SAND2012-8625P

Sandia National Laboratories

Exceptional service in the national interest

The Importance of Determining Proper Market Value for Solar PV Systems

Geoff Klise – Sandia National Laboratories

SAND 2012-xxxx

SunShot Solar Rooftop Challenge Real Property Impact Workshop

Nashville, TN October 9, 2012

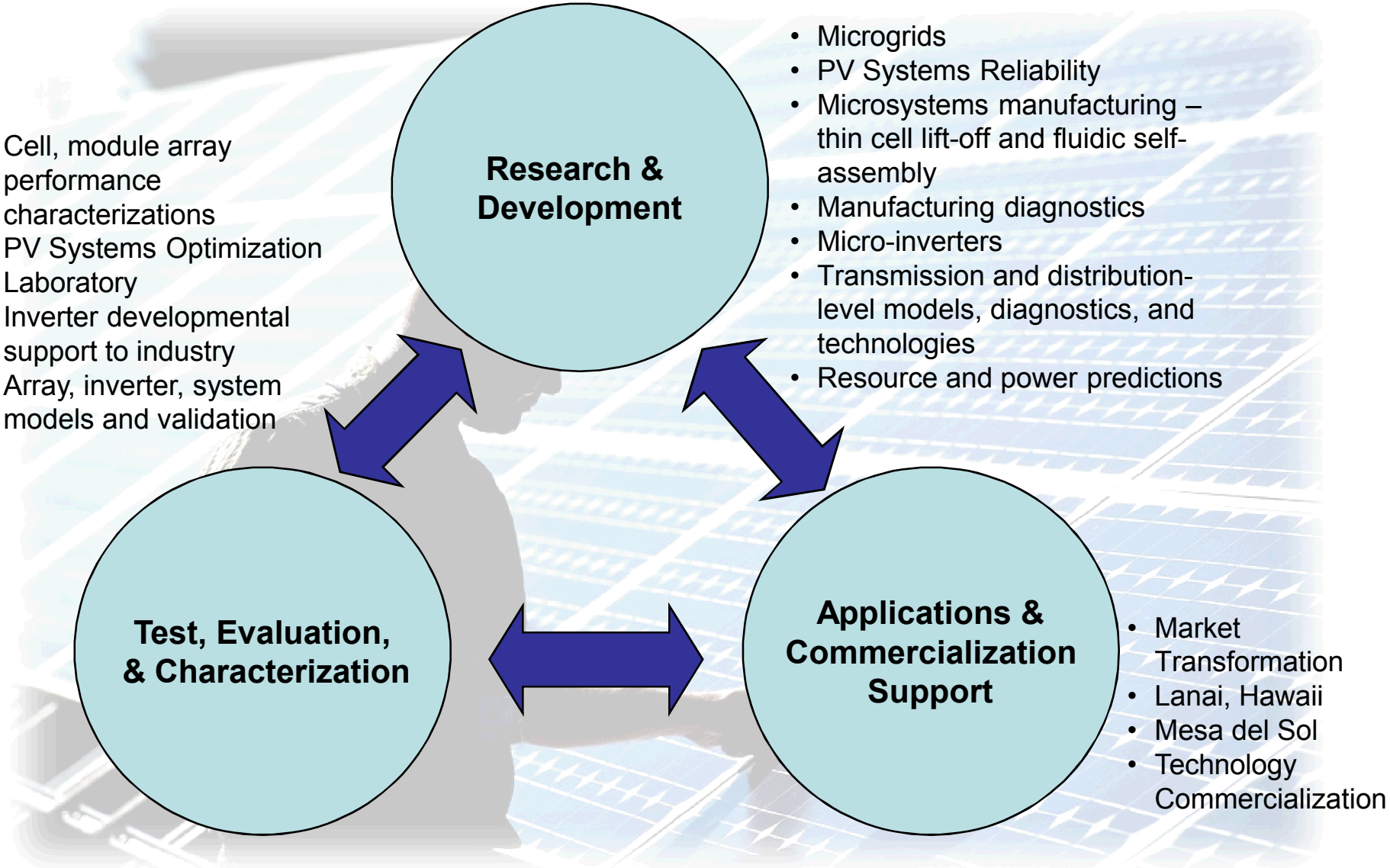
U.S. DEPARTMENT OF ENERGY

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Today's Talk

- Sandia PV dept. background
- Problem Statement
- Current challenges with PV valuation & importance of 'getting it right'
- Past efforts and research for valuation of PV systems
- ***PV Value*** methodology and examples
- Current and proposed efforts around use of ***PV Value***
- Benefits to stakeholders

The Tenants of Sandia's PV Program



- Cell, module array performance characterizations
- PV Systems Optimization Laboratory
- Inverter developmental support to industry
- Array, inverter, system models and validation

- Microgrids
- PV Systems Reliability
- Microsystems manufacturing – thin cell lift-off and fluidic self-assembly
- Manufacturing diagnostics
- Micro-inverters
- Transmission and distribution-level models, diagnostics, and technologies
- Resource and power predictions

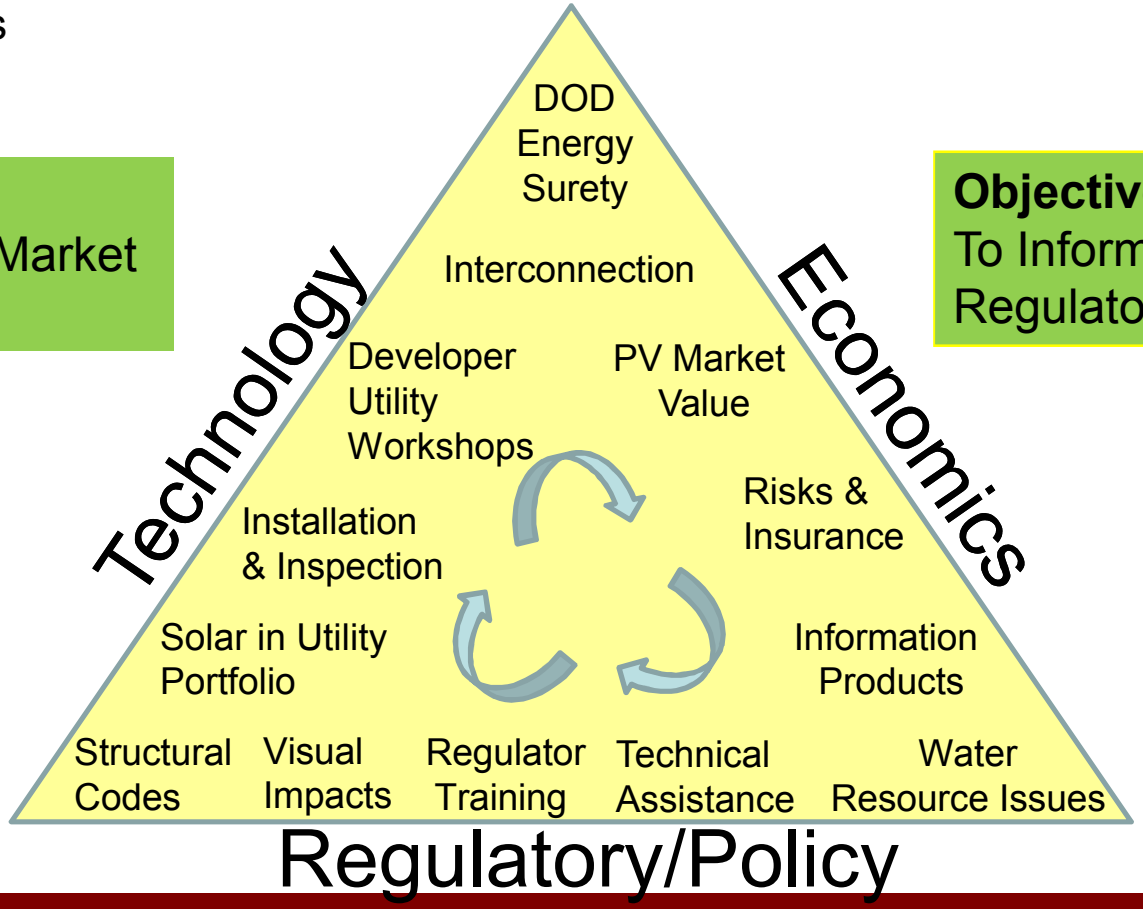
- Market Transformation
- Lanai, Hawaii
- Mesa del Sol
- Technology Commercialization

Solar Market Transformation

- Market Transformation promotes the commercialization of solar technologies by addressing non-technical issues that act as barriers to the adoption of solar energy technologies
- The Market Transformation effort identifies and prioritizes significant barriers beyond traditional "cost" issues and develops specific activities and external partnerships to address those barriers

Goals:
To Increase Market Penetration

Objectives:
To Inform Policy and Regulatory Environment



Why does the valuation of a PV system matter?

It matters because…

- Proper valuation impacts adoption rates and diffusion of solar PV in the market place
  - Uncertainty on impact to home value before ROI is reached
  - Homeowner's don't want this uncertainty if having to sell the property with the attached PV system
  - Understanding potential market value in addition to energy savings value may lead to more purchases
- Impacts a consumer's decision to adopt solar
- Realistic value = "Bankability"
- Valuation standards will decrease risk, which can lead to…
  - Lower cost financing
  - Increase in LTV ratio
- May help revive residential PACE financing
- Provide estimates for lease to purchase FMV for IRS purposes

Current challenges with PV valuation & importance of ‘getting it right’

Current Challenges with PV Valuation

Many stories of **no value** given to PV system during refinance or sale

- Appraisers are ignoring cost and income approaches, which could be used when comparable sales are generally not available
- Appraisers must be knowledgeable or reject the assignment (USPAP)

Don't know does not equal $0

- This is the result of appraisers relying on comparable sales, *or*
- Lenders/Underwriters conveying they won't accept appraisal with PV

These issues impact a consumer's decision to adopt solar PV

Uniform Standards of Professional Appraisal Practice

Sandia National Laboratories

COMPETENCY RULE

An appraiser must: (1) be competent to perform the assignment; (2) acquire the necessary competency to perform the assignment; or (3) decline or withdraw from the assignment.

Being Competent

The appraiser must determine, prior to accepting an assignment, that he or she can perform the assignment competently. Competency requires:

1. **the ability to properly identify the problem to be addressed; and**
2. **the knowledge and experience to complete the assignment competently; and**
3. **recognition of, and compliance with, laws and regulations that apply to the appraiser or to the assignment.**

Comment: Competency may apply to factors such as, but not limited to, an appraiser's familiarity with a specific type of property or asset, a market, a geographic area, an intended use, specific laws and regulations, or an analytical method. If such a factor is necessary for an appraiser to develop credible assignment results, the appraiser is responsible for having the competency to address that factor or for following the steps outlined below to satisfy this COMPETENCY RULE.

For assignments with retrospective opinions and conclusions, the appraiser must meet the requirements of this COMPETENCY RULE at the time of the assignment, rather than the effective date.

Uniform Standards of Professional Appraisal Practice

Sandia National Laboratories

Acquiring Competency

If an appraiser determines he or she is not competent prior to accepting an assignment, the appraiser must:

1. **disclose the lack of knowledge and/or experience to the client before accepting the assignment;**
2. **take all steps necessary or appropriate to complete the assignment competently; and**
3. **describe, in the report, the lack of knowledge and/or experience and the steps taken to complete the assignment competently.**

Comment: Competency can be acquired in various ways, including, but not limited to, personal study by the appraiser, association with an appraiser reasonably believed to have the necessary knowledge and/or experience, or retention of others who possess the necessary knowledge and/or experience.

In an assignment where geographic competency is necessary, an appraiser who is not familiar with the relevant market characteristics must acquire an understanding necessary to produce credible assignment results for the specific property type and market involved.

Lack of Competency

If the assignment cannot be completed competently, the appraiser must decline or withdraw from the assignment.

Uniform Standards of Professional Appraisal Practice

Sandia National Laboratories

Standards Rule 1-4

In developing a real property appraisal, an appraiser must collect, verify, and analyze all information necessary for credible assignment results.

(a) **When a sales comparison approach is necessary for credible assignment results, an appraiser must analyze such comparable sales data as are available to indicate a value conclusion.**

(b) **When a cost approach is necessary for credible assignment results, an appraiser must:**

(i) **develop an opinion of site value by an appropriate appraisal method or technique;**

(ii) **analyze such comparable cost data as are available to estimate the cost new of the improvements (if any); and**

(iii) **analyze such comparable data as are available to estimate the difference between the cost new and the present worth of the improvements (accrued depreciation).**

Uniform Standards of Professional Appraisal Practice

Sandia National Laboratories

Standards Rule 1-4

(c) **When an income approach is necessary for credible assignment results, an appraiser must:**

(i) **analyze such comparable rental data as are available and/or the potential earnings capacity of the property to estimate the gross income potential of the property;**

(ii) **analyze such comparable operating expense data as are available to estimate the operating expenses of the property;**

(iii) **analyze such comparable data as are available to estimate rates of capitalization and/or rates of discount; and**

(iv) **base projections of future rent and/or income potential and expenses on reasonably clear and appropriate evidence.**[13]

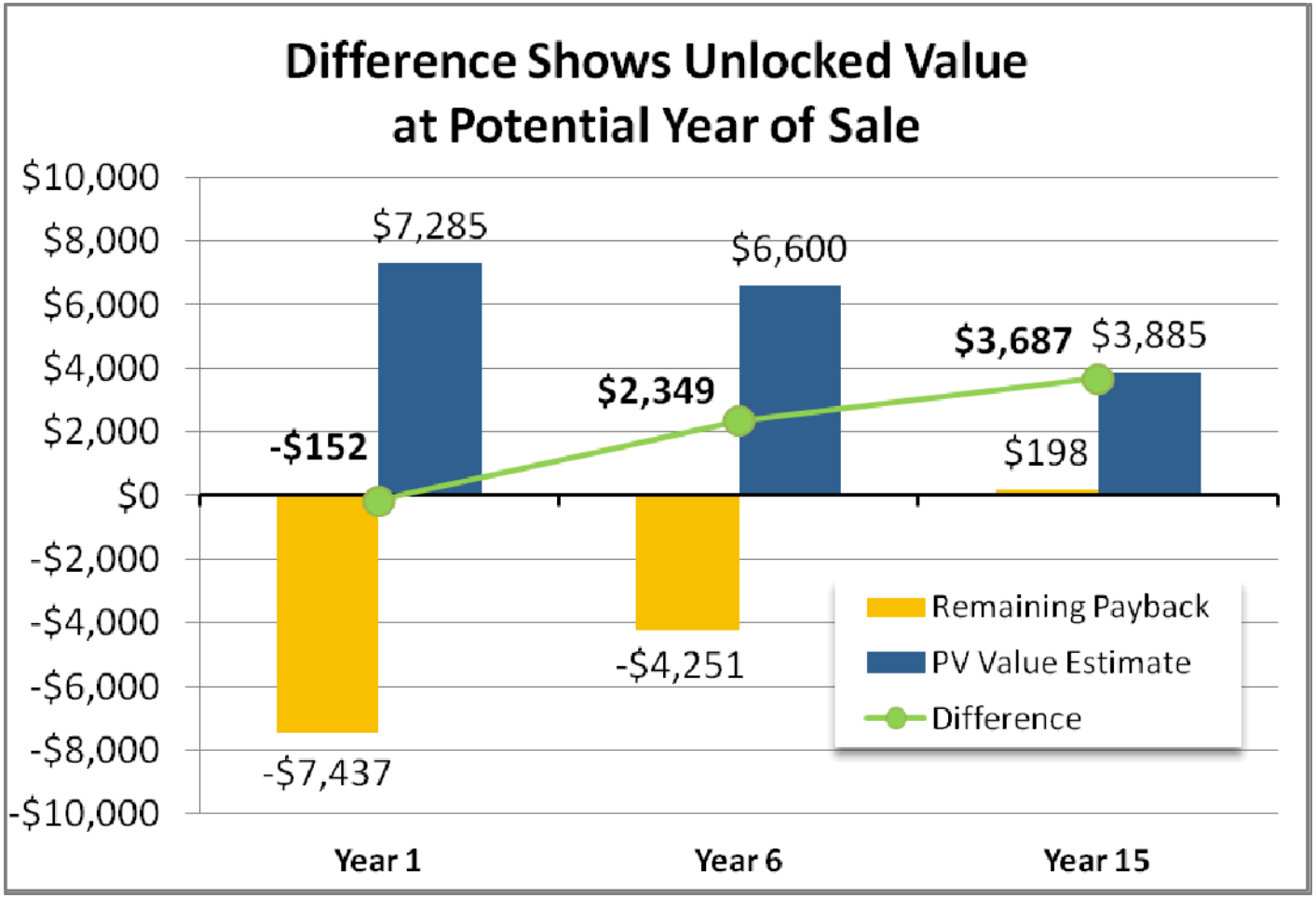
Comment: In developing income and expense statements and cash flow projections, an appraiser must weigh historical information and trends, current supply and demand factors affecting such trends, and anticipated events such as competition from developments under construction.

Challenges with Leasing

- Residential properties:
  - Leasing costs more than purchasing, though it can bring more people in for little or no money down
  - Appraisers need to ensure they know if system is leased. It can't be included in an appraised value
    - There is value in electricity saved, so what is an appraiser to do?
  - It's not clear how GBMs will allow leased system to transfer with property sale. Leased system might have to be removed, or paid off.
  - What is Fair Market Value in a lease to purchase transaction?
- Commercial properties:
  - Understand who owns PV system due to third-party PPA or lease
  - Possible to treat building 'roof as rented space' in a way that captures income stream from PV system.
- Assessors need to know who owns PV system

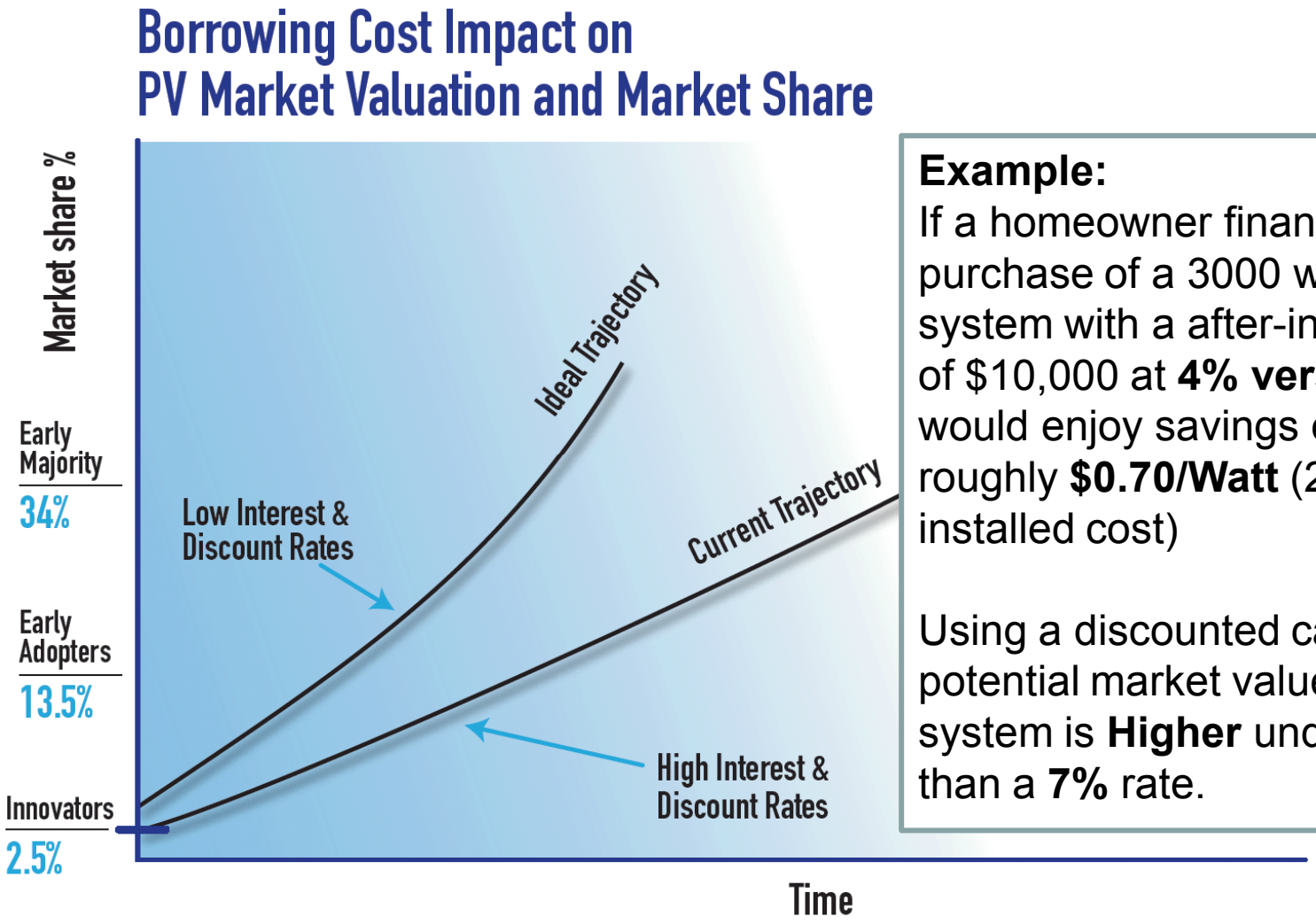
If done right, 'Value Perception' will change

- A payback of 15 years should not be a barrier to PV ownership if the homeowner decides to sell before the PV system is paid off
- There is a value to the system that can be **unlocked** *well before* payback



If done right, market share will increase

Sandia National Laboratories



Example:
If a homeowner financed the purchase of a 3000 watt (DC) system with a after-incentives cost of $10,000 at **4% versus 7%,** they would enjoy savings equating to roughly **$0.70/Watt** (22% of the net installed cost)

Using a discounted cash flow, the potential market value of this system is **Higher** under a **4%** rate than a **7%** rate.

Past efforts and research on PV system valuation

Past Research Efforts

- Webb (1980) and Harris (1984) outline case for valuing solar PV after initial boom in the 1970's and 1980's
- Johnson and Kaserman (1983); Nevin and Watson (1998) discuss premise for 20:1 approach, where $1 saved = $20 in value
- Supported by Black (2004, 2009) for PV system value
- Conference paper by Laquatra et al. (2002) disputed 20:1 results
- Report by McCabe and Merry (2010) challenged 20:1 approach applied to PV

Past Research Efforts, cont.

Research focused on California market, where PV market is more mature. i.e., better chance to find comparable sales and more builders of new homes offering PV

- Increase in home value and sale price due to PV: Farhar and Coburn (2006), Hoen et al. (2011) and Dastrup et al. (2011)
- Hoen et al. (2011) results:
  - Premiums: New home with PV $2.50/Watt and existing home with PV $6.50/Watt
- LBNL and SNL will be using PV Value with LBNL California dataset to better understand discrepancy, and determine premium in other markets

Problems with relying on old studies

Sandia National Laboratories

Past valuation research is confusing when applied to PV

- Energy efficiency studies are being applied to PV (*with no PV in research sample*)
- A high ratio of **Increased Property Value** from **Energy Bill Savings** is promoted (e.g., 20:1) , however…..
- No analyses of actual market values to support this exact ratio

Market is changing fast

- Cost for PV system has been decreasing
- Methods are needed to support real-time valuation analysis

So What Does This Mean?

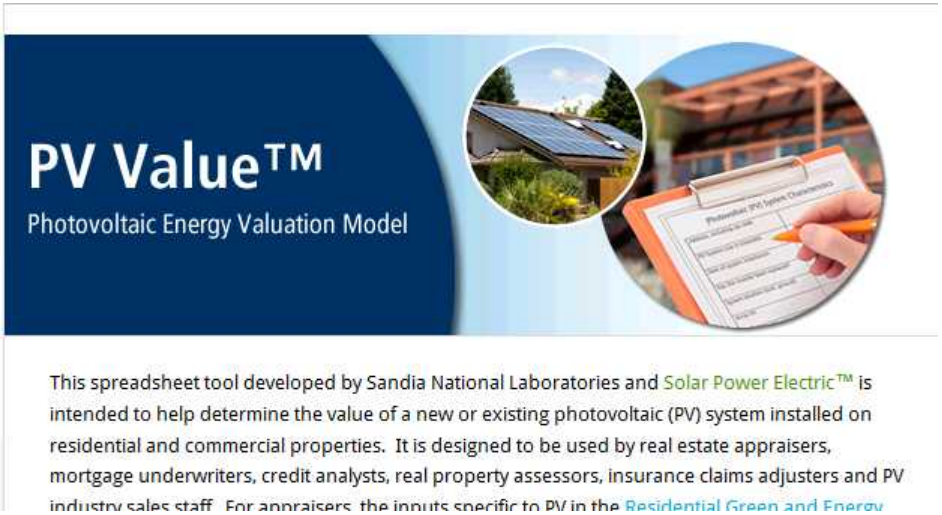
- A sales premium for PV does exist in California (with high variation)
- An exact 20:1 methodology has not been proven
- Results do not differentiate appraisal techniques, or lack thereof
- Considerable work remains to determine what properties with PV sell for in other states
- **Most recently – FHFA challenged past valuation research in PACE rulemaking comments**

PV Value methodology & examples

How PV Value Started

- Effort by Solar Power Electric working with Appraisal Institute to develop financial algorithm for "income approach" that follows standard appraisal principles
- Sandia Labs working with Kennecott Land in Salt Lake City to develop methodology for valuing homes in Daybreak Development

Combined Efforts



Appraisal Methodology

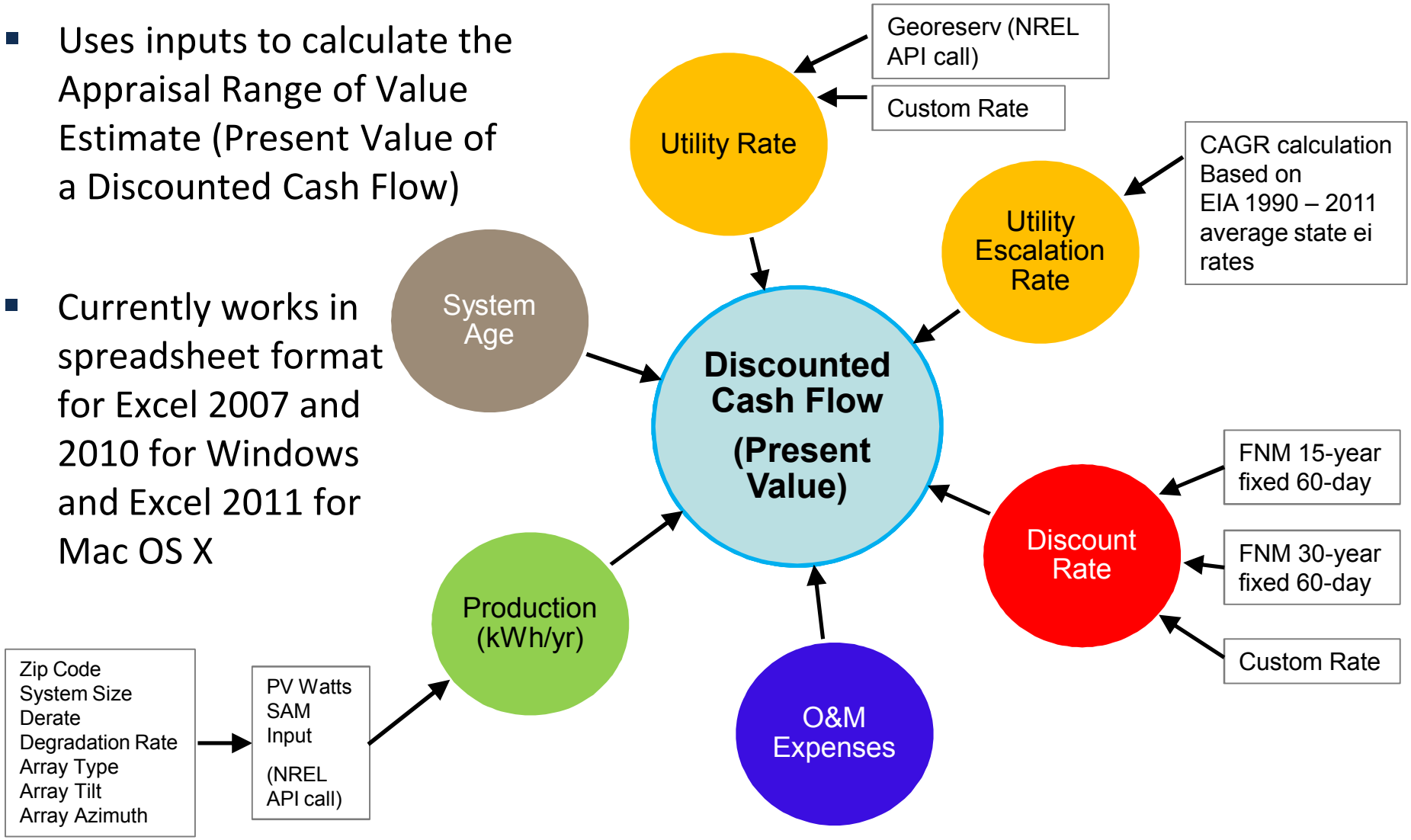
- The PV Value tool uses the **Income Capitalization Approach**

The value of a property is equal to the capitalized value of the net income stream that property can generate

- Useful when comparables are few or non-existent
- For PV, the value of the income stream is related to energy production, existing electricity rate, utility escalation rate, discount rate and O&M expenses over its remaining useful lifetime

How PV Value Works

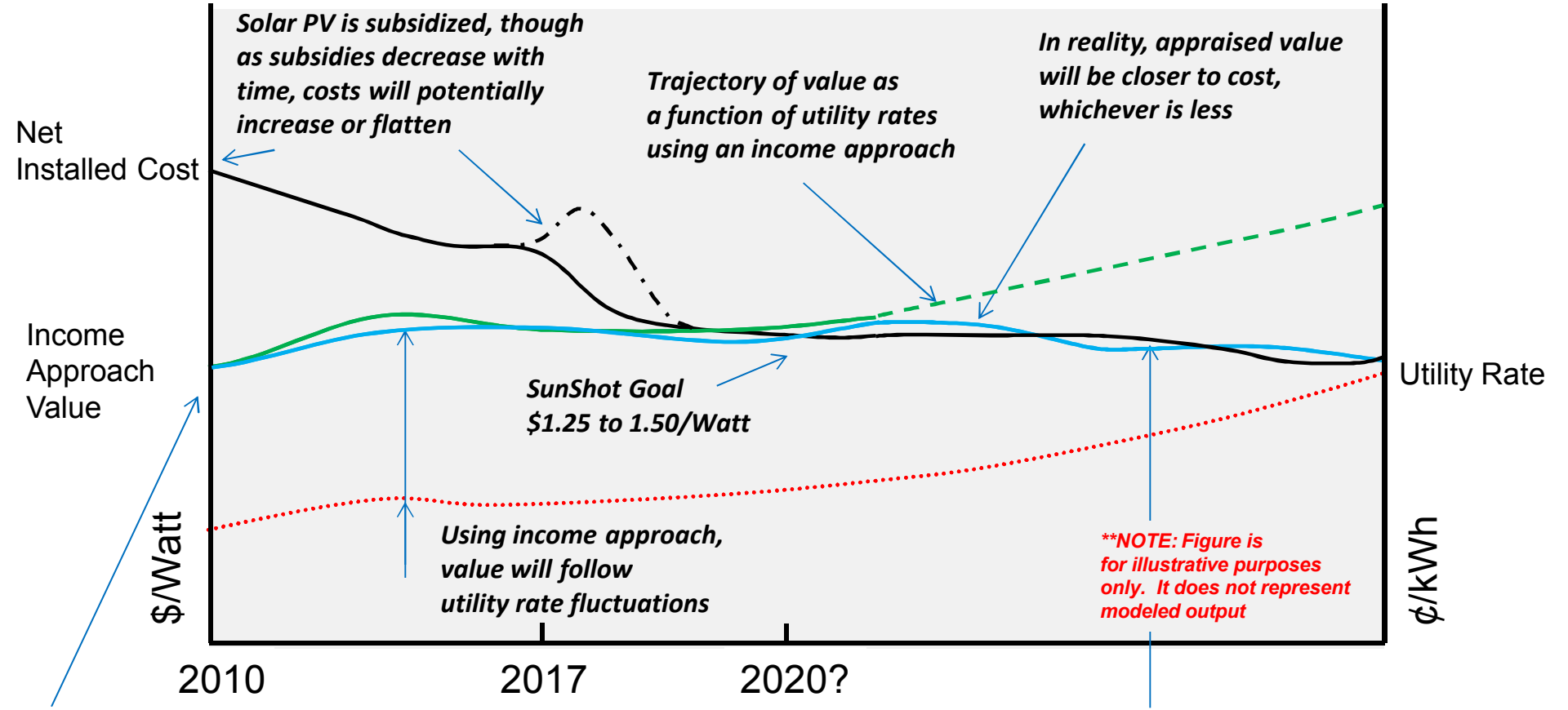
- Uses inputs to calculate the Appraisal Range of Value Estimate (Present Value of a Discounted Cash Flow)
- Currently works in spreadsheet format for Excel 2007 and 2010 for Windows and Excel 2011 for Mac OS X



Sandia National Laboratories

Demonstration of **PV Value v1.1**

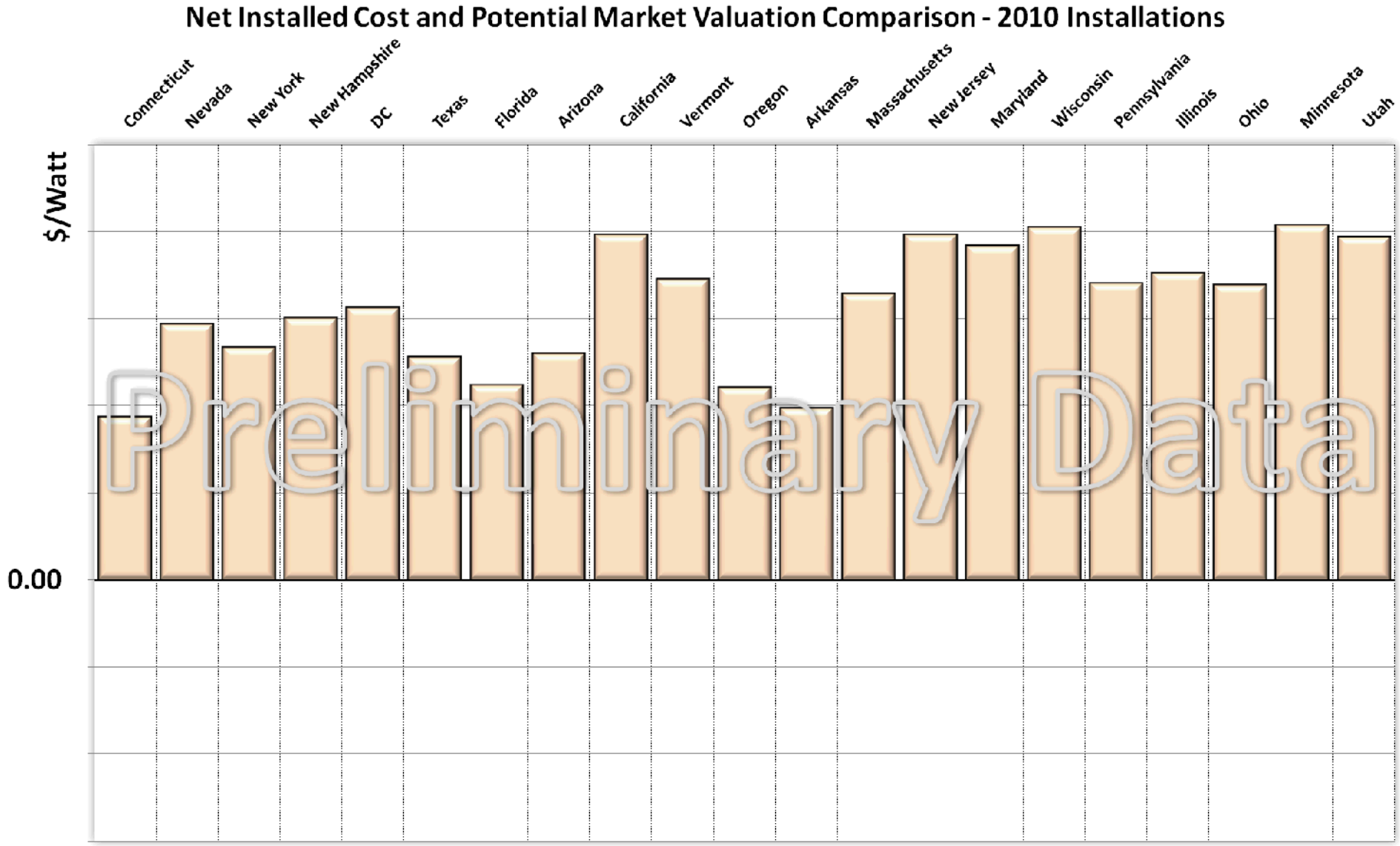
Implied Relationship Between Installed Cost Value & Income Approach Value



Due to low utility and escalation rates, income approach values are less than net installed cost in most states

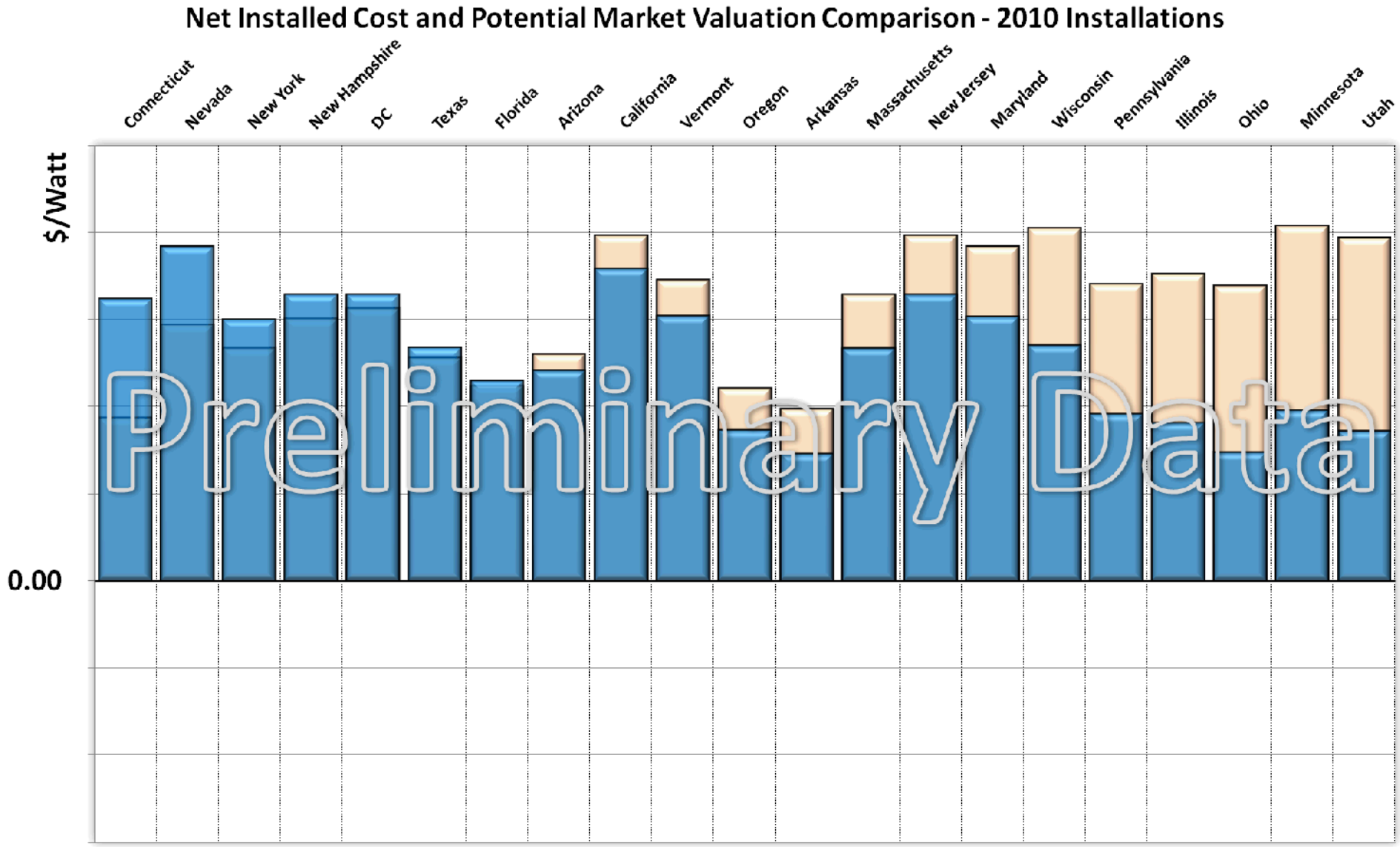
Cycle continues where cost and appraised value fluctuate depending on what market will bear and what customers are willing to pay

Residential Market



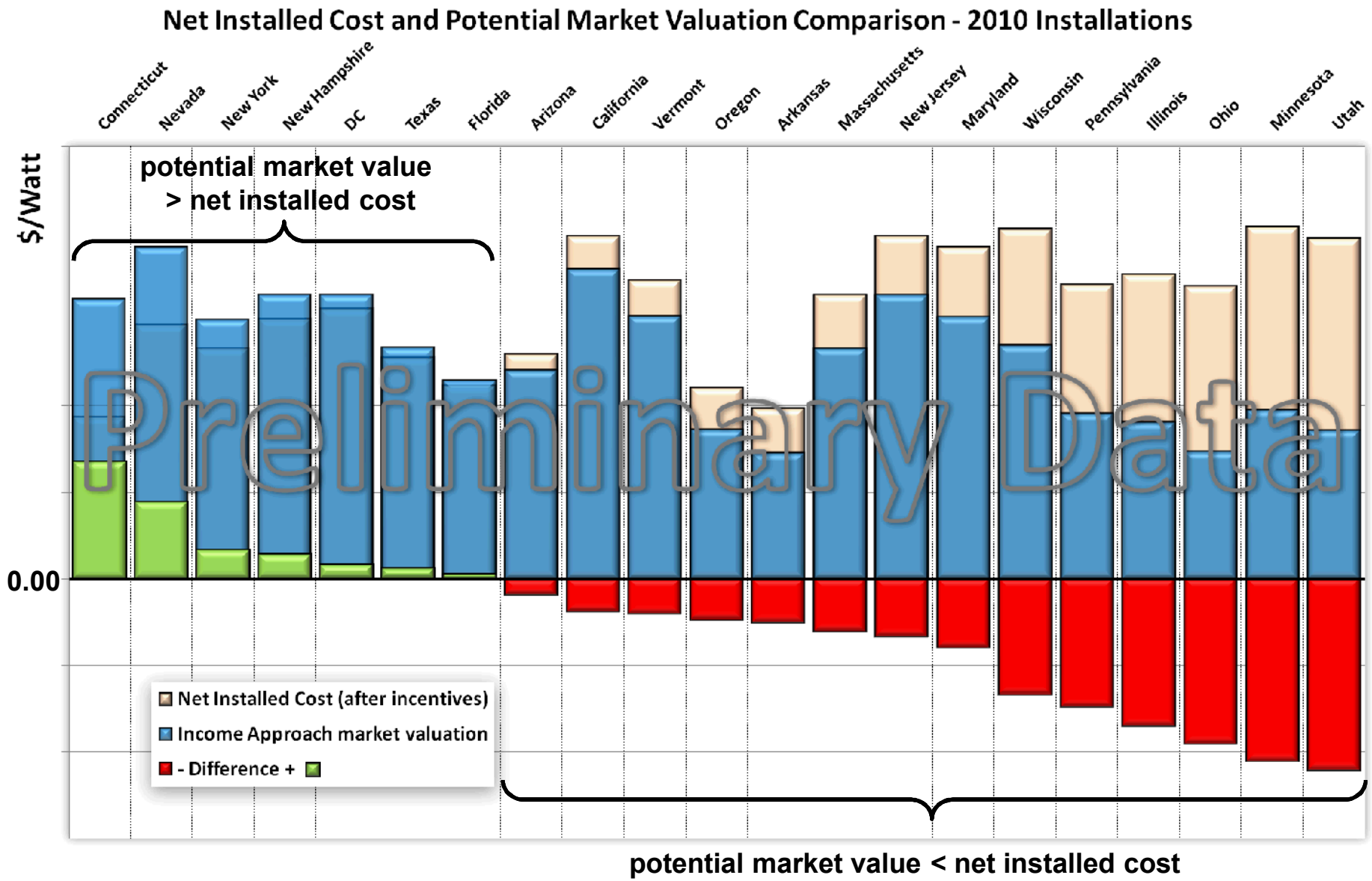
States shown are those used in Barbose et al. (2011) "Tracking the Sun IV" for installed cost comparison

Residential Market



States shown are those used in Barbose et al. (2011) "Tracking the Sun IV" for installed cost comparison

Residential Market



States shown are those used in Barbose et al. (2011) "Tracking the Sun IV" for installed cost comparison

Sandia National Laboratories

Current & proposed efforts around the use of **PV Value**

Current Efforts in Support of PV Value

- Estimating Installed Value Across the U.S.
  - What is relationship between value determined with income and cost approaches?
  - When should one approach used over the other?
  - Manuscript being prepared for Appraisal Journal
- Working with Appraisal Institute to develop class around residential and commercial appraising of PV systems
  - Will be offered February/March 2013
  - Target audience is appraisers and underwriters
- Adding additional features to increase robustness of algorithm and applicability to commercial PV systems

2013-2015 Goals

Lower Costs - Increase access to lower PV financing interest rates, and potentially allow financing PV through 1st mortgage

- Through decreasing risk for lenders and underwriters

Decrease Barriers - Attract new market participants

- For example, attract homeowners that are resistant to buy a PV system because the relatively long payback period required via energy savings

Wide Range Of Supporters

Other Proposed Efforts

- Engage HUD on PowerSaver loans
  - Help kick-start the program for loans with PV systems
  - Help them understand value, which will allow for LTV increase
  - This could eventually get into Desktop Underwriter and trickle down to FNM, FMC, VA
- Demonstrate Savings to Investment Ratio (SIR) for residential PACE programs
  - Version of PV Value that will allow for comparison between annual PACE payments and present value of energy savings using PV Value
  - May show what interest rates will make PACE work in different parts of the country, and
  - Where combination of lower installed cost and higher utility rates will show an SIR > 1
  - Use this method for commercial PACE programs, with some modifications

Benefits to Stakeholders

- PV System Adopters
- Appraisers
- Installers/Integrators
- Assessors
- Solar PV Sales

Benefits to Stakeholders

PV System Adopters

Appraisers

Installers/Integrators

Assessors

Solar PV Sales

PV System Adopters

- Establishing standard for valuation will help attract low-cost financing
  - Key is getting GBM holders (FNM, FMA, FHA, VA) to accept valuation estimate by appraiser (residential market)
  - When they do, this will open up PV systems to be rolled into 1st mortgage (purchase or re-finance)
  - This will increase the adoption rate of solar PV and help bring down the overall installed cost of the PV system

Consider how many more purchases of PV may occur if lower rates are available through 1st mortgages

PV System Adopters

- This work will reinforce investment decisions made by PV system purchasers
- It will help those that lease systems help with ‘lease to purchase’ market value determinations
- This work has the potential to revive residential PACE financing
- Other mortgage products may eventually be allowed by F

Benefits to Stakeholders

PV System Adopters

Appraisers

Installers/Integrators/Sales

Assessors

Appraisers

- Appraisers will become educated about PV systems and help the industry reflect the demand for properties with PV systems.
- Their involvement will add value to the process by recognizing the unique energy generating role of a PV system
- This recognition will ‘unlock’ the value of the PV system
- This will reduce tension between property owner and appraiser that wants PV system valued, especially if there is a willing buyer
- Help convince GBMs of PV market value using a bottom-up approach, will hopefully lead to new underwriting standards

Benefits to Stakeholders

PV System Adopters

Appraisers

Installers/Integrators/Sales

Assessors

Installers/Integrators/Sales

- Can you figure out the size of this array from looking at it?
- What is the month and year of installation?
- Is there a custom derate factor for this system that takes into account the shading?

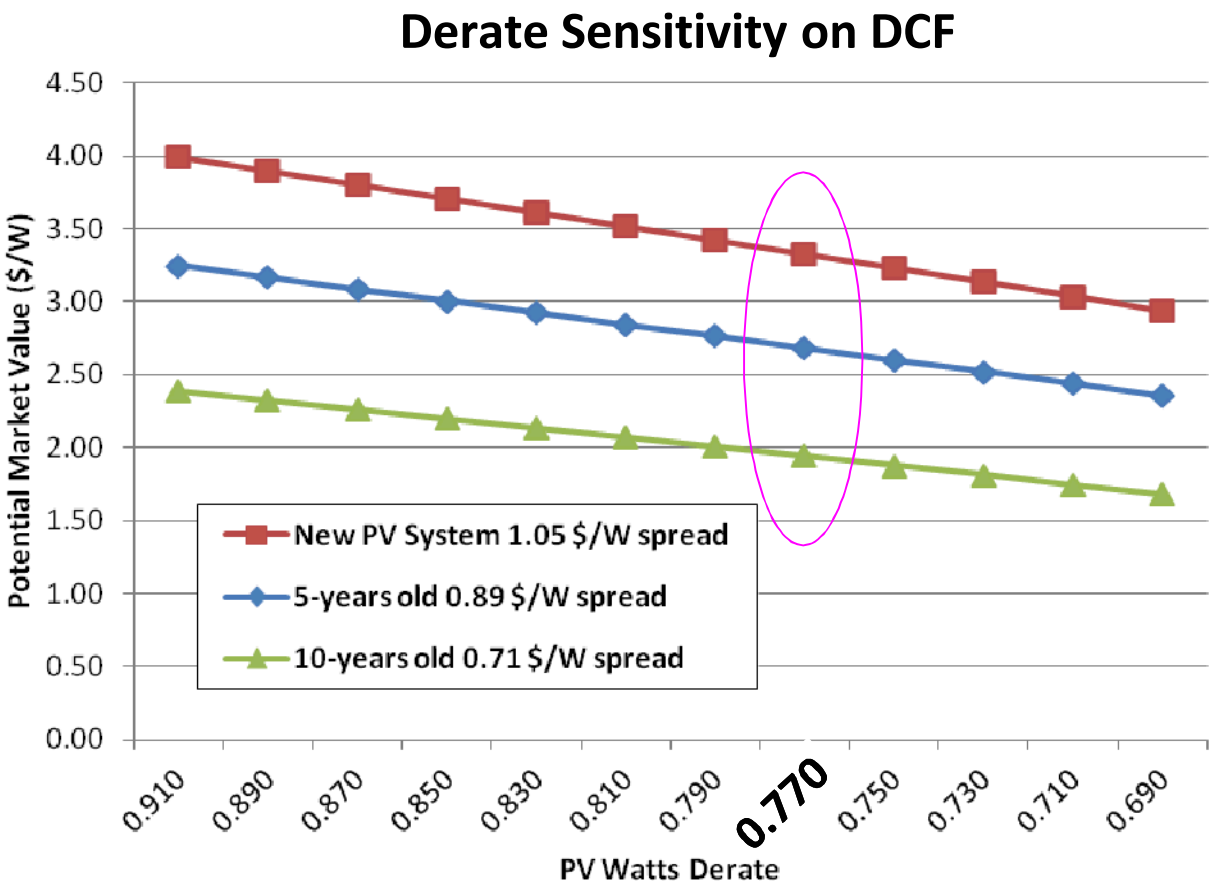
- Do you know how long the module warranty period is for?
- How about the azimuth direction the modules are facing and the slope of the modules?

Installers/Integrators/Sales

- Installers can use this as a sales tool, as it's use is accepted by appraisers, then there is certainty that the PV system being sold has a value beyond just the energy saved each month
- There could be an additional 'service' offered to appraisers that need assistance with the value determination
  - More complex systems
  - Determine proper derate factor
  - To check if system is working correctly
- Respond to appraiser inquiries about installed cost
  - Appraiser uses cost, income and sales comparison approach to make value determination

Installers/Integrators/Sales

- Derate sensitivity decreases as PV system ages. Spread is lower
- For a new 5kW system, example shows around a $5,000 difference for this hypothetical market



Installers/Integrators/Sales

- Permanent Documentation – Beyond NEC 690
  - STC DC and AC in kW
  - Initial detailed derate factor used in commissioning report
    - What SolarPro October/November 2009 “PV System Commissioning” article defines as **K_s**
    - Percent of outperformance (if system is underperforming **K_s** then **K_s** may not be correct)
  - Derate used for PVWatts
    - **K_s** along with additional derate factors adjusting for ac wiring, soiling & system availability
  - Orientation (tilt & azimuth)
  - Inverter model number
  - Module model number
  - Installation date

Benefits to Stakeholders

PV System Adopters

Appraisers

Installers/Integrators/Sales

Assessors

Assessors

- Knowledge of solar PV may help in research for differentiating leased vs. owned systems
- Standardized approach
- May reduce valuation challenges by PV system owners on the PV portion of the valuation estimate

Justin Barnes from NC Solar will be addressing topics of interest to assessors at lunch

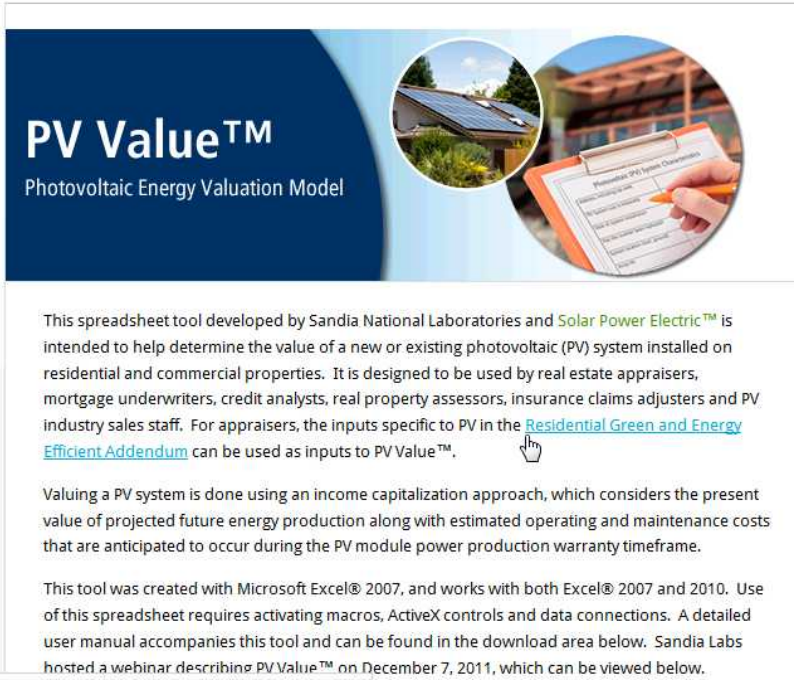
Where to Download PV Value

Formally endorsed by the Appraisal Institute on January 31, 2012

Sandia National Laboratories

http://pv.sandia.gov/pvvalue

PV Value™



Energy Sense/Finance

www.pvvalue.com

Coming Soon

References

Barbose, G., N. Darghouth, R. Wiser and J. Seel, "Tracking the Sun IV - An Historical Summary of the Installed Cost of Photovoltaics in the United States from 1998 to 2010," LBNL-5047E, Lawrence Berkeley National Laboratory, Berkeley, CA, (2011).

Black, A. "Economics of Solar Electric Systems for Consumers: Payback and other Financial Tests," (2009). Available at: http://www.ongrid.net/papers/PaybackOnSolarSERG.pdf

Black, A. "Why is a Solar Electric Home Worth More?" (2004). Available at: http://www.ongrid.net/papers/HomeWorthMoreASES04.pdf

Dastrup, S., J.G. Zivin, D.L. Costa, and M.E. Kahn, "Understanding the Solar Home Price Premium: Electricity Generation and 'Green' Social Status," UC Center for Energy & Environmental Economics, Berkeley, CA, (2010).

Farhar, B.C, and T.C. Coburn, "A New Market Paradigm for Zero-Energy Homes: The Comparative San Diego Case Study," NREL/TP-550-38304-01, National Renewable Energy Laboratory, Golden, CO, (2006).

Harris, J. "The Value of Solar Energy: Chic, Patriotism and Economic Reality." The Real Estate Appraiser and Analyst, Fall, 5-7, (1984).

Hoen, B., R. Wiser, P. Cappers, and M. Thayer "An Analysis of the Effects of Residential Photovoltaic Energy Systems on Home Sales Prices in California," LBNL-4476E, Lawrence Berkeley National Laboratory, Berkeley, CA, (2011).

Johnson, R.C., and D.L. Kaserman, "Housing Market Capitalization of Energy-Saving Durable Good Investments," Economic Inquiry, 374-386, (1983).

Laquatra, J., D.J. Dacquisto, P. Emrath, and J.A. Laitner, "Housing Market Capitalization of Energy Efficiency Revisited," In Proceedings of the 2002 ACEEE Summer Study on Energy Efficiency in Buildings, 8, 141-152, Washington, DC. American Council for an Energy-Efficient Economy, (2002).

McCabe, M. and L. Merry, "Resale Market Value of Residential Solar PV," Journal of Sustainable Real Estate, Volume 2 Industry Perspectives, (2010). Available at: http://www.costar.com/josre/industryPerspectives.htm

Nevin, R., and G. Watson "Evidence of Rational Market Values for Home Energy Efficiency," The Appraisal Journal, 68, 401-409, (1989).

Webb, J.R., "The Influence of Solar Energy Systems on the Value of Dwellings: Theory vs. Practice," The Real Estate Appraiser and Analyst, January-February, 4-6, (1980).

Thank You

Sandia National Laboratories

Additional questions can be directed to:

Geoff Klise
gklise@sandia.gov

PV Value can be downloaded from:

http://pv.sandia.gov/pvvalue