size value differences in this market area are minimal, and therefore, after speaking with a prominent area listing agent, the conclusion was drawn that the larger lot would contribute "around $5,000" to the value of these properties. Thus, the PV system contributed a total of $5,000 to the subject property.

Relying on the agent's statement of value is a weakness of this paired sale; however, there were no other paired sales available to corroborate/rebut this agent's statement. Therefore, the value indication by the paired sales analysis is given minimal consideration in the reconciliation.

Thus, the following is the most reasonable conclusion:

As of October 2012, a value indication using the Paired Sales Analysis is:
$1,620 per KW
for a 3.08 kW, 3-year old system with 22 years remaining useful life.

B. Cost Approach (Using Local Builder Costs)

Current builder costs were extracted using building permit information for the City of Wheat Ridge:

Date of Permit	Address	Total system Cost	kWs	Cost per kW
10/04/2012	6330 W 30th Ave	$15,840	5.28	$3,000
08/29/2012	12226 W 34th Pl	$17,710	5.06	$3,500

Based on this data and cost data from other markets, a per kW cost of $3,500 is reasonable.

The subject property has a 3.08 kW system, thus:

3.08 kW X $3,500 per kW = $10,780

Depreciation is based on the system's actual age (as of October 2012), compared to its useful life:

Straight-line age/life method	
Age of system:	3 years
Useful life:	25 years[243]
3/25 = 12% depreciated	

$10,780 less depreciation = $9,486

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $9,500 (rounded). This figure, however, does not include functional obsolescence. To account for functional obsolescence, the following adjustments are made:

$9,500 less ($1000 X 3.08kW for functional obsolescence) = $6,500 for a 3.08 kW system

This figure is then used to draw the following conclusion:

As of June 2012, a value indication using the cost approach is:
$2,100 (rounded) per kW
for a 3.08 kW, 3- year old system with 22 years remaining useful life.

[243] The subject property's PV system is 3 years old and has a 25 year warranty. Total useful life is based on the life of the warranty.

C. Income Approach (Using a Gross Rent Multiplier)

An estimated 30% of the properties in this subdivision are rented. Thus, there is ample rental data available for comparison and a GRM is a reasonable indicator of market value in this subdivision. As per the GRM chart provided earlier, a GRM for the subject property is 164.

By calculating the subject's average estimated monthly savings, the GRM can be used to estimate the value contribution of these savings.

1) Subject's yearly energy production is estimated[244] at 4487 kWh
2) Current utility rates are $0.11 per kWh
3) 4487 kWh X $0.11 = $493.57/12 = $41.13 per month
4) $41.13 X (GRM of 164) = **$6,745** (for a 3.08 kW system)

These figures are then reduced to a per kW estimate:

As of June 2012, the value indicated using the income approach is: **$2,190 (rounded) per kW** for a 3.08 kW, 3-year old system with 22 years remaining of useful life.

Rental income is a factor nearly 30% of potential buyers take into account in this neighborhood. Also, there is ample rental information available. For this reason, the income approach is given consideration in the reconciliation of values.

[244] The estimated savings rate is based on the probable number of kWh's the system will generate in a year (per PV Value®) and using local utility rates.

E. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 22 years. The system is already three years old, so the remaining useful life is only 22 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80033	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	3080	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$1366.82
Module Degradation rate	0.5	Net Yield Rate (Custom)[245]	2.72	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	18.4	Discount Rate(low)	3.22			Actual Age/Years	3
Azimuth	189	Discount rate (average)	4.47			Remaining Energy/Years	22
KWh Produced/Year	4487	Discount rate (high)	5.72				

**Note:* XXXX *= User Input* XXXX *= User Input Override* XXXX *= Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$490.33

Present value estimate of accumulated energy production for remaining 22 years	
Low	$5,810.50
Average	$6,626.50
High	$7,597.45

As per the above data, the indicated value by the income approach is between $5,800 and $7,600 (both figures are rounded) for a 3.08 kW system.

As of October 2012, a value indication using the income approach is:
$1,880 to $2,500 (rounded) per kW
for a 3.08 kW, 3-year old system with 22 years remaining of useful life.

In this circumstance, this data is considered very relevant. The utility savings are important in this market area and there was ample data available to develop the income approach. Thus, this value indication is taken into consideration in the final reconciliation and is a reflection of how this buyer considered the value contribution of the PV system.

245 Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The listing agent indicated that the system did bring value to the property and the utility savings were an added benefit.
- The home sold very quickly.

In this circumstance, the income of the PV system played a role in the price of the home and the income was given the most consideration.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
$1,620 per kW	$2,100 per kW	$2,190 per kW (GRM)
		$2,070 to $2,440 per kW (PV Value)

The paired sales analysis has weak data, and therefore, the only indicator taken from the paired sales analysis is that the PV system has a positive value.

The cost approach has good data and is reflective of actual local builder costs and the market's reaction to those costs.

The income approach provides two value indicators, both of which are consistent with one another. Thus, the value indicators from the income approach are relevant and are given the greatest consideration in the reconciliation of values.

As of October 2012, the value is: **$2,070 to $2,190 per kW** for a 3.08 kW, 3-year old system with 22 years remaining of useful life and with a location in Wheat Ridge, market area "A"
Marketing time was 11 days: 39 days less than the market average of 50 days.

Denver, Subdivision "A": Case Study 22

SUBDIVISION A			
Subdivision location:	Denver, Co	**Price range of homes sold[246] in market area:**	$150,000 to $1,127,803 Median: $424,450 Model: to many to be relevant
Number of detached homes in subdivision:	3063	**Age range of homes:**	2002 to 2011
Percentage of Rentals:	11%	**Gross Rent Multiplier chart for market area:**	One similar rental was found with a GRM of 163.
Quality of Construction:	Average to Excellent	**Type of homes:**	New urbanism development. Charming homes with a variety of architectural details
Number of homes sold in 6 months[247]:	138	**Range of above-grade square footages:**	1185-4500
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	Unknown
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 22			
Purchase Date:	October, 2011	**Sales Price of house:**	$324,900
Age of home:	11 years	**Above-grade sq.ft. of home:**	1451
Total days on market[248]:	63	**Average Days on Market for subdivision[249]:**	76
Gross Rent Multiplier for similar home:	163		
Other green and/or energy efficient features: Green-built			

MARKET CONDITIONS AT TIME OF SALE for Case Study 22 :	STABLE
The median sale price was seasonally stable from the year prior. The number of sales and the number of days on market were down slightly from six months prior. Supply and demand were in balance.	

[246] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[247] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[248] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[249] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 22			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Listing Agent
	kW	2.8	MLS listing
	Date of Permit	Nov, 2006	Permit
	Manufacturer of panels	Mitsubishi	Permit
	Warranty on panels	25 Years	(assumed)
	Manufacturer of Inverter	Fronius	Permit
	Warranty on Inverter	10 Years	(assumed)
	Type	Fixed	Observation
	Tilt	22.60	Observation
	Energy Production per panel		(unknown)
	Energy Production Estimate (for 1 year)	4271	(assumed)
	Location	Roof	Observation
	Age of panels	5 years	Permit
	Inverter type	Wall mount	(assumed)
	Age of Inverter	5 years	(assumed)
	Original gross cost		(unknown)
	Azimuth	171	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Listing Agent:* The buyers were extremely interested in the system and worked at length with the original installer to understand the economic benefits of the system. Other prospective buyers asked a lot of questions about maintenance, the agreement with Xcel and how the systems work. These specific buyers were extremely interested in the long-term financial savings and the overall environmental impact. Property took a long time to sell because potential buyers did not understand the system. The PV system did add value. Education of the buyer is key. *Buyer's Agent*: The PV system was a huge selling point. These buyers were very interested in green features. The PV was the reason they bought the house. Saving on utility costs was extremely important to them.		

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #22

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 22:

✓	Listing Agent	✓	Permit
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
✓	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis	✓	Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to help determine the contribution value (if any) of Case Study 22's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
✓	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis[250]

	Subject	Comp 1	Comp 2
Sale Price	$324,900	$324,500	$323,500
Sale Date	October, 2011	August, 2011	May, 2011
Days to Sale	63	191	5
Square Feet	1451	1451	1451
Photovoltaic	Yes	No	No
Basement	Full Unfinished	Full Finished	Full Finished

All three properties are the exact same model of home. The subject property does not have a finished basement, yet Comp 1 and Comp 2 both have 600 sqft, finished basements. Thus, the value of the subject's PV system is the same as a 600 sqft, finished basement. Basement finish in this market area (for this type of home) is worth approximately $12 per square foot, for an estimated value contribution of $7,200 for a 2.8kW PV system ($2,570 per kW).

Thus, the following is the most reasonable conclusion:

As of October 2011, a value indication using the Paired Sales Analysis is:
$2,570 per kW
for a 2.8 kW, 5-year old system with 20 years remaining useful life.

[250] Similar features of these two properties include a similar year of construction, style, lot size, view, location and quality of construction.

B. Cost Approach (Using Local Builder Costs)

Based on the way the permits are kept and filed for Denver County, it was not possible to use permit data from Denver to determine the replacement cost of the PV system for the subject property. Thus, cost data is used from the city of Wheat Ridge (since costs are the same, regardless of the county):

Date of Permit	Address	Total system Cost	kWs	Cost per kW
10/14/2011	2655 Quay St	$15,000	4.14	$3,623
09/01/2011	7101 W 48th Ave	$14,800	4.23	$3,498
08/23/2011	4301 Newcombe St	$30,000	10.0	$3,000

Based on the above permit data, a reasonable current cost estimate for a PV system in this area is $3,500 per kW.

The subject property has what is assumed to be a 2.8 kW system, therefore, the following calculations can be made:

2.8 kW X $3,500 =$9,800

Depreciation is based on the system's actual age (as of November, 2011), compared to its useful life:

Straight-line age/life method	
Age of system:	5 years
Useful life:	25 years[251]
5/25 = 20% depreciated	

$9,800 less depreciation = $7,840

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $7,840. This, however, does not take into consideration functional obsolescence. Functional obsolescence is accounted for below:

$7,840 less ($1000 X 2.8kW for functional obsolescence) = $5,040 for a 2.8 kW system

As of October 2011, a value indication using the cost approach is:
$1,800 (rounded) per kW
for a 2.80 kW, 5-year old system with 20 years remaining useful life.

[251] The subject property's PV system is 5 years and is assumed to have a 25 year warranty. Total useful life is based on the life of the warranty. If the estimated warranty period is incorrect, this could alter the conclusions and opinions reached in this report.

This is given consideration in the reconciliation. The available cost data is adequate and representative of the immediate market area.

C. Income Approach (Using a Gross Rent Multiplier)

The GRM for a like-quality house is 163.

By calculating the subject's average estimated monthly savings, the GRM can be used to estimate the value contribution of these savings.

1) Subject's yearly energy production is estimated[252] at 4271 kWh
2) Utility rates were $0.11
3) 4271 kWh X $0.11 = $468.81/12 = $39.15 per month
4) $39.15 X (GRM of 163) = **$6,381** (for a 2.80 kW system)

These figures are then reduced to a per kW estimate:

As of October 2011, the value indicated using the income approach is: **$2,280 (rounded) per kW** for a 3.08 kW, 5 year old system with 20 years remaining of useful life.

The GRM is a reflection of income in this market area. The data noted above is reliable and representative of the subject property, and therefore, the value indicator is given consideration in the reconciliation.

[252] The estimated savings rate is based on the probable number of kWh's the system will generate in a year (per PV Value®) and using local utility rates.

D. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 20 years. The system is already five years old, so the remaining useful life is only 20 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80238	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	2800	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$1162.72
Module Degradation rate	0.5	Net Yield Rate (Custom)[253]	4.34	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	22.6	Discount Rate(low)	4.84			Actual Age/Years	5
Azimuth	171	Discount rate (average)	6.09			Remaining Energy/Years	20
KWh Produced/Year	4271	Discount rate (high)	7.34				

**Note:* *XXXX = User Input* *XXXX = User Input Override* *XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$461.88

Present value estimate of accumulated energy production for remaining 20 years	
Low	$4,513.87
Average	$5,059.20
High	$5,694.82

As per the above data, the indicated value by the income approach is between $4,500 and $5,700 (both figures are rounded) for a 2.80 kW system.

As of October 2011, a value indication using the income approach is:
$1,500 to $2,040 (rounded) per kW
for a 3.08 kW, 5-year old system with 20 years remaining of useful life.

The income data is reliable and based on a complete set of specifications. Therefore, the income approach is relevant and applicable for this market area.

[253] Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The listing agent and the buyer's agent both stated that the PV system was of extreme importance to these buyers.
- The buyers were very interested in the utility savings, and as a result, the financial aspects of the system were very important to them.

In this circumstance, the buyers were very knowledgeable and were very willing to pay for the present value of future energy benefits for the property.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
$2,570 per kW	$1,800 per kW	$2,280 per kW (GRM)
		$1,500 to $2,040 per kW (PV Value)

The paired sales analysis was conclusive. Combined with the selling agent's comments, it was confirmed that the PV system did add value to the property.

The cost approach falls slightly at the low end of the value range; however, it is given some consideration since the data used to produce the cost approach was current and relevant.

The income approach to value is given the greatest consideration. The income approach data has two indicators, both of which have reliable data sources.

Given that this buyer's greatest motivation was income, the income approach is given the most consideration, followed by the paired sales analysis and the cost approach.

In conclusion, the final value estimate is:

As of October 2011, the value is:
$1,800 to $2,280 per kW
for a 2.8 kW, 5-year old system with 20 years remaining of useful life and with a location in Denver, Co, Subdivision "A"

Marketing time was longer for this property. The agent stated that, at this time, PV systems were relatively new and buyers were leery of them (until they learned about them). PV had a negative impact on marketing time.

Denver, Subdivision "A": Case Study 23

SUBDIVISION A			
Subdivision location:	Denver, Co	**Price range of homes sold[254] in market area:**	$270,000 to $940,000 Median: $460,000 Model: to many to be relevant
Number of detached homes in subdivision:	3063	**Age range of homes:**	2002 to 2011
Percentage of Rentals:	11%	**Gross Rent Multiplier chart for market area:**	No relevant data was found.
Quality of Construction:	Average to Excellent	**Type of homes:**	New urbanism development. Charming homes with a variety of architectural details
Number of homes sold in 6 months[255]:	99	**Range of above-grade square footages:**	1185-4500
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	Unknown
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 23			
Purchase Date:	January, 2013	**Sales Price of house:**	$520,000
Age of home:	2 years	**Above-grade sq.ft. of home:**	2484
Total days on market[256]:	78	**Average Days on Market for subdivision[257]:**	47
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: HERS 43			

MARKET CONDITIONS AT TIME OF SALE for Case Study 23 :	INCREASING
Values increased 1% per month for the last six months. The days on market decreased to only 47 days and the sale-to-list price ratio increased to 99%. Inventory was very low and demand was high.	

[254] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[255] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[256] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[257] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 22

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Listing Agent
kW	3.0	MLS listing
Date of Permit	June, 2011	Permit
Manufacturer of panels		(unknown)
Warranty on panels	25 Years	(assumed)
Manufacturer of Inverter		(unknown)
Warranty on Inverter	10 Years	(assumed)
Type	Fixed	Observation
Tilt	45	Observation
Energy Production per panel		(unknown)
Energy Production Estimate (for 1 year)	4576	PV Value ®
Location	Roof	Observation
Age of panels	2 years	Permit
Inverter type	Wall mount	(assumed)
Age of Inverter	2 years	(assumed)
Original gross cost		(unknown)
Azimuth	171	Solmetric Roof Azimuth tool

Real Estate Agent comments:

Listing Agent: In this area, people take the PV system for granted (they are an expected feature at this point). Buyers like the money saving aspect of the systems. It adds minimal value, but does attract buyers.
Buyer's Agent: Did not provide feedback.

NOTE:

As noted earlier, most permit data for Denver County is extremely limited, with many details unrecorded. This builder is the same builder who installed PV on the homes in the Westminster subdivisions used earlier in this report.

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #23

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 23:

✓	Listing Agent	✓	Permit (minimal information available)
	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis		Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 23's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis

	Comp 1	Comp 2	Comp 3
Sale Price	$324,900	$324,500	$323,500
Sale Date	October, 2011	August, 2011	May, 2011
Days to Sale	63	191	5
Square Feet	1451	1451	1451
Photovoltaic	Yes	No	No
Basement	Full Unfinished	Full Finished	Full Finished

This is the same paired sales analysis that is used in Case Study 22. Case Study 22 and this case study are in the same identical market area. This paired sale is for a lower-valued home. However, as noted earlier in this study, the value of a PV system relates to the market area and the specifications of the PV system itself. Value of a PV system does not vary based on the value of the home it is installed.

This was the only reasonable pair found. All three sales were for the same exact model of home. Comp 1 does not have a finished basement, yet Comp 2 and Comp 3 both have 600 sq.ft., finished basements. Thus, the value of the subject's PV system is the same as a 600 sq.ft., finished basement. Basement finish in this market area (for this type of home) is worth approximately $12 per square foot; for an estimated value contribution of $7,200, or $2,570 per kW.

As of January 2013, a value indication using the Paired Sales Analysis is:
$2,570 per kW.

B. Cost Approach (Using Local Builder Costs)

Based on the way the permits are kept and filed for Denver County, it was not possible to use permit data from Denver to determine the replacement cost of the PV system for the subject property. Thus, cost data is used from the city of Wheat Ridge (since costs are the same, regardless of the county):

Date of Permit	Address	Total system Cost	KW's	Cost per KW
06/21/2012	4355 Newland St	$18,238	6.5	$2,805
07/12/2012	10 Morningside	$18,720	6.24	$3,000
05/07/2012	4265 Dudley St	$31,387	6.75	$4,649
02/15/2012	4455 Yarrow St	$30,000	7.58	$3,957

Based on the above permit data, a reasonable current cost estimate for a PV system in this area is $3,500 per kW.

The subject property has what is assumed to be a 3.0 kW system, therefore, the following calculations can be made:

3.0 kW X $3,500 =$10,500

Depreciation is based on the system's actual age (as of January, 2013), compared to its useful life:

Straight-line age/life method	
Age of system:	2 years
Useful life:	25 years[258]
2/25 = 8% depreciated	

$10,500 less depreciation = $9,660

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $9,660. This, however, does not take into account functional obsolescence. Therefore, the following adjustment is made to account for functional obsolescence:

$9,660 less ($1000 X 3.0kW for functional obsolescence) = $6,700 (rounded)

As of January 2013, a value indication using the cost approach is:
$2,200 (rounded) per kW
for a 3.0 kW, 2-year old system with 23 years remaining useful life.

[258] The subject property's PV system is 2 years and is assumed to have a 25 year warranty. Total useful life is based on the life of the warranty. If the estimated warranty period is incorrect, this could alter the conclusions and opinions reached in this report.

This is given consideration in the reconciliation. PV systems are expected in this area and thus, cost is relevant to the market.

D. Income Approach (Using PV Value)

The PV Value tool was used to determine the present value of the energy that will be produced by the subject's PV system over the next 23 years. The system is already two years old, so the remaining useful life is only 23 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		**Discount Rate Calculation**		**Electricity Rate Inputs**		**Operation & Maintenance Inputs**	
Zip Code	80238	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	3000	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (Average)	175			Inverter cost	$1128.70
Module Degradation rate	0.5	Net Yield Rate (Custom)[259]	3.70	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	45	Discount Rate(low)	4.20			Actual Age/Years	2
Azimuth	171	Discount rate (average)	5.55			Remaining Energy/Years	23
KWh Produced/Year	4576	Discount rate (high)	6.70				

Note: XXXX = User Input XXXX = User Input Override XXXX = Calculated Value

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$502.52

Present value estimate of accumulated energy production for remaining 23 years	
Low	$5,826.52
Average	$6,607.46
High	$7,538.53

As per the above data, the indicated value by the income approach is between $5,800 and $7,500 (both figures are rounded) for a 3.0 kW system.

As of January 2013, a value indication using the income approach is:
$1,900 to $2,500 (rounded) per kW
for a 3.00 kW, 2-year old system with 23 years remaining of useful life.

PV systems are expected in this market area and utility savings are important to area buyers. Thus, the income approach is considered to be very relevant to the subject property. The data used to develop the income approach is sufficient to produce a reliable value indication.

[259] Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- PV systems are expected in this market area.
- These buyers are very interested in monthly utility savings.

In this circumstance, buyers in this area are knowledgeable about the income value of PV systems and expect these homes to have PV systems.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
$2,570 per kW	$2,200 per kW	$1,900 to $2,500 per kW (PV Value)

The paired sales analysis had considerable adjustments and, therefore, while applicable, was given the least amount of consideration. The paired sales analysis falls outside the value range indicated by the other approaches.

The cost approach is also applicable. The data used to develop the cost approach was based on a different area; however, the data was still considered to be relevant and reflective of actual local costs.

The income approach to value is given consideration. The data is adequate and reflective of buyers' actions in this market area.

The income approach is given the most consideration, followed by the cost approach and, finally, the paired sales analysis.

In conclusion, the final value estimate is:

As of January 2013, the value is: **$1,900 to $2,500 per kW** for a 3.0 kW, 2-year old system with 23 years remaining of useful life and with a location in Denver, Co, Subdivision "A"
Marketing time was normal. Properties are expected to have PV systems. Only those without PV systems experience adverse marketing conditions.

Denver, Subdivision "A": Case Study 24

SUBDIVISION A			
Subdivision location:	Denver, Co	**Price range of homes sold[260] in market area:**	$270,000 to $850,000 Median: $424,500 Model: to many to be relevant
Number of detached homes in subdivision:	3063	**Age range of homes:**	2002 to 2011
Percentage of Rentals:	11%	**Gross Rent Multiplier chart for market area:**	No relevant rental data was found.
Quality of Construction:	Average to Excellent	**Type of homes:**	New urbanism development. Charming homes with a variety of architectural details
Number of homes sold in 6 months[261]:	102	**Range of above-grade square footages:**	1185-4500
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	Unknown
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 24			
Purchase Date:	April, 2012	**Sales Price of house:**	$485,000
Age of home:	3 years	**Above-grade sq.ft. of home:**	2282
Total days on market[262]:	16	**Average Days on Market for subdivision[263]:**	77
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: Energy efficient home (details not known)			

MARKET CONDITIONS AT TIME OF SALE for Case Study 24 :	STABLE
The median sale price was perfectly stable from the six months prior. Number of days on market was stable, as were the absorption rates and sale-to-list price ratios.	

[260] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[261] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[262] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[263] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 24			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Listing Agent
	kW	3.0	(assumed)
	Date of Permit	July, 2009	Permit
	Manufacturer of panels		(unknown)
	Warranty on panels	25 Years	(assumed)
	Manufacturer of Inverter		(unknown)
	Warranty on Inverter	10 Years	(assumed)
	Type	Fixed	Observation
	Tilt	45	Observation
	Energy Production per panel		(unknown)
	Energy Production Estimate (for 1 year)	4569	PV Value
	Location	Roof	Observation
	Age of panels	3 years	Permit
	Inverter type	Wall mount	(assumed)
	Age of Inverter	3 years	(assumed)
	Original gross cost		(unknown)
	Azimuth	180	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Listing Agent:* In this area, people take the PV system for granted (they are an expected feature at this point). Buyers like the money saving aspect of the system. It adds minimal value, but does attract buyers. This agent was the same agent as for Case Study #22 *Buyer's Agent:* PV was a "nice perk." The buyers were "excited" about it. Buyer's agent was not sure if it contributed a dollar figure to the value or not. Buyers would have bought the house anyway (even without PV).		
NOTE:	As noted earlier, most permit data for Denver County is extremely limited, with many details unrecorded. This builder is the same builder who installed PV on the homes in the Westminster case studies used earlier in this report. Attempts were made to contact the installer (to obtain additional information), to no avail.		

DEVELOPING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #24

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 24:

✓	Listing Agent	✓	Permit (minimal information available)
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis		Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 24's PV system:

✓	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

A. Paired Sales Analysis

	Comp 1	Comp 2	Comp 3
Sale Price	$324,900	$324,500	$323,500
Sale Date	October, 2011	August, 2011	May, 2011
Days to Sale	63	191	5
Square Feet	1451	1451	1451
Photovoltaic	Yes	No	No
Basement	Full Unfinished	Full Finished	Full Finished

Again, this is the same paired sale used for Case Study 22 and Case Study 24. The subject property is located in the same immediate subdivision as the paired sales properties. This was the only reasonable pair found. All three sales are the same exact model of home. Comp 1 does not have a finished basement, yet Comp 2 and Comp 3 both have 600 sq.ft., finished basements. Thus, the value of the subject's PV system is the same as a 600 sq.ft., finished basement. Basement finish in this market area (for this type of home) is worth approximately $12 per square foot; for an estimated value contribution of $7,200, or $2,570 per kW.

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As of April 2012, a value indication using the Paired Sales Analysis is:
$2,570 per kW.

B. Cost Approach (Using Local Builder Costs)

Based on the way the permits are kept and filed for Denver County, it was not possible to use permit data from Denver to determine the replacement cost of the PV system for the subject property. Thus, cost data is used from the city of Wheat Ridge (since costs are the same, regardless of the county):

Date of Permit	Address	Total system Cost	kWs	Cost per kW
06/21/2012	4355 Newland St	$18,238	6.5	$2,805
07/12/2012	10 Morningside	$18,720	6.24	$3,000
05/07/2012	4265 Dudley St	$31,387	6.75	$4,649
02/15/2012	4455 Yarrow St	$30,000	7.58	$3,957

Based on the above permit data, a reasonable current cost estimate for a PV system in this area is $3,500 per kW.

The subject property has what is assumed to be a 3.0 kW system; therefore, the following calculations can be made:

3.0 kW X $3,500 =$10,500

Depreciation is based on the system's actual age (as of January, 2013), compared to its useful life:

Straight-line age/life method	
Age of system:	3 years
Useful life:	25 years[264]
3/25 = 12% depreciated	

$10,500 less depreciation = $9,240

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $9,240. This figure, however, does not take into consideration functional obsolescence. Adjusting for functional obsolescence results in the following value indication:

$9,420 less ($1000 X 3.0kW for functional obsolescence) = $6,420 total value

As of April 2012, a value indication using the cost approach is:
$2,140 (rounded) per kW
for a 3.0 kW, 3-year old system with 22 years remaining useful life.

[264] The subject property's PV system is 3 years and is assumed to have a 25 year warranty. Total useful life is based on the life of the warranty. If the estimated warranty period is incorrect, this could alter the conclusions and opinions reached in this report.

This data has weak support. Since so many assumptions had to be made about the system (including the system size), the value indication by the cost approach is minimally reliable.

C. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 22 years. The system is already three years old, so the remaining useful life is only 21 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		Discount Rate Calculation		Electricity Rate Inputs		Operation & Maintenance Inputs	
Zip Code	80238	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	3000	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$1123.26
Module Degradation rate	0.5	Net Yield Rate (Custom)[265]	4.21	Utility Escalation rate	1.89	System Warranty/Years	25
Tilt	45	Discount Rate(low)	4.71			Actual Age/Years	3
Azimuth	180	Discount rate (average)	5.96			Remaining Energy/Years	22
KWh Produced/Year	4569	Discount rate (high)	7.21				

**Note: XXXX = User Input XXXX = User Input Override XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$499.28

Present value estimate of accumulated energy production for remaining 22 years	
Low	$5,360.38
Average	$6,041.03
High	$6,845.19

As per the above data, the indicated value by the income approach is between $5,400 and $6,800 (both figures are rounded) for a 3.0 kW system.

As of April 2012, a value indication using the income approach is:
$1,800 to $2,270 (rounded) per kW
for a 3.00 kW, 3 year old system with 22 years remaining of useful life.

As noted earlier, because the size of the PV system is not 100% verifiable, this data is considered questionable, therefore, the value indication is weakly supported.

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265 Interest rate is from Interest Rate Chart contained in the addenda.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- PV systems are expected in this market area.
- These buyers weree very interested in monthly utility savings and were "excited" to have a PV system.

Buyers in this area are knowledgeable about the income value of PV systems and expect these homes to have PV systems.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
$2,570 per kW	$2,140 per kW	$1,800 to $2,270 per kW (PV Value)

The paired sales analysis was conclusive. This was the only verified, supported data available, and therefore, the value indication from the paired sales analysis is given full consideration in the reconciliation.

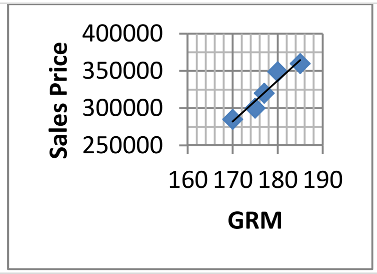
It was necessary to make assumptions regarding the exact size of the subject's PV system, therefore, the value indicators from the cost approach and the income approach are not reliable.

In conclusion, the final value estimate is:

As of April 2012, the value is: **$2,570 per kW** for a 3.0 kW, 3-year old system with 22 years remaining of useful life and with a location in Denver, Co, Subdivision "A"
Marketing time was 16 days: 61 days faster than the market average. Listing agent stated that PV was expected on these homes and thus, only homes without PV suffered longer marketing times.

Given the scarcity of verifiable and reliable data, this case study is considered to be minimally relevant to the overall study.

Denver, Subdivision "B": Case Study 25

SUBDIVISION B			
Subdivision location:	Denver, Co	**Price range of homes sold[266] in market area:**	$150,000 to $1,175,000 Median: $285,000 Model: to many to be relevant
Number of detached homes in subdivision:	3019	**Age range of homes:**	1885 to 2012 (median: 1930)
Percentage of Rentals:	26%	**Gross Rent Multiplier chart for market area:**	
Quality of Construction:	Average to Excellent	**Type of homes:**	Urban. Turn of the century homes. University area.
Number of homes sold in 6 months[267]:	169	**Range of above-grade square footages:**	451-3800
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	Unknown
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 25			
Purchase Date:	November, 2012	**Sales Price of house:**	$349,150
Age of home:	72	**Above-grade sq.ft. of home:**	1068
77	51	**Average Days on Market for subdivision[268]:**	46
Gross Rent Multiplier for similar home:	180		
Other green and/or energy efficient features: None known			

MARKET CONDITIONS AT TIME OF SALE for Case Study 25 :	STABLE
This property was sold right at the tipping point; values were still stable but just hinting at the increasing values that were to come.	

[266] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[267] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[268] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 25			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Listing Agent
	kW		(unknown)
	Date of Permit		(unknown)
	Manufacturer of panels		(unknown)
	Warranty on panels	25 Years	(assumed)
	Manufacturer of Inverter		(unknown)
	Warranty on Inverter	10 Years	(assumed)
	Type	Fixed	Observation
	Tilt	22.6	Observation
	Energy Production per panel		(unknown)
	Energy Production Estimate (for 1 year)		(unknown)
	Location	Roof	Observation
	Age of panels		(unknown)
	Inverter type	Wall mount	(assumed)
	Age of Inverter		(assumed)
	Original gross cost		(unknown)
	Azimuth	192	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Listing Agent:* Some potential buyers liked the PV, and some perceived it as a hassle. The market currently does not know enough about the systems. The buyers of this property were "all about saving energy" and the PV sold the home. It was very important to marketing. It added value, but the listing agent is not sure how much. *Buyer's Agent:* Did not provide any feedback.		
NOTE:	As noted earlier, most permit data for Denver County is extremely limited, with many details unrecorded. The permit from Nov. 18, 2012 (after the house was purchased) only referenced that the panels had to be removed to replace the roof. The panels were then reinstalled.		

DETERMINING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #25

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 25:

✓	Listing Agent		Permit
	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis	✓	Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 25's PV system:

	Sales Comparison (Paired Sales Analysis)
	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

Because details regarding the subject's PV system are not available, it was not possible to use the applicable GRM of 180 nor was it possible to use the PV Value tool. Thus, no indicators were available to determine the possible value contribution of the subject's PV systems.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- While the listing agent indicated that these buyers loved the PV system and she felt it added value, it was not possible to quantify that value.
- There is a lack of data to make a reliable and supportable conclusion of value.
- There was no reliable way to verify the various specifications of this PV system. Without specifications, the GRM and PV Value tool cannot be reasonably utilized.

As of November 2012, the value is: **Most Likely a Positive Value of Unknown amount** for system of unknown size and age and with a location in Denver, Co, Subdivision "A"
The agent felt the PV increased the marketability of the home.

Denver, Subdivision “C”: Case Study 26

SUBDIVISION C			
Subdivision location:	Denver, Co	**Price range of homes sold[269] in market area:**	$146,320 to $399,000 Median: $217,000 Model: no mode
Number of detached homes in subdivision:	936	**Age range of homes:**	1951 to 1956 (with 22 homes built in the 1980s, of which the subject property is one)
Percentage of Rentals:	15%	**Gross Rent Multiplier chart for market area:**	No relevant rental data was found.
Quality of Construction:	Fair to Good	**Type of homes:**	Contemporary California Ranch-style homes built in the 1950s.
Number of homes sold in 6 months[270]:	23	**Range of above-grade square footages:**	792-2300
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	Unknown
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 26			
Purchase Date:	May, 2011	**Sales Price of house:**	$266,000
Age of home:	28 years	**Above-grade sq.ft. of home:**	1435
Total days on market[271]:	52	**Average Days on Market for subdivision[272]:**	89
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: None noted			

MARKET CONDITIONS AT TIME OF SALE for Case Study 26 :	STABLE
The market was just barely stable (it had been declining up until a few months prior to this sale date).	

[269] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[270] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[271] For this report, “Days on Market” is defined as the number of days between the list date and the date of contract.
[272] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 26			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Listing Agent
	kW		(unknown)
	Date of Permit	August, 2007	Permit
	Manufacturer of panels		(unknown)
	Warranty on panels	25 Years	(assumed)
	Manufacturer of Inverter		(unknown)
	Warranty on Inverter	10 Years	(assumed)
	Type	Fixed	Observation
	Tilt	30.26	Observation
	Energy Production per panel		(unknown)
	Energy Production Estimate (for 1 year)		(not able to calculate)
	Location	Roof	Observation
	Age of panels	4 years	Permit
	Inverter type	Wall mount	(assumed)
	Age of Inverter	4 years	(assumed)
	Original gross cost		(unknown)
	Azimuth	176	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Listing Agent:* People liked the idea of PV and were interested in the savings, once it was explained to them. Buyers were scared of the system and were worried about maintenance costs and upkeep. This system reduced the utility bills significantly. It did not impact the marketability of the home. It did not add or subtract from value. There were no comps to support a value. The maintenance was the biggest perceived obstacle that had to be overcome (people thought the system would be a lot of work). *Buyer's Agent:* Did not provide feedback.		
NOTE:	As noted earlier, most permit data for Denver County is extremely limited, with many details unrecorded. This builder is the same builder who installed PV on homes in the Westminster case studies used earlier in this report.		

DETERMINING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #26

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 26:

✓	Listing Agent		Permit (minimal information available)
	Selling Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
	PV Value	✓	Subdivision Analysis
	Paired Sales Analysis		Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 26's PV system:

	Sales Comparison (Paired Sales Analysis)
	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

Like Case Study 25, details regarding the subject's PV system are not available; therefore, it was not possible to use the PV Value tool, or a GRM. Additionally, since the size of the system was not known, the cost approach could not be developed.

From the agent's comments, the income of the system did matter to the buyers. However, without the exact specifications of the PV system, it is not possible to use the income approach or the cost approach to develop an opinion of market value.

As of May 2011, the value is: **Not able to be developed (too many details about the specifications of the PV system were not able to be located)** for a system of unknown size and unknown age in an infill subdivision located in Denver, Co, Subdivision "C"
The PV system did not help marketability.

This property is utilized as a case study because it met the initial qualification criteria to be selected as a case study. After further investigation, the conclusion that this case study offered no relevant information. The property, however, was still retained to enhance the overall integrity of this entire study (the 30 case studies are truly a random representation of the market area). It is to be expected that when a random sample is chosen, a few of the chosen case studies will prove to contribute little to the overall study.

Regardless, this case study demonstrates that it is necessary for appraisers to fully investigate the value of homes that have PV systems, since not all data is created equal and not all properties have enough market data to develop a reliable opinion of the contributory value of the PV system.

Denver, Market Area "D": Case Study 27

SUBDIVISION D			
Subdivision location:	Denver, Co	**Price range of homes sold[273] in market area:**	$102,400 to $568,000 Median: $252,850 Mode: to many to be relevant
Number of detached homes in subdivision:	Over 3000	**Age range of homes:**	1947 to 2009
Percentage of Rentals:	11%	**Gross Rent Multiplier chart for market area:**	Not enough relevant rental data was found (what was found was inconsistent).
Quality of Construction:	Fair to Very Good	**Type of homes:**	Post World-War II area with many 1950's ranch style homes in an urban location. Regeneration is evident in some parts
Number of homes sold in 6 months[274]:	133	**Range of above-grade square footages:**	802-4700
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	Unknown
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 27			
Purchase Date:	August, 2012	**Sales Price of house:**	$332,900
Age of home:	9 years	**Above-grade sq.ft. of home:**	1528
Total days on market[275]:	5	**Average Days on Market for subdivision[276]:**	56
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: Energy efficient home (was a major selling point)			

MARKET CONDITIONS AT TIME OF SALE for Case Study 27 :	STABLE
The median sale price was seasonally perfectly stable from a year ago. Number of days on market was stable, as were the absorption rates and sale-to-list price ratios.	

[273] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[274] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[275] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[276] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 27

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Homeowner
kW	4.2	(assumed)
Date of Permit		(unknown/estimated 5 years ago per homeowner)
Manufacturer of panels	Sharp	Homeowner
Warranty on panels	20 Years	(assumed)
Manufacturer of Inverter	Fronius	Homeowner
Warranty on Inverter	10 Years	(assumed)
Type	Fixed	Observation
Tilt	26.5	Observation
Energy Production per panel		(unknown)
Energy Production Estimate (for 1 year)		PV Value
Location	Roof	Observation
Age of panels	5 years	(estimated per homeowner)
Inverter type	Wall mount	(assumed)
Age of Inverter	5 years	(estimated)
Original gross cost		(unknown)
Azimuth	193	Solmetric Roof Azimuth tool

Real Estate Agent comments:

Listing Agent: Buyers did not provide specific feedback to the agent on the PV system. Rather, the entire energy efficiency of the home was a plus.
Buyer's Agent: No feedback given.
Homeowner: The entire home was energy efficient, so one feature alone did not stand out: the buyer liked all the energy efficient features as a package. Nearly 100% of the electric bills were covered by the PV system. The energy efficiency did decrease marketing time and did increase the sale price.

NOTE:

As noted earlier, most permit data for Denver County is extremely limited, with many details unrecorded. The homeowner was able to provide some additional information.

DETERMINING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #27

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 27:

✓	Listing Agent		Permit (minimal information available)
	Buyer's Agent	✓	Exterior inspection of subject property
✓	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis		Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to help determine the contribution value (if any) of Case Study 27's PV system:

	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

A. Cost Approach (Using Local Builder Costs)

Based on the way the permits are kept and filed for Denver County, it was not possible to use permit data from Denver to determine the replacement cost of the PV system for the subject property. Thus, cost data is used from the city of Wheat Ridge (since costs are the same, regardless of the county):

Date of Permit	Address	Total system Cost	kWs	Cost per kW
06/21/2012	4355 Newland St	$18,238	6.5	$2,805
07/12/2012	10 Morningside	$18,720	6.24	$3,000
05/07/2012	4265 Dudley St	$31,387	6.75	$4,649
02/15/2012	4455 Yarrow St	$30,000	7.58	$3,957

Based on the above permit data, a reasonable current cost estimate for a PV system in this area is $3,500 per kW.

The subject property has what is reported to be a 4.2 kW system; therefore, the following calculations can be made:

4.2 kW X $3,500 =$14,700

Depreciation is based on the system's actual age (as of August, 2012), compared to its useful life:

Straight-line age/life method	
Age of system:	5 years
Useful life:	20 years[277]
5/20 = 25% depreciated	

[277] The subject property's PV system is 5 years and is assumed to have a 20 year warranty. Total useful life is based on the life of the warranty. The actual life is estimated. If this is incorrect, this could alter the conclusions and opinions reached in this report.

$14,700 less depreciation = $11,000 (rounded)

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $9,240. This does not take into account the functional obsolescence. With functional obsolescence considered, the following figures are developed:

$11,000 less ($1000 X 4.2kW for functional obsolescence) = $6,800 total value

As of August 2012, a value indication using the cost approach is:
$1,620 (rounded) per kW
for a 4.2 kW, 5-year old system with 15 years remaining useful life.

The cost data is reflective of the exact market area in which the subject property is located in and thus, provides a good indicator of market value.

B. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 15 years. The system is assumed to be five years old, so the remaining useful life is only 15 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		**Discount Rate Calculation**		**Electricity Rate Inputs**		**Operation & Maintenance Inputs**	
Zip Code	80224	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	4200	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$1922.45
Module Degradation rate	0.5	Net Yield Rate (Custom)[278]	3.89	Utility Escalation rate	2.44	System Warranty/Years	20
Tilt	26.5	Discount Rate(low)	4.39			Actual Age/Years	5
Azimuth	193	Discount rate (average)	5.64			Remaining Energy/Years	15
KWh Produced/Year	6402	Discount rate (high)	6.89				

**Note: XXXX = User Input XXXX = User Input Override XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$692.41

[278] Interest rate is from Interest Rate Chart contained in the addenda.

Present value estimate of accumulated energy production for remaining 15 years	
Low	$5,277.15
Average	$5,787.47
High	$6,359.37

As per the above data, the indicated value by the income approach is between $5,300 and $6,400 (both figures are rounded) for a 4.2 kW system.

As of August 2012, a value indication using the income approach is:
$1,260 to $1,520 (rounded)
per kW for a 4.20 kW, 5-year old system with 15 years remaining of useful life.

This value indication has weak market support. Several of the important specifications about the system were assumed and therefore, the reliability of this value indicator is greatly diminished.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- This buyer very much took the utility savings into consideration.
- The home sold extremely quickly and for top value because of the energy efficient features.

This buyer was knowledgeable about the income value (and was aware of the size of the system).

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
n/a	$1,620 per kW	$1,260 to $1,520 per kW (PV Value)

An adequate paired sale was not available.

The only reliable value indicator is the one generated by using the cost approach. The value indicator of the cost approach is $1,620 per kW.

As of August 2012, the value is: **$1,620 per kW** for a 4.2 kW, 5-year old system with 15 years remaining of useful life and with a location in Denver, Co, market area "D"
Marketing time was 4 days: 52 days faster than the market average of 56. Homeowner believed PV helped the marketability of the home.

Denver, Subdivision "E": Case Study 28

SUBDIVISION E			
Subdivision location:	Denver, Co	**Price range of homes sold[279] in market area:**	$164,900 to $826,474 Median: $365,000 Mode: none
Number of detached homes in subdivision:	2000 in the entire area (136 in the subjects' s small subarea)	**Age range of homes:**	1912 to 1956
Percentage of Rentals:	5%	**Gross Rent Multiplier chart for market area:**	No relevant rental data was found. Not traditionally a rental area.
Quality of Construction:	Average to Very Good	**Type of homes:**	Very urban area with many bungalow style homes on standard 6250 sq.ft. rectangular lots
Number of homes sold in 6 months[280]:	66	**Range of above-grade square footages:**	552-3600
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	Unknown
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 28			
Purchase Date:	April, 2013	**Sales Price of house:**	$404,000
Age of home:	76 years	**Above-grade sq.ft. of home:**	868
Total days on market[281]:	6	**Average Days on Market for subdivision[282]:**	45
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: None known			

MARKET CONDITIONS AT TIME OF SALE for Case Study 28 :	INCREASING
This area increased 1% per month over the past six months. Demand was very high and supply was low. This put upward pressure on values, as multiple offers were common for many properties	

[279] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[280] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[281] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[282] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 28

Details of the subject's PV system:

Category	Details	Source
Ownership	Owned	Listing Agent
kW	2.52	PV Installer
Date of Permit	May, 2007	Permit
Manufacturer of panels		(unknown)
Warranty on panels	25 Years	PV Installer
Manufacturer of Inverter		(unknown)
Warranty on Inverter	10 Years	PV Installer
Type	Fixed	Observation
Tilt	18.3	Observation
Energy Production per panel		(unknown)
Energy Production Estimate (for 1 year)	3645	PV Value
Location	Roof	Observation
Age of panels	6 years	Permit
Inverter type	Wall mount	(assumed)
Age of Inverter	6 years	(assumed)
Original gross cost		(unknown)
Azimuth	189	Solmetric Roof Azimuth tool

Real Estate Agent comments:

Listing Agent: This was an unusual circumstance where the panels had to be removed to replace the roof. The panels were then placed back on the roof by the time of sale. These buyers were specifically looking for a home on which they could install solar, so finding a home they liked that already had solar was a plus. Appraiser did not understand the PV system or how to value it, and thought the value was less than half the cost. This system saves about $30 per month. This $30 per month can be directly applied to buying more house. Many buyers do not understand PV.

Selling Agent: Did not provide feedback

NOTE:

As noted earlier, most permit data for Denver county is extremely limited with many details not recorded.

DETERMINING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #28

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 24:

✓	Listing Agent	✓	Permit
	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
✓	Estimated Utility savings	✓	Market conditions research
✓	PV Value	✓	Subdivision Analysis
✓	Paired Sales Analysis	✓	Installer for this PV system

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 28's PV system:

	Sales Comparison (Paired Sales Analysis)
✓	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
✓	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)
✓	Income Approach (Mortgage savings)

A. Cost Approach (Using Local Builder Costs)

Based on the way the permits are kept and filed for Denver County, it was not possible to use permit data from Denver to determine the replacement cost of the PV system for the subject property. Thus, cost data is used from the city of Wheat Ridge (since costs are the same, regardless of the county):

Address	Date of Permit	Total system Cost	kWs	Cost per kW
7483 Dale Ct	02/13/2013	$7,920	2.64	$3,000
9520 Pierce St	02/13/2013	$12,960	4.32	$3,000
5726 W 115th Pl	02/13/2013	$16,560	5.52	$3,000
11350 Quivas Way	03/11/2013	$30,345	8.67	$3,500

Based on the above permit data, a reasonable current cost estimate for a PV system in this area is $3,500 per kW.

The subject property has what is assumed to be a 2.52 kW system, and therefore, the following calculations can be made: 2.52 kW X $3,500 =$8,820

Depreciation is based on the system's actual age (as of April 2013), compared to its useful life:

Straight-line age/life method	
Age of system:	6 years
Useful life:	25 years[283]
6/25 = 24% depreciated	

$8,820 less depreciation = $6,700 (rounded)

[283] The subject property's PV system is 6 years and is assumed to have a 19 year warranty. Total useful life is based on the life of the warranty. If the estimated warranty period is incorrect, this could alter the conclusions and opinions reached in this report.

Thus, as per actual local builder costs, the current cost (as-is) of the subject property's PV system is $6,700. This does not take into consideration functional obsolescence. Adjusting for functional obsolescence results in the following value indicator:

$6,700 less ($1000 X 2.52kW for functional obsolescence) = $4,180 (total value)

As of April 2013, a value indication using the cost approach is: **$1,660 (rounded) per kW** for a 2.52 6-year old system with 19 years remaining useful life.

The cost approach is taken into consideration. These buyers were looking to install PV on their new home and were fortunate enough to find a home with PV already on it. Thus, cost was relevant to these buyers.

The cost data available was current and taken from the immediate market area; therefore, the value indication by the cost approach is a very good indicator of the market value of this PV system.

B. Income Approach (Using PV Value)

The PV Value tool was used to develop the present value of the energy that will be produced by the subject's PV system over the next 19 years. The system is already six years old, so the remaining useful life is only 19 years. The applicable specifications for the subject property's PV system are noted below:

Solar Resource Calculation		**Discount Rate Calculation**		**Electricity Rate Inputs**		**Operation & Maintenance Inputs**	
Zip Code	80211	Basis Points (low)	50	Public Service Co. of Co		15 Year (cents per watt)	75
System Size in Watts	2520	Basis Points (high)	300	Residential Rate	11.15		
Derate factor	0.770	Basis Points (average)	175			Inverter cost	$1183.37
Module Degradation rate	0.5	Net Yield Rate (Custom)[284]	3.59	Utility Escalation rate	1.95	System Warranty/Years	25
Tilt	18.3	Discount Rate(low)	4.09			Actual Age/Years	6
Azimuth	189	Discount rate (average)	5.34			Remaining Energy/Years	19
KWh Produced/Year	3645	Discount rate (high)	6.59				

**Note:* *XXXX = User Input* *XXXX = User Input Override* *XXXX = Calculated Value*

Using the above figures, the following calculations were generated:

Value of the energy produced this year
$392.21

[284] Interest rate is from Interest Rate Chart contained in the addenda.

Present value estimate of accumulated energy production for remaining 19 years	
Low	$3,755.64
Average	$4,225.00
High	$4,769.96

As per the above data, the indicated value by the income approach is between $3,800 and $4,800 (both figures are rounded) for a 2.52 kW system.

As of April 2013, a value indication using the income approach is:
$1,500 to $1,870 (rounded) per kW
for a 2.52 kW, 6-year old system with 19 years remaining of useful life.

These buyers were interested in the $30-per-month savings in utility bills. Thus, this method is considered relevant to this market area. Adequate and reliable data was available to sufficiently develop a value indication using this approach to value.

C. Income Approach (Mortgage)

When deciding whether to purchase the subject property, the listing agent mentioned that the $30 savings per month was directly translated into being able to obtain a larger mortgage.

This $30 translates in the following additional value the homebuyers could finance at today's lending rate of 3.59%:

$6,500

When translated into a value per kW, the following figures are generated:

As of April 2013, a value indication using the income approach is:
$2,600 (rounded)
per kW for a 2.52 kW, 6-year old system with 19 years remaining of useful life.

This is given only moderate consideration since the $30 figure came from the agent and not from any verified data.

Summary and Conclusions

Market Perception/Reaction to the Subject's PV System:

- The listing agent thinks the value may have contributed 50% of the cost.
- The buyers were interested in the utility savings.
- The buyers were willing to buy a PV system and install it themselves.

In this circumstance, buyers in the area are knowledgeable about the income value and costs of PV systems.

Reconciliation of Each Value Indication:

Paired Sales Analysis	Cost Approach	Income Approach
n/a	$1,660 per kW	$1,500 to $1,870 per kW (PV Value)
		$2,600 per kW (mortgage savings)

The cost data reflects market actions and, given that the cost data used to develop the cost approach was current and local, the value indicator from the cost approach is given great consideration in the reconciliation.

The income approach to value is given consideration. There was reliable data available to develop an income approach using the PV Value tool. The value indicator using the estimated mortgage savings falls outside of the range of the other value indicators and therefore, is given no consideration.

In conclusion, the final value estimate is:

As of April 2013, the value is: **$1,700 per kW** for a 2.52 kW, 6-year old system with 19 years remaining of useful life and with a location in Denver, Co, Subdivision "E"
Marketing time was 6 days: 39 days faster than the market average of 45 days.

Denver, Subdivision "F": Case Study 29

SUBDIVISION F			
Subdivision location:	Denver, Co	**Price range of homes sold[285] in market area:**	$136,000 to $589,278 Median: $311,000 Model: no mode
Number of detached homes in subdivision:	Over 1000	**Age range of homes:**	1890 to 1956
Percentage of Rentals:	12%	**Gross Rent Multiplier chart for market area:**	No relevant rental data was found for this type of property.
Quality of Construction:	Fair to Very Good	**Type of homes:**	Turn-of-the century Victorian style homes. One of the original developments in Denver
Number of homes sold in 6 months[286]:	65	**Range of above-grade square footages:**	800-3600
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	Unknown
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 29			
Purchase Date:	August, 2012	**Sales Price of house:**	$582,675
Age of home:	116 years	**Above-grade sq.ft. of home:**	3546
Total days on market[287]:	194	**Average Days on Market for subdivision[288]:**	44
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: None noted			

MARKET CONDITIONS AT TIME OF SALE for Case Study 29 :	STABLE
The market was seasonally stable. Days-on-market were beginning to decline, supply was just beginning to decline and the sale-to-list price ratio was hinting of increases. The market was about to go from stable to increasing, but had not yet definitively done so.	

[285] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[286] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[287] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[288] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 29			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Listing Agent
	kW		(unknown)
	Date of Permit	Nov, 2010	Permit
	Manufacturer of panels		(unknown)
	Warranty on panels	25 Years	(assumed)
	Manufacturer of Inverter		(unknown)
	Warranty on Inverter	10 Years	(assumed)
	Type	Fixed	Observation
	Tilt	45	Observation
	Energy Production per panel		(unknown)
	Energy Production Estimate (for 1 year)		(not able to calculate)
	Location	Roof	Observation
	Age of panels	2 years	Permit
	Inverter type	Wall mount	(assumed)
	Age of Inverter	2 years	(assumed)
	Original gross cost		(unknown)
	Azimuth	272	Solmetric Roof Azimuth tool
Real Estate Agent comments:	*Listing Agent:* This was a very unique property (a very grand Victorian style home with many period features and a very dated kitchen). This was the most expensive home in the area. The PV had no extra appeal or relevance to this property. *Buyer's Agent:* The PV had nothing to do with the reason the buyers bought the home. It had no impact on their decisions.		
NOTE:	As noted earlier, most permit data for Denver County is extremely limited, with many details unrecorded.		

DETERMINING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #29

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 29:

✓	Listing Agent		Permit (minimal information available)
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
	PV Value	✓	Subdivision Analysis
	Paired Sales Analysis		Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to help determine the contribution value (if any) of Case Study 29's PV system:

	Sales Comparison (Paired Sales Analysis)
	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

Because details regarding the subject's PV system were not available, it was not possible to use the PV Value tool, nor was it possible to develop the cost approach.

Therefore, this case study offered no conclusive information.

As of August 2012, the value is: **Not able to be developed (too many specifications about the system are unknown)** for a system of unknown size and unknown age in an infill subdivision located in Denver, Co, Market Area
The PV system did not help marketability.

This property is utilized as a case study because it met the initial qualification criteria to be selected as a case study. After further investigation, the conclusion was reached that this case study offered no relevant information. The property, however, was still retained to enhance the overall integrity of this entire study (the 30 case studies are truly a random representation of the market area). It is to be expected that when a random sample is chosen, a few of the chosen case studies will prove to contribute little to the overall study.

Regardless, this case study demonstrates that it is necessary for appraisers to fully investigate the value of homes that have PV systems, since not all data is created equal and not all properties have enough market data to develop a reliable opinion of the contributory value of the PV system.

Denver, Subdivision "G": Case Study 30

SUBDIVISION G			
Subdivision location:	Denver, Co	**Price range of homes sold[289] in market area:**	$77,000 to $762,488 Median: $317,075 Model: No mode
Number of detached homes in subdivision:	Over 1000	**Age range of homes:**	Most homes were built before 1960. Urban area. Regeneration is evident
Percentage of Rentals:	Unable to determine	**Gross Rent Multiplier chart for market area:**	No relevant rental data was found for this price range of home.
Quality of Construction:	Fair to Excellent	**Type of homes:**	Brick ranch homes built before 1960. Regeneration is evident. Standard 6250 sq.ft. rectangular lots.
Number of homes sold in 6 months[290]:	100	**Range of above-grade square footages:**	800-3700
Number of PV permits:	Unknown	**Number of homes that sold after they had PV installed:**	Unknown
Range of kWs installed:	Unknown	**Range of cost for PV systems over a three year period:**	Unknown
Median kW amount installed:	Unknown	**Median gross cost of PV systems:**	Unknown

GENERAL PROPERTY INFORMATION: Case Study 30			
Purchase Date:	August, 2011	**Sales Price of house:**	$553,000
Age of home:	New	**Above-grade sq.ft. of home:**	1865
Total days on market[291]:	8	**Average Days on Market for subdivision[292]:**	76
Gross Rent Multiplier for similar home:	n/a		
Other green and/or energy efficient features: None noted			

MARKET CONDITIONS AT TIME OF SALE for Case Study 30 :	STABLE
An extremely balanced and stable market. Supply and demand were in balance and sale-to-list price ratios were a healthy 98%.	

[289] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[290] Figures are for homes sold through the Metrolist MLS in the 6 months prior to the closing date of the subject property.
[291] For this report, "Days on Market" is defined as the number of days between the list date and the date of contract.
[292] Information is based on sales that sold in the six months proper to the closing date of the subject property.

PHOTOVOLTAIC SYSTEM For Case Study 30			
Details of the subject's PV system:	**Category**	**Details**	**Source**
	Ownership	Owned	Listing Agent
	kW		(unknown)
	Date of Permit	2011	(assumed)
	Manufacturer of panels		(unknown)
	Warranty on panels	25 Years	(assumed)
	Manufacturer of Inverter		(unknown)
	Warranty on Inverter	10 Years	(assumed)
	Type	Fixed	Observation
	Tilt		(unknown)
	Energy Production per panel		(unknown)
	Energy Production Estimate (for 1 year)		
	Location	Roof	Observation
	Age of panels	0	(assumed)
	Inverter type	Wall mount	(assumed)
	Age of Inverter	0	(assumed)
	Original gross cost		(unknown)
	Azimuth	183	(assumed)
Real Estate Agent comments:	*Listing Agent:* (Since this sale was so long ago, and this agent sold several new homes on this street, the feedback was only general and not specific to this subject property). PV helped sell the home, as it gave the developer an edge over the competition. It adds value, but nowhere near the cost to install it. *Buyer's Agent*: No feedback was given.		
NOTE:	As noted earlier, most permit data for Denver County is extremely limited, with many details unrecorded.		

DETERMINING THE CONTRIBUTORY MARKET VALUE OF THE PHOTOVOLTAIC SYSTEM FOR Case Study #30

DATA SOURCES Attempts were made to contact and gather data from all of the following sources. The sources that are marked with a check are those for which information was successfully obtained for Case Study 30:

✓	Listing Agent		Permit (minimal information available)
✓	Buyer's Agent	✓	Exterior inspection of subject property
	Homeowner	✓	Most recent MLS listing
	Utility Records	✓	Assessor's property records
	Estimated Utility savings	✓	Market conditions research
	PV Value	✓	Subdivision Analysis
	Paired Sales Analysis		Area rental data

APPRAISAL METHODS

The appraisal methods noted below were used to develop the contribution value (if any) of Case Study 30's PV system:

	Sales Comparison (Paired Sales Analysis)
	Cost Approach (Using local builder costs and the Age/Life Depreciation method)
	Income Approach (Using PV Value)
	Income Approach (Using a Gross Rent Multiplier)

The size of this system was not known or advertised. In examining the aerial photo of this house, the PV system looks extremely small (about five panels). In all likelihood, this is a 1- 1.5 kW system that was installed only to increase the marketability of the home. According to the real estate agents comments, it did just that.

Given that the size of the system is unknown, it was not possible to develop either the cost approach or the income approach. No conclusions regarding the value of the PV system are able to be developed, since it proved impossible to find all of the specifications about the subject's PV system.

Therefore, the conclusion was drawn that this system added no value to the property.

As of August 2011, the value is:
Not able to be developed (it was not possible to know the exact specifications of this PV system)
per kW for a system of unknown size and age in a subdivision located in Denver, Co, Subdivision "G"

The PV system did help marketability. The home sold in 8 days: 68 days less than the market average of 76 days.

This property is utilized as a case study because it met the initial qualification criteria to be selected as a case study. After further investigation, the conclusion was reached that this case study offered no relevant information. The property, however, was still retained to enhance the overall integrity of this entire study (the 30 case studies are truly a random representation of the market area). It is to be expected that when a random sample is chosen, a few of the chosen case studies will prove to contribute little to the overall study.

Regardless, this case study demonstrates that it is necessary for appraisers to fully investigate the value of homes that have PV systems, since not all data is created equal and not all properties have enough market data to develop a reliable opinion of the contributory value of the PV system.

Part 5: Summary

SUMMARY OF 30 CASE STUDIES

Based on the data contained in this report, all 30 case studies can be summarized into the following table (organized by system size):

CASE STUDY	LOCATION	Sold Date	Low value indication per kW	High value indication per kW	Size of System (in kWs)	Low Value Indication	High Value Indication	Days on Market	Market Area Days on Market	Sold % Faster
10	Arvada, Subdivision C	Feb-2013	$1,990	$2,200	1.38	$2,746	$3,036	Positive	Unknown	Incnclsv
11	Arvada, Subdivision C	Feb-2013	$1,990	$2,200	1.38	$2,746	$3,036	Positive	Unknown	Incnclsv
5	Broomfield, Subdivision C	Aug-2011	$1,620	$1,620	2.1	$3,402	$3,402	23	90	75%
28	Denver, Subdivision E	Apr-2013	$1,700	$1,700	2.52	$4,284	$4,284	6	45	86%
16	Westminster, Subdivision A	Apr-2013	$300	$300	2.7	$810	$810	13	57	78%
22	Denver, Subdivision A	Nov-2011	$1,800	$2,280	2.8	$5,040	$6,384	63	76	17%
1	Broomfield, Subdivision A	Jan-2013	$1,800	$1,800	2.8	$5,040	$5,040	27	36	25%
23	Denver, Subdivision A	Nov-2011	$1,900	$2,500	3	$5,700	$7,500	78	47	NEGATIVE
12	Westminster, Subdivision A	Mar-2012	$2,000	$2,000	3	$6,000	$6,000	Positive	Unknown	Positive
24	Denver, Subdivision A	Apr-2012	$2,570	$2,570	3	$7,710	$7,710	16	77	80%
15	Westminster, Subdivision A	Nov-2012	$1,870	$2,430	3	$5,610	$7,290	Positive	Unknown	Positive
14	Westminster, Subdivision A	Feb-2013	$1,570	$2,000	3	$4,710	$6,000	Positive	Unknown	Positive
21	Wheat Ridge, Market Area A	Oct-2012	$2,070	$2,190	3.08	$6,375	$6,745	11	50	78%
19	Wheat Ridge, Market Area A	Jun-2012	$2,100	$2,100	3.36	$7,056	$7,056	21	68	70%
17	Westminster, Subdivision A	May-2013	$1,450	$1,860	3.6	$5,200	$6,696	9	57	84%
3	Broomfield, Subdivision A	Dec-2012	n/a	n/a	3.96	n/a	n/a	11	49	78%
4	Broomfield, Subdivision B	Apr-2013	$1,500	$1,630	4.1	$6,150	$6,683	Incnclsv	Incnclsv	Incnclsv
27	Denver, Market Area D	Aug-2012	$1,620	$1,620	4.2	$6,804	$6,804	4	56	93%
13	Westminster, Subdivision A	Nov-2012	$1,740	$1,800	4.2	$7,308	$7,560	9	93	4%
7	Arvada, Subdivision A	Aug-2012	$0	$0	4.76	$0	$0	22	45	52%
20	Wheat Ridge, Market Area A	Apr-2012	n/a	n/a	4.9	n/a	n/a	Incnclsv	Incnclsv	Incnclsv
18	Wheat Ridge, Market Area A	May-2012	$1,500	$1,860	5	$7,500	$9,300	54	76	29%
2	Broomfield, Subdivision A	Mar-2013	$1,900	$1,900	5.5	$10,450	$10,450	27	28	4%
8	Arvada, Subdivision A	Mar-2013	$1,660	$1,820	5.72	$9,495	$10,410	100	45	NEGATIVE
6	Broomfield, Subdivision D	Aug-2011	$1,700	$1,800	6.75	$11,475	$12,150	4	51	92%

9	Arvada, Subdivision B	Jun-2012	$1,700	$1,700	7.13	$12,121	$12,121	32	61	48%
26	Denver, Subdivision C	May-2011	n/a	n/a	Unknown	n/a	n/a	52	89	42%
30	Denver, Subdivision G	Aug-2011	n/a	n/a	Unknown	n/a	n/a	8	76	90%
29	Denver, Subdivision F	Aug-2012	n/a	n/a	Unknown	n/a	n/a	194	44	NEGATIVE
25	Denver, Subdivision B	Nov-2012	Positive	Positive	Unknown	Positive	Positive	51	46	NEGATIVE

After comparing the value indications based on sale date, days on market and system size, it was clear the only meaningful pattern relating to value was the size of the property's PV system, followed by its age. There was no value trend pattern based on sale date, location or even on the length of time the property was on the market. As would be expected, the above data shows that the larger systems typically sell for more than the smaller systems; however, overall, the value per kW is very similar, regardless of the size of the system.

A few notable points can be made about the table above. These points are summarized below.

Of the 30 case studies:

- None of the homes were sold for less because they had a PV system.
- Twenty-one homes sold for higher because they had a PV system.

Of the properties where PV contributed positively to their value:

- The LOW value indication per kW ranged (excluding the one $300 per kW indicator as it had extenuating circumstances) from $1,450 to $2,570.
- The HIGH value indication per KW ranged (again, excluding the $300 per kW indicator) from $1,620 to $2,570.
- Thus, the LOW and HIGH value indications are in the same general value range.

With regard to the marketability of the properties with PV systems:

- Four had longer marketing times because they had PV systems.
- Twenty four properties had much lower marketing times as compared to the average days-on-market for their area.

For the vast majority of properties that were studied, it is clear that PV systems added value and decreased marketing times. These findings make sense, given how extremely common it was for real estate agents to use the word "excited" with regard to how buyers felt about PV systems. Almost no negative feedback was received regarding PV systems. Even so, a very common stumbling block (to sellers being able to realize the full added value of a PV system) was education. PV systems are still relatively new to the market area and the majority of buyers have a lot of questions about them. In fact, many of the case studies that had the lower value indications had them partially as a result of the fact that listing agents did not adequately work to educate potential buyers on the features and benefits of the PV systems. On the other hand, agents who realized higher value contributions of PV systems continually stated that educating buyers was the “key”.

After all of the data was compiled and considered in the three approaches to value (the sales comparison approach, the cost approach and the income approach), it was evident that in most circumstances, there was market data to support the relevance of using all three approaches to value:

Sales Comparison Approach: When paired sales were available, they showed that the market did pay a premium for PV systems.

Cost Approach: Market data clearly indicated that the value of a PV system is currently less than its actual net cost in this market area. PV systems are a superadequacy. However, with prices decreasing on PV systems, this could very well change in the foreseeable future.

Income Approach: With regard to utility savings (i.e. “income”), it was evident that the market very much placed value on saving money each month. Therefore, appraisal methods that used the income approach were relevant.

While the above three approaches to value were typically applicable to the majority of the case studies in this report, appraisers, performing their own appraisals, will always need to weigh the strengths and weakness of the data available for each approach. They will also need to weigh whether each approach is relevant and reflective of market conditions for their valuation assignment.

IN CLOSING:

The value conclusions reached above are for these 30 individual case studies themselves and are not meant to be a broad statement about the value of any PV system. The contributory value of any feature, including a PV system, is always a “moving target” and, as such, appraisers will continually need to monitor the market for changes in demand for PV systems, just as they currently do for all other property features.

At the very least, this study demonstrates that PV systems are now common enough in this market area that their potential value (and impact on marketability) will need to be studied by appraisers. There is enough evidence to show that, in most circumstances, the market itself sees a monetary benefit to having a PV system. Still, that monetary benefit will vary by market area, over time, and on a house-by-house basis. Therefore, PV systems typically deserve the attention of the appraiser to ensure that any potential value is adequately reflected in the appraisal.

APPENDIX

Appendix A:

Resources:

Azimuth (to calculate the azimuth of a specific house)

www.tools.solmetric.com/tools/roofazimuthtool

Energy Usage (the average consumption rate per house, listed by state)

www.eia.gov (in the search bar, type in: "*How much electricity does an American home use*?)

Energy Usage (to estimate how much energy a specific household might use)

www.hesprolbl.gov

Current Utility Rates (by state)

www.openei.org

Solar Energy Rebates and Incentives (listed by state)

www.cleanenergyauthority.com/solar-rebates-and-incentives

PV Value®

www.pvvalue.com

Appendix B: The Residential Green and Energy Efficient Addendum

AI Reports® Form 820.04*	Client File #:		Appraisal File #:	
	Residential Green and Energy Efficient Addendum			
	Client:			
	Subject Property:			
	City:		State:	Zip:

Additional resources to aid in the valuation of green properties and the completion of this form can be found at http://www.appraisalinstitute.org/education/green_energy_addendum.aspx

The appraiser hereby certifies that the information provided within this addendum:

- has been considered in the appraiser's development of the appraisal of the subject property only for the client and intended user(s) identified in the appraisal report and only for the intended use stated in the report.
- is not provided by the appraiser for any other purpose and should not be relied upon by parties other than those identified by the appraiser as the client or intended user(s) in the report.
- is the result of the appraiser's routine inspection of and inquiries about the subject property's green and energy efficient features. Extraordinary assumption: Data provided herein is assumed to be accurate and if found to be in error could alter the appraiser's opinions or conclusions.
- is not made as a representation or as a warranty as to the efficiency, quality, function, operability, reliability or cost savings of the reported items or of the subject property in general, and this addendum should not be relied upon for such assessments.

Green Building: The practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's lifecycle from siting to design, construction, operation, maintenance, renovation, and deconstruction. This practice expands and complements the classic building design concerns of economy, utility, durability, and comfort.[1] High Performance building and green building are often used interchangeably.

Six Elements of Green Building: A green building has attributes that fall into the six elements of green building known as (1) site, (2) water, (3) energy, (4) materials, (5) indoor air quality, and (6) maintenance and operation. A Green Building will be energy efficient but an energy efficient building is not synonymous with Green Building.

Green Features

The following items are considered within the appraised value of the subject property:

Certification	Year Certified:	Certifying Organization: ☐ Home Innovation Research Labs (ICC-700) ☐ USGBC (LEED) ☐ Other:	☐ Verification Reviewed on site	☐ Certification attached to this report
Rating	Score:	☐ LEED Certified: ☐ LEED Silver ☐ LEED Gold ☐ LEED Platinum		
		☐ ICC-700 *National Green Building Standard* Certified: ☐ Bronze ☐ Silver ☐ Gold ☐ Emerald		
		Green Certifying Organization URL (website)		
Additions	Explain any additions or changes made to the structure since it was certified:			
	Do changes require recertification to verify rating is still applicable? ☐ Yes ☐ No			
Comments Attach the rating worksheet that provides the ratings for each element to provide a better understanding of the features. The worksheet will assist in comparing the subject to sales rated by different organizations	If a property is built green but not formally certified, it still deserves proper description and analysis to value the features. The market analysis is of the structure's physical, economic, and locational attributes and not an analysis of its label alone.			

Client:		**Client File #:**	
Subject Property:		**Appraisal File #:**	

ENERGY EFFICIENT ITEMS

The following items are considered within the appraised value of the subject property:

Insulation	☐ Fiberglass Blown-In ☐ Foam Insulation ☐ Cellulose ☐ Fiberglass Batt Insulation ☐ Other (Describe): ☐ Basement Insulation (Describe): ☐ HERS Insulation Installed Rating: ☐ 1 ☐ 2 ☐ 3 (See Glossary)						R-Value: ☐ Walls ☐ Ceiling ☐ Floor
Envelope	Envelope Tightness: Unit: ☐ CFM25 ☐ CFM50 ☐ ACH50 ☐ ACHnatural ☐ Envelope Tightness based on Blower Door Test						
Water Efficiency	☐ Reclaimed Water System (Explain): ☐ Greywater reuse system	☐ Cistern - Size: Gallons					Location of cistern:
	☐ WaterSense® fixtures	☐ Rain Barrels Provide Irrigation					
Windows	☐ ENERGY STAR®	☐ Low E	☐ High Impact	☐ Storm	☐ Double Pane ☐ Triple Pane	☐ Tinted	☐ Solar Shades
Day Lighting	☐ Skylights - #:	☐ Solar Tubes - #:	☐ Other (Explain):				☐ ENERGY STAR Light Fixtures
Appliances	ENERGY STAR® Appliances: ☐ Dishwasher ☐ Refrigerator ☐ Other:	Water Heater: ☐ Solar ☐ Heat Pump ☐ Tankless ☐ Coil Size: Gal.	Appliance Energy Source: ☐ Propane ☐ Electric ☐ Natural Gas ☐ Other (Describe):				
HVAC (Describe in Comments Area)	☐ High Efficiency HVAC SEER: Efficiency Rating: % AFUE* % *Annual Fuel-Utilization Efficiency	☐ Heat Pump Efficiency Rating: COP: HSPF: SEER: EER:	☐ Thermostat/Controllers				☐ Passive Solar (Defined in Glossary)
	☐ Programmable Thermostat		☐ Radiant Floor Heat				☐ Geothermal
Energy Rating	☐ ENERGY STAR ®Home - Version: ☐ Other (Describe): Home Energy Score (HES) (Score range 1-10): ☐ Certification Attached						
Indoor Air Quality	☐ Indoor Air PLUS Package	☐ Energy Recovery Ventilator Unit or Whole Building Ventilation System					☐ Non Toxic Pest Control
HERS Information	Rating:	Monthly Energy Savings on Rating: $					Date Rated:
Utility Costs	Average Annual Utility Cost: $ per month based on:						# of Occupants:
Energy Audit	☐ Infrared Photograph Attached Has an energy audit/rating been performed on the subject property? ☐ Yes ☐ No ☐ Unknown If yes, comment on work completed as result of audit.						
Comments (Include source for information provided	Information was provided by:						

Client:		Client File #:	
Subject Property:		Appraisal File #:	

Solar Panels

The following items are considered within the appraised value of the subject property:

Description	Array #1 ☐ Leased ☐ Owned	Array #2 ☐ Leased ☐ Owned	**Description**	**Solar Thermal Water Heating System**
kW (size)			**If Active System - type**	☐Direct ☐ Indirect
Manufacturer of Panels			**If Passive System - type**	☐ Integral collector ☐ Thermosyphon
Warranty on Panels			**Storage Tank Size**	# Gallons:
Age of Panels			**Collector Type**	☐ Flat-Plat Collector ☐ Integral Collector ☐ Evacuated-Tube Solar
Energy Production kWh per Array				
Source for Energy Production Estimate			**Back-Up System**	☐ Conventional Water Htr ☐ Tankless On Demand ☐ Tankless Heat Pump
Location (Roof, Ground, Etc.)			**Age of System**	
Tilt/Slope for Array			**Warranty Term**	
Azimuth per Array			**Manufacturer**	
Age of Inverter(s)			**Solar Energy Factor (SEF)** (Rating range 1 to 11 - higher number is more efficient)	
Manufacturer				
Warranty Term				
Name of Utility Company:		Cost per kWh charged by Company: $ /kWh		
Comments (Discuss incentives available for new panels, condition of current panels, and any maintenance issues. If leased, provide the lease terms.) A free online tool and manual for valuing the energy production of the Solar PV System is available at www.pvvalue.com	Discuss source of information and define other renewable energy sources, such as wind, hydropower, biomass power, etc.			

Client:		**Client File #:**	
Subject Property:		**Appraisal File #:**	

Location - Site			
The following items are considered within the appraised value of the subject property:			
Walk Score	Score:	Source: (Example: http://www.walkscore.com)	
Public Transportation	☐ Bus – Distance: Blocks	☐ Train – Distance: Blocks	☐ Subway – Distance: Blocks
Site	Orientation - front faces: ☐ East/West ☐ North/South	Landscaping: ☐ Water Efficient ☐ Natural	
Comments			

Incentives – Amount of Incentive and Terms	
The following items are considered within the appraised value of the subject property:	
Federal	
State	
Local	
Source (For example www.dsireusa.org)	
Comments Incentives offset cost and should be	

Client:		Client File #:	
Subject Property:		Appraisal File #:	

Residential Green and Energy Efficient Addendum
Glossary and Resources

ICC-700 National Green Building Standard (NGBS): An ANSI-approved residential green building standard developed by the National Association of Home Builders (NAHB) and the International Code Council (ICC). It is applicable to single and multifamily projects, renovations and additions and residential land development. To comply, all buildings must incorporate sustainable lot development techniques and address energy, water & material resource efficiency and indoor environmental quality. Also, all owners must be educated about building operation and maintenance. Certification to the NGBS is provided by the **Home Innovation Research Labs**. http://www.nahb.org/page.aspx/generic/sectionID=2510 or http://www.homeinnovation.com/

LEED: Leadership in Energy and Environmental Design is redefining the way we think about the places where we live, work and learn. As an internationally recognized mark of excellence, LEED provides building owners and operators with a framework for identifying and implementing practical and measurable green building design, construction, operations and maintenance solutions. http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1988

Energy Star®: ENERGY STAR certified new homes must meet strict energy efficiency guidelines set by the U.S. Environmental Protection Agency. These homes are independently verified to be at least 15% more energy efficient than homes built to the 2009 International Energy Conservation Code (IECC), and feature additional measures that deliver a total energy efficiency improvement of up to 30 percent compared to typical new homes and even more compared to most resale homes. http://www.energystar.gov/index.cfm?c=new_homes.hm_index

Home Energy Score (HES): The Home Energy Score is similar to a vehicle's mile-per-gallon rating. The Home Energy Score allows homeowners to compare the energy performance of their homes to other homes in the area. It also provides homeowners with suggestions for improving their homes' efficiency.

The process starts with a home energy assessor collecting energy information during a brief home walk-through. The assessor then scores the home on a scale of 1 to 10, with a score of 10 indicating that the home has excellent energy performance. A score of 1 indicates that the home needs extensive energy improvements. In addition to providing the score, the home energy assessor provides the homeowner with a list of recommended energy improvements and the associated cost savings estimates. http://www1.eere.energy.gov/buildings/residential/hes_index.html

HERS Index: The Home Energy Rating System (HERS) Index is the Industry Standard by which a home's energy efficiency is measured. It's also the nationally recognized system for inspecting and calculating a home's energy performance. http://www.resnet.us/hers-index This Index is assessed by a qualified third party certifier based on the physical characteristics of the house. The energy estimates from this assessment may vary depending on the lifestyle of the occupants, increasing utility expenses, and changes in the maintenance or characteristics of the energy features.

Building Envelope: The building envelope is everything that separates the building's interior from the exterior. This includes the foundation, exterior walls, roof, doors and windows.

Geothermal: A geothermal heat pump uses the constant below ground temperature of soil or water to heat and cool your home. http://energy.gov/energysaver/articles/geothermal-heat-pumps

Low-E: Low emittance indicates a coating is added to the glass surface. The coating allows visible light to pass through the glass while stopping the radiant heat energy from the sun and heat sources in the building from passing through the glass. Approximately 40% of the sun's harmful ultra violet rays are blocked and insulation enhanced.

Whole Building Ventilation System: A whole building ventilation system assists in a controlled movement of air in tight envelope construction and may include air-purifying systems. Whole building ventilation equipment is often a part of the forced air heating or cooling systems.

Energy Recovery Ventilation System: Often called Heat Recovery Ventilators (HRV). These systems replenish the indoor air without wasting all the energy already used to heat the indoor air. In some climates, these systems are also used to handle water vapor in the incoming air.

Passive Solar: Passive solar is technology for using sunlight to light and heat buildings with no circulating fluid or energy conversion system. http://rredc.nrel.gov/solar/glossary A complete passive solar building design has the following five elements: (1) aperture (collector) (2) absorber (3) thermal mass (4) distribution (5) control. http://www.nrel.gov/docs/fy01osti/27954.pdf

SEER: Seasonal energy efficiency ratio - The higher the SEER rating, the more energy efficient the equipment is. A higher SEER can result in lower energy costs. http://www.energystar.gov/index.cfm?c=tax_credits.tx_definitions&dts=ssps,mcs,seer,eer

Water Sense: EPA released its Final Version 1.1 WaterSense New Home Specification. This specification will be effective January 1, 2013 and establishes the criteria for new homes labeled under the WaterSense program and is applicable to newly constructed single-family and multi-family homes. http://www.epa.gov/watersense/new_homes/homes_final.html

Appendix C: Definition of Market Value

The most probable price, as of a specified date, in cash, or in terms of equivalent to cash, or in other precisely revealed terms for which the specified property rights should sell after reasonable exposure in a competitive market under all conditions requisite to a fair sale, with the buyer and seller each acting prudently, knowledgeably, and for self-interest, and assuming that neither is under undue duress.

Appendix D: Survey sent to homeowners

STATE OF COLORADO

COLORADO ENERGY OFFICE
1580 Logan Street, Suite 100
Denver, CO 80203-1625
Phone: (303) 866-2100
Fax: (303) 866-2930
www.colorado.gov/energy

John Hickenlooper, Governor

March 18, 2013

Dear [**Recipient Name**]:

The Colorado Energy Office is conducting a study on the potential impact that photovoltaic (PV) solar systems have on real estate transactions in Colorado. We want to determine the marketability and/or possible value contribution of PV systems for residential properties. We are contacting you because you purchased a home in the last few years that has a PV system.

Enclosed is a short questionnaire. The answers to these questions will help us identify what impact the solar system on your new home had on your decision to purchase this specific house. Your personal information (name, address) is confidential and will not be published in our final report.

Lisa Desmarais, a residential appraiser, is helping us conduct this study and will be collecting your information. Please return the questionnaire to her using the enclosed envelope, or contact her at XXX-XXX-XXXX or email, xxxxxx, to provide your answers.

Your response is greatly appreciated.

Sincerely,

Peter Rusin, Residential Program Associate
Colorado Energy Office
John W. Hickenlooper, Governor

1) At the time of purchase, did you consider the photovoltaic system a (POSITIVE), (NEGATIVE) or a (NEUTRAL) feature of the home?

2) When you bought the home, what information, if any, did you want to know about the system?

3) How important was it to you to have a photovoltaic system?

4) What, if anything, do you like about the system?

5) What, if anything, do you not like about the system?

6) Now that you have lived in the home a while, do you like the system (MORE THAN), (THE SAME AS), or (LESS THAN) when you purchased the home?

7) Do you think the photovoltaic system adds monetary value to your home? If yes, how much?

8) Of the list below, can you mark which features (if any) were (MORE), (LESS) or of (EQUAL) importance to having a photovoltaic system?

	MORE	LESS	EQUAL			MORE	LESS	EQUAL
Location					**School**			
View					**Deck/Patio/Porch**			
Updating					**Price**			
Garage (size)					**Square Footage of home**			
Fireplace					**Basement**			
Number of bedrooms					**Basement features (finished, walkout, etc.)**			
Number of bathrooms					**Energy Efficiency**			
Condition of home					**Size of lot**			
Den/Study					**Big kitchen**			
Formal Dining Room					**Architectural Details of the house**			
Instant hot water					**Newer windows**			
Appliances					**Flooring material (carpet, wood, etc.)**			
Heating system (type and age)					**Air conditioning**			
Landscaping					**Green Features**			
OTHER	(Please fill in any other features you would like to rank)				**OTHER**	(Please fill in any other features you would like to rank)		

9) Next time you go to buy a house, will you look for one with a photovoltaic system? If yes, why? If no, why?

10) What size is your PV Solar System? If you are not sure of the size, you might look through paperwork on the system given to you by the previous owner or you can look on the system DC disconnect or inverter sometimes there is a label that states the system size.

11) Did you believe the PV system would result in lower energy costs for you?

12) If yes, how much did you believe you would save per month?

13) After purchase, do you think energy cost savings were realized?

14) Did you think you could afford to spend more on a house payment per month because your overall utility costs were going to be lower?

15) If yes, how much more did you allot to the mortgage payment that you would not have (if you did not have PV)?

16) Did the PV Solar System play any role or influence your decision to buy the home?

Appendix E:

Current limitations of Marshall & Swift Cost data (as of May, 2013)

Marshall & Swift cost figures represent the estimated cost to replace most construction items in a home (flooring, furnaces, windows, etc). For the purposes of this study, the specific cost data we are using are those figures from Marshall & Swift which pertain to photovoltaic systems. The cost figures they generate are meant to provide a cost estimate for a PV system of *like utility* vs. the actual costs of the exact PV system a specific property has. In appraiser terms: the cost figures generated by Marshall & Swift represent the estimated "*replacement*" cost and not the "*reproduction*" costs of the PV system.

Thus, there is no expectation that the cost figures provided by Marshall & Swift will exactly match the specifications of the exact, specific system an appraiser is studying. Rather, they will reflect the cost of a PV system that is of like-utility. This is an acceptable appraisal practice to use this type of data.

That said, the most current data set as of (December 2013) of Marshall & Swift cost figures for PV systems is as follows:

Photovoltaic array, grid-tied, sloped roof mounted, aluminum rack, safety switches, AC/DC inverter with:

1)	*6- 230 watt panels, 16 VDC, 1.4 kW/non-tempered*	*EACH*	*$8000*
2)	*5- 205 watt panels, 16 VDC, 1.6 kW*	*EACH*	*$13,700*
3)	*7- 240 watt panels, 16 VDC, 1.6 kW/non-tempered*	*EACH*	*$8,850*

**Note: cost data is effective as of 03/2012*

If an appraiser is appraising a home in December of 2013 in Arvada, Colorado with a new, 2.8 kW, grid-tied, sloped roof mounted PV system with safety switches and an AC/DC inverter, they would use the above data in the following manner:

$8000 (Cost for 1.4 kW) + $8000 (Cost for an additional 1.4kW) = $16,000
$16,000 X the current cost multiplier of 1.0 X the current local multiplier of .98[293] *=* <u>*$15,680*</u>

These figures, however, are neither current nor representative of what type of systems are common in the study market area. Thus, the appraiser should not place emphasis on the current Marshall & Swift PV cost figures.

Additional reasons the above figures are currently flawed are as follows:

- Systems are scalable so the per-watt cost for the larger systems is a bit lower than the per-watt cost for smaller systems. The above cost data does not reflect actual system sizes, nor does it reflect the scalable costs of various sizes. For the three cost examples noted above, the per-watt cost is $5.98, $13.37 and $5.26 respectively, which makes no sense with the fact that solar systems are generally indexed by the per-watt cost.

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[293] All multipliers are provided in the Marshall & Swift Cost Handbook.

- Current local costs are about $3.50 per watt (or, $3,500 per kW). Thus, the above cost data is not a reflection of local costs.
- The costs noted above make reference to "16 VDC," which is only of importance if a solar system has batteries- which is not the case with most grid-tied systems. Thus, the above cost data includes the expensive and unnecessary component of a battery system.
- It is not understood why the cost system would refer to un-tempered panels. Every solar model that local installers were familiar with had tempered glass (the panels would not last very long in the elements otherwise).
- The local multipliers do not apply in this circumstance. Since the costs of photovoltaic systems have been dropping dramatically in price over the last two years, the local multiplier is not applicable.
- Different roof materials result in higher installation costs (i.e. concrete tile roofs cost more to install on then composition roofs).

To further understand the Marshall & Swift data, contact was made with the company to try and understand how their cost figures were generated. They were kind enough to indicate they would forward my request to the research team; the research team was not able to get back to me in the one-month time frame that I was hoping they could help me in. Thus, the above summary was compiled without input from Marshall & Swift. It is probable they will be reworking their figures in the near future, so it is suggested the appraiser check the cost figures each time they are updated to see when they become a reflection of their local costs.

Appendix F:

One way to gather the information you need on a PV system:

1) When setting up an appointment with the homeowner, ask if they have a PV system.
    - If they do, ask if you can email them a copy of the Residential Green and Energy Addendum. Instruct them how to fill it out.
    - If they have a PV system, let them know you would like to collect the following information when you inspect the property:
        - A copy of their utility bills for the last year.
        - The most recent systems performance test they have had (if any).
        - A copy of their lease (if applicable).
        - A copy of their agreement with Xcel (if applicable).
            - Note the dates of the agreement.
            - Note if there are any PBI payments received by the homeowner.
2) Before going to the house, pull up the permit data on the PV system.
    - The permit *may* tell you:
        - The age of the system (when it was installed).
        - If the system was finalized or not (if it was not, you cannot be certain it was installed correctly).
        - The type of panels (monocrystalline, polycrystalline, thin film)
        - The warranty length of the panels.
        - The warranty length of the inverter(s).
        - If the inverter(s) is wall-mounted or if the system has microinverters.
        - The wattage of each panel.
        - The manufacture of the panels.
        - The manufacture of the inverter(s).
        - Where the system is installed (i.e. on the south-facing roof, etc.)
    - If this information is not available on the permit, this is information you should try to obtain from the homeowner.
3) Use the azimuth tool to determine the azimuth of the panels.
4) When on-site:
    - Observe the condition of the panels and if they are shaded.
    - Find the inverter(s) (if they are wall-mounted).
    - Observe and calculate the slope of the roof.
    - Take the kWh reading from the inverter(s).

If the data you are gathering regarding a PV system is for a comparable property (and not the subject property), then you will need to rely a combination of on information you can get from the listing agent, information from the selling agent, information from the homebuyer (if possible), building permit information, internet tools (i.e. the azimuth tool and energy estimate tool) and observing the exterior of the property as is reasonably possible.

Appendix G:

Interest rate chart

Taken from www.hsh.com, interest rates have trended in the following way over the past several years:

	15 Year Fixed-Rate Mortgage	30 year Fixed-Rate Mortgage
Jan-2010	4.89	5.48
Feb-2010	4.79	5.39
Mar-2010	4.71	5.32
April-2010	4.79	5.40
May-2010	4.65	5.24
June-2010	4.58	5.13
July-2010	4.43	4.96
Aug-2010	4.28	4.81
Sep-2010	4.23	4.76
Oct-2010	4.09	4.64
Nov-2010	4.10	4.69
Dec-2010	4.44	5.06
Jan-2011	4.46	5.10
Feb-2011	4.57	5.26
Mar-2011	4.44	5.12
April-2011	4.41	5.13
May-2011	4.18	4.92
June-2011	4.03	4.77
July-2011	4.02	4.80
Aug-2011	3.77	4.54
Sep-2011	3.64	4.39
Oct-2011	3.71	4.41
Nov-2011	3.64	4.34
Dec-2011	3.60	4.29
Jan-2012	3.53	4.23
Feb-2012	3.48	4.20
Mar-2012	3.52	4.27
April-2012	3.45	4.21
May-2012	3.34	4.09
June-2012	3.26	3.99
July-2012	3.18	3.89
Aug-2012	3.17	3.89
Sep-2012	3.09	3.80
Oct-2012	3.02	2.72
Nov-2012	2.98	3.66
Dec-2012	2.94	3.62
Jan-2013	2.98	3.70
Feb-2013	3.08	3.83
Mar-2013	3.05	3.82
April-2013	2.94	3.59

Appendix H:

Realtor Information sheet

Your Solar (Photovoltaic) System [1]

This house is equipped with a photovoltaic system, thus, it converts sunlight into energy.

Size:___________________

Typically, residential solar systems range in size from 1 kW to 10 kW.

Energy Production last year:___________

The average homeowner in Colorado uses 8,532 kWh's of electricity per year.

Age of system:___________________

Most solar panels are warranted for at least 25 years, however, they could easily physically last 50 years. A degeneration rate of around .05% per year is typical.

Owned/Leased:___________________

A leased system is owned by a third party. If leased, the terms of that lease should be read.

Maintenance Costs:

The only maintenance costs expected over the first 20 years is the probable one-time replacement of the inverter. The cost of the inverter will vary depending on size and type. Inverters are typically warranted for 10 years.

Income producing____(yes) or (no)____

A few PV systems generate income from Xcel in addition to saving on utilities. Xcel pays some homeowners a monthly payment for *all* the energy they produce, while other homeowners receive payments for their *excess* energy. The length and type of agreement will vary.

[1] *This form is not copyrighted and thus, may be copied and used by market participants. Acknowledgement of the creators (Lisa Desmarais (appraiser), Whitney Painter and Steve Kinney), however, must be noted.*

Appendix I:

Using the Azimuth tool available online

To determine the azimuth of a specific PV system, you can use the Azimuth tool that is available for free online at www.tools.solmetric.com/tools/roofazimuthtool .

To use the tool:

1) Type in the property address you are determining the Azimuth for.
2) Click the “Find” button.
3) An aerial photo of that property will come up.
4) Zoom in until the roof line of the property takes up most of the photo (assuming the PV system is located on the roof).
5) Click on the “Azimuth Tool” button. A gray “+” will appear.
6) Use your mouse to move the “+” sign.
7) Align the “+” sign with the very top of the PV panels.
8) Click once and start to move your gray “+” again. An anchored red line will appear.
9) Your line will look like the arrow noted below:

10) Follow the exact parallel of the PV panels to the bottom of the PV panels. Click again. This will set your line and display three numbers along with a compass looking diagram.
11) This compass item has your azimuth. The azimuth is the number that is outlined in white (i.e. the midpoint number).

The azimuth will not be 100% accurate (though it will be very close). This number, however, is more than accurate enough for appraising purposes.

Appendix J:

Scope of Work and Steps Taken to Ensure Competency

During the course of this study, numerous details regarding PV systems were discovered that were previously unknown to this appraiser. Thus, the following steps were taken to ensure competency:

- In-depth discussions and study were made with a certified PV installer (Whitney Painter). Ms. Painter also contributed to, read and edited all information pertaining to the specifications of PV systems (i.e. technical details, incentives, rebates, etc.)
- This appraiser attended two full-day courses on appraising properties with green features (taught by Sandy Adomatis).
- The Energy Task Board members were periodically contacted by me to review drafts and offer advice, feedback and guidance.
- An expert (John Schwartz, MAI) in the discount analysis method was sought and he provided guidance, input, review and expertise.
- An expert (Harold McCloud, MAI) on the Marshall & Swift Cost information was sought to provide general input on the cost figures generated from Marshall & Swift.
- One of the authors (Geoff Klise) of the PV Value tool was directly contacted to provide further information on the tool itself. Geoff contributed to writing, editing and compiling all information contained in the PV Value™ information sections of this study.
- Two books were read (*Solar Electric Basics* by Dan Chiras *and An Introduction to Green Homes* by Alan Simmons), as well as numerous articles.
- Extensive study was made into rebate and incentive programs, PV warranties, electrical components, net-metering, azimuths, peak daylight hours, shading, degeneration, derate factors, valuation tools, market perception, market participants, and other relevant subjects.

In addition to the above steps performed, the following is a list of the **scope of work** completed for this study:

- Interview five on-site builder representatives.
- Review 11 builder websites and marketing materials.
- Receive, organize, categorize and review bulk photovoltaic permit data from the cities of Arvada, Broomfield and Westminster.
- Review individual permits for specific properties (including those used in the case study and others that were eliminated as potential case studies).
- Review Multiple Listing Service data.
- Interview around 150 real estate agents. (While approximately 200 were contacted, about 150 responded back to requests for feedback and information).