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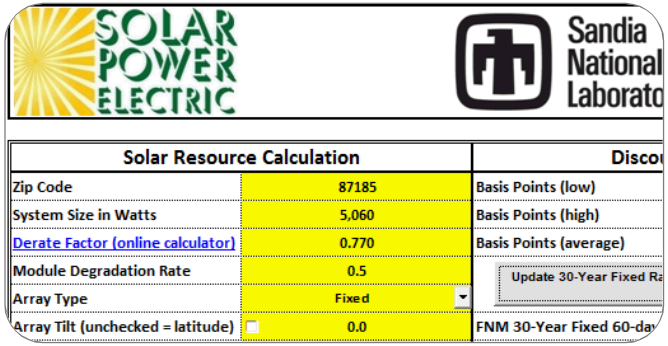

Photovoltaic System Valuation Model – PV Value™

Geoff T. Klise & Jamie L. Johnson

December 7, 2011

U.S. DEPARTMENT OF ENERGY | NNSA

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About the Presenters:

- Geoffrey T. Klise is a staff member at Sandia National Laboratories in the Earth Systems Analysis Department and provides system level analysis techniques for analyzing technical and policy related questions for solar, biofuels, climate change and water resource issues. He has also worked in both the private sector and in state government.

- Jamie L. Johnson is the General Manager of Solar Power Electric™ - a FL state certified unlimited electrical contractor. He holds both NABCEP Certifications for Solar PV Installer™ and PV Technical Sales Professional™. Mr. Johnson has over 15 years of experience in the financial services sector beginning his career with the IRS, and then spending over a decade working in the mortgage banking and asset management industry.

If you have any questions during today's webinar, please e-mail:

driley@sandia.gov

We will try and answer all relevant questions to the valuation model after the presentation

Today's Presentation

- Background
- Importance of Valuing Energy Production
- Approach
  - Appraisal Methodology
  - Link to Appraisal Institute Green Addendum
  - Limitations
- Model Demonstration
  - Four locations in the U.S.
  - Different configurations and sizes
- Future Work
- Questions

Background

- Separate efforts by Jamie Johnson of Solar Power Electric and Geoff Klise of Sandia Labs led to a coordinated effort to develop photovoltaic valuation model
  - Initial effort by Jamie focused on Florida for Appraisal Institute
  - Initial effort by Geoff focused on Salt Lake City, Utah
- Peer reviewed by licensed appraisers
- Currently finalizing tool – waiting on distribution license
- This tool will be FREE

Importance

- Value of PV system may or may not be included in the sale price of a property
  - Comparable properties – Limited or none
  - Cost and incentives unknown
  - Knowledge of appraiser
  - Non-working system
- If home or business owner is not compensated for investment, depressed demand may result
- In the absence of comparable properties, how might a system be valued in a way that follows standard appraisal methodology?

Approach

- This model takes 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
- Realistic value = ‘bankability’

Limitations

- Not for leased systems
- Only valid for grid-tied systems with net metering
- Applies to residential and commercial properties
- Commercial depreciation is not addressed
- Needs internet access to work
- Does not address aesthetic and ‘green cache’ value
- Does not include SREC’s, REC’s, net differentials, FIT’s, above and beyond net metering

AI Reports®
Form 820.03*

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

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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): ☐ Floor Insulation (Describe):				R-Value: ☐ Walls ☐ Ceiling ☐ Floor	
Water Efficiency	☐ Reclaimed Water System (Explain): ☐ Rain Barrels - #:		☐ Cistern - Size: Gallons ☐ Rain Barrels Provide Irrigation		Location:	
Windows	☐ ENERGY STAR®	☐ Low E	☐ High Impact	☐ Storm	☐ Double Pane ☐ Triple Pane	☐ Tinted ☐ Solar Shades
Day Lighting	☐ Skylights - #:	☐ Solar Tubes - #:	☐ ENERGY STAR Light Fixtures	☐ Other (Explain):		
Appliances	ENERGY STAR Appliances: ☐ Range/Top ☐ Dishwasher ☐ Refrigerator ☐ Other:		Water Heater: ☐ Solar ☐ Tankless (On Demand) Size: Gal.	Appliance Energy Source: ☐ Propane ☐ Electric ☐ Natural Gas ☐ Other (Describe):		
HVAC (Describe in Comments Area)	☐ High Efficiency HVAC – SEER: ☐ Programmable Thermostat		☐ Heat Pump ☐ Wind	☐ Thermostat/Controllers ☐ Radiant Floor Heat	☐ Passive Solar ☐ Geothermal	
Energy Rating	☐ ENERGY STAR Home ☐ HPwES (Home Performance with ENERGY STAR) ☐ Other (Describe):			☐ Indoor Air PLUS Package ☐ Energy Recovery Ventilator Unit ☐ Certification Attached		
HERS Information	Rating:	Date Rated:	Monthly Energy Savings on Rating: $			
Utility Costs	Average Utility Cost: $ per month based on:			☐ Dashboards - #:		
Energy Audit	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						

Solar Panels

The following items are considered within the appraised value of the subject property:

Description	Array #1	Array #2	Array #3	Array #4
KW				
Age of Panels				
Energy Production Kwh per Array				
Source for Production				
Location (Roof, Ground, Etc.)				
If Roof/Slope for Array				
Azimuth per Array				
Age of Inverter(s)				
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)				

*NOTICE: The Appraisal Institute publishes this form for use by appraisers where the appraiser deems use of the form appropriate. Depending on the assignment, the appraiser may need to provide additional data, analysis and work product not called for in this form. The Appraisal Institute plays no role in completing the form and disclaims any responsibility for the data, analysis or any other work product provided by the individual appraiser(s).
AI Reports® AI-820.03 Residential Green and Energy Efficient Addendum © Appraisal Institute 2011, All Rights Reserved June 2011

Location 1

Residential – Rooftop fixed*

Client:		Client File #:
Subject Property:	Anytown Florida - 33980 zip code	Appraisal File #:

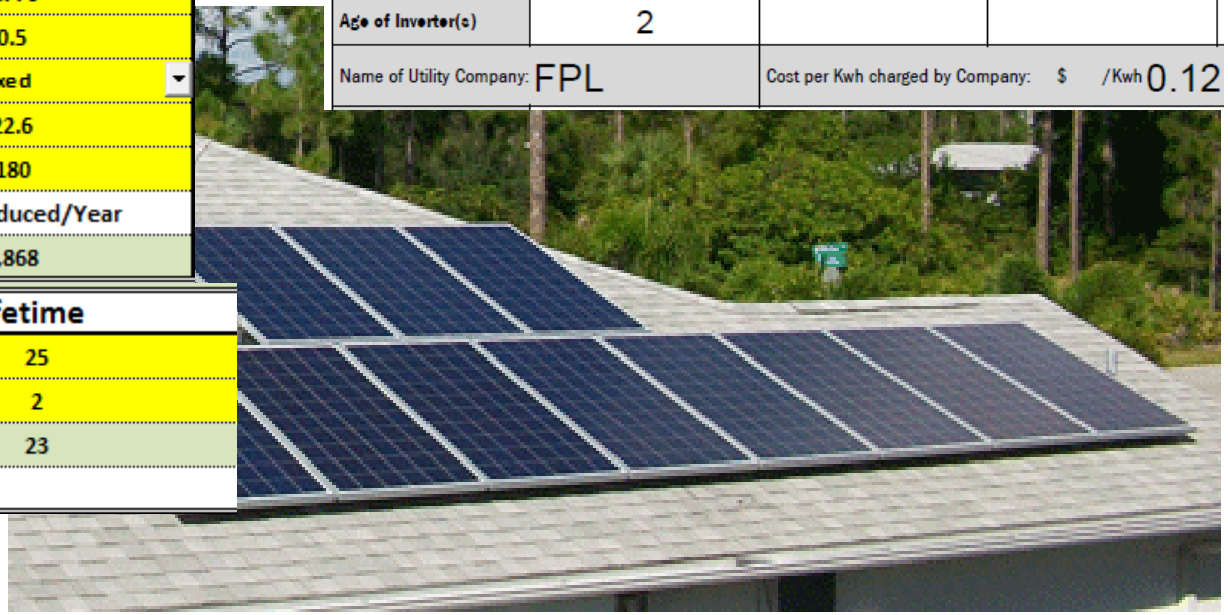
Solar Panels

The following items are considered within the appraised value of the subject property:

Decoription	Array #1	Array #2	Array #3
KW	5.06		
Age of Panels	2		
Energy Production Kwh per Array	16,400		
Source for Production	inverter		
Location (Roof, Ground, Etc.)	Roof		
If Roof/Slope for Array	22.6		
Azimuth per Array	180		
Age of Inverter(s)	2		
Name of Utility Company:	FPL	Cost per Kwh charged by Company: $ /Kwh	0.12

Solar Resource Calculation	
Zip Code	33980
System Size in Watts	5,060
Derate Factor (online calculator)	0.770
Module Degradation Rate	0.5
Array Type	Fixed
Array Tilt (unchecked = latitude)	22.6
Array Azimuth (default = South)	180
Calculate PV Production	kWh Produced/Year
	6,868

System Age and Remaining Lifetime	
Module Warranty/Years	25
Age of System/Years	2
Remaining Energy/Years	23



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*Representative Example

Location 2

Commercial – Rooftop fixed*

Client:		Client File #:
Subject Property:	Anytown California - 90302 zip code	Appraisal File #:

Solar Panels

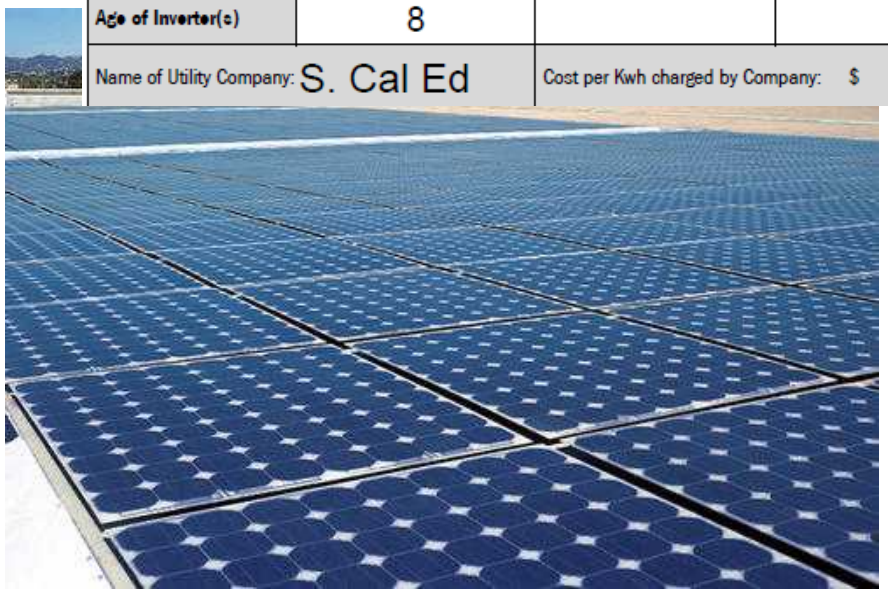
The following items are considered within the appraised value of the subject property:

Description	Array #1	Array #2	Array #3
KW	172		
Age of Panels	8		
Energy Production Kwh per Array	1,423,591		
Source for Production	Inverter		
Location (Roof, Ground, Etc.)	Roof		
If Roof/Slope for Array	0		
Azimuth per Array	180		
Age of Inverter(s)	8		

Name of Utility Company: S. Cal Ed — Cost per Kwh charged by Company: $ /Kwh 0.14

Solar Resource Calculation	
Zip Code	90302
System Size in Watts	127,000
Derate Factor (online calculator)	0.770
Module Degradation Rate	0.5
Array Type	Fixed
Array Tilt (unchecked = latitude)	0.0
Array Azimuth (default = South)	180
Calculate PV Production	kWh Produced/Year
	164,454

System Age and Remaining Lifetime	
Module Warranty/Years	25
Age of System/Years	8
Remaining Energy/Years	17



NREL Photographic Information eXchange

*Representative Example

Location 3

Commercial – Ground Mount fixed*

Solar Resource Calculation	
Zip Code	87105
System Size in Watts	500,000
Derate Factor (online calculator)	0.770
Module Degradation Rate	0.5
Array Type	Fixed
Array Tilt (unchecked = latitude)	20.0
Array Azimuth (default = South)	180
Calculate PV Production	kWh Produced/Year
	796,799

System Age and Remaining Lifetime	
Module Warranty/Years	25
Age of System/Years	15
Remaining Energy/Years	10
Has inverter been replaced?	No

*Representative Example

Client:		Client File #:
Subject Property:	New Mexico - 87105 zip code	Appraisal File #:

Solar Panels

The following items are considered within the appraised value of the subject property:

Description	Array #1	Array #2	Array #3
KW	500		
Age of Panels	15		
Energy Production Kwh per Array	12,678,178		
Source for Production	Inverter		
Location (Roof, Ground, Etc.)	Ground		
If Roof/Slope for Array	20		
Azimuth per Array	180		
Age of Inverter(s)	15		

Name of Utility Company: PNM — Cost per Kwh charged by Company: $ /Kwh 0.07

Photograph from Sandia National Laboratories

Location 4

Commercial – Rooftop fixed*

Client:		Client File #:
Subject Property:	Anytown Illinois - 60625 zip code	Appraisal File #:

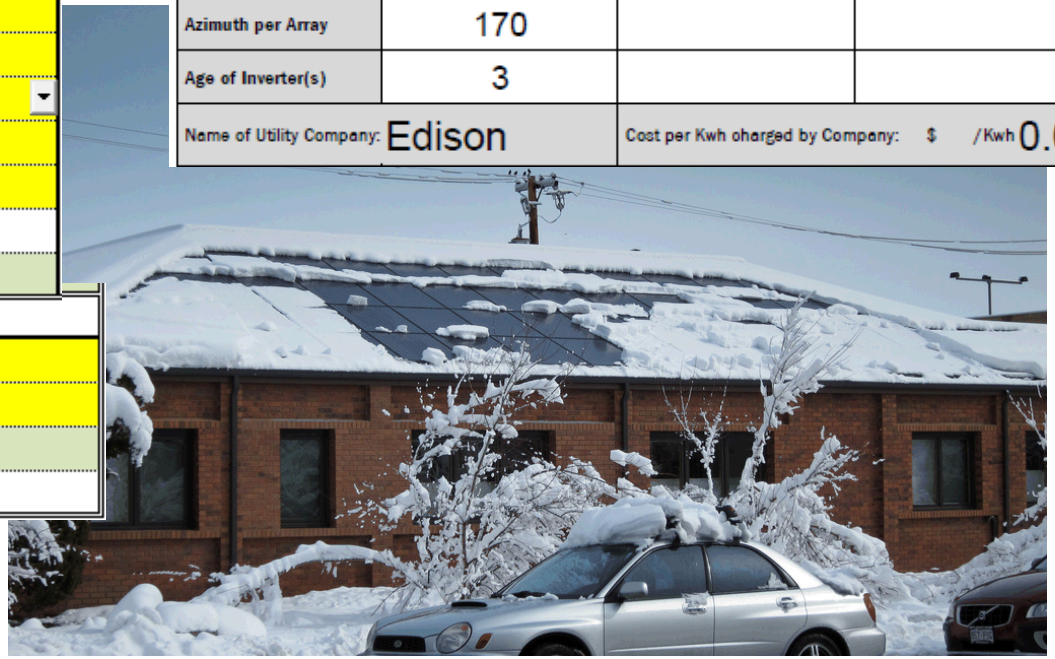
Solar Panels

The following items are considered within the appraised value of the subject property:

Description	Array #1	Array #2	Array #3
KW	8		
Age of Panels	3		
Energy Production Kwh per Array	30,244		
Source for Production	Inverter		
Location (Roof, Ground, Etc.)	Roof		
If Roof/Slope for Array	5/12 (22.6)		
Azimuth per Array	170		
Age of Inverter(s)	3		
Name of Utility Company:	Edison	Cost per Kwh charged by Company: $ /Kwh	0.08

Solar Resource Calculation	
Zip Code	60625
System Size in Watts	8,000
Derate Factor (online calculator)	0.770
Module Degradation Rate	0.5
Array Type	Fixed
Array Tilt (unchecked = latitude)	22.6
Array Azimuth (default = South)	180
Calculate PV Production	kWh Produced/Year
	9,194

System Age and Remaining Lifetime	
Module Warranty/Years	25
Age of System/Years	3
Remaining Energy/Years	22



*Representative Example

Future Work

- Validate model with sales data. Partnering with Lawrence Berkeley Natl. Lab, Solar Power Electric™, Appraisal Institute, national mortgage lenders
- Incorporate additional interest rates
- Incorporate microinverter costs
- *Include system demand data*
- *Convert spreadsheet into web application for next version. Viewable with iPhone, iPad, Android*
- *Integrate utility data from OpenEI, including time of use rates*

Thank you for Attending

Please address questions to driley@sandia.gov

We will take this time to any questions you may have

Sandia National Laboratories

Additional questions can be directed to:

Geoff Klise – gklise@sandia.gov

Jamie Johnson – jjohnson@spefl.com

A recording of this webinar and power point slides will be available at:
http://energy.sandia.gov/?page_id=2727

Appraisal Institute Residential Green and Energy Efficient Addendum:
http://www.appraisalinstitute.org/education/green_energy_addendum.aspx