



**ASA-LA and SCCAI
Annual Joint Dinner
Common Sense Solar**

**Solar Photovoltaic System,
Valuation and Leasing
Overview**

James Finlay, MRICS

May 12, 2015

Presentation Overview

- Global solar PV growth, market view
- Solar PV and market valuation research
- Ownership Options : buy or lease
- Valuation of owned systems
- My solar PV experience
- Basic lease clause variables

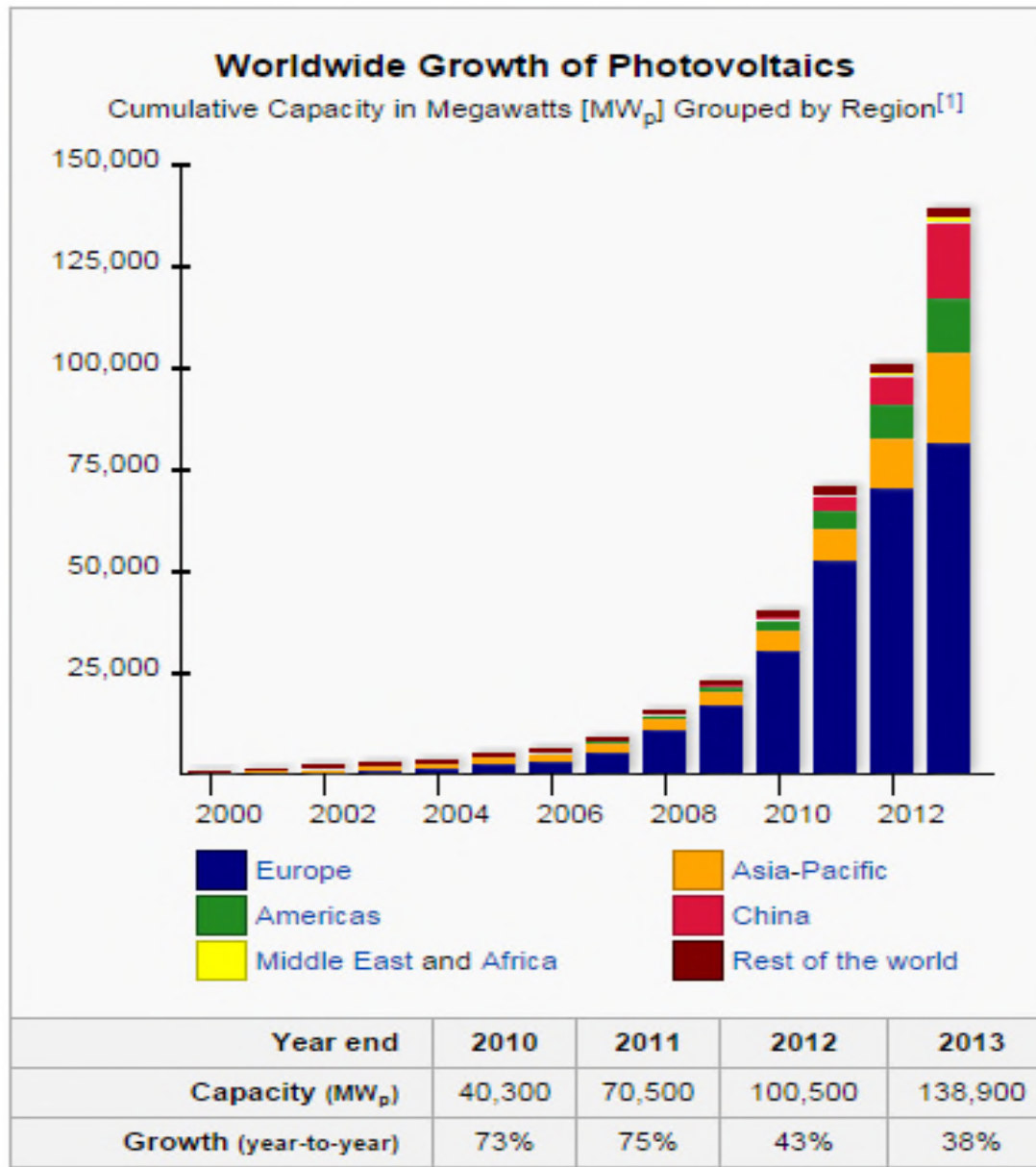


Solar PV Market Overview

- Dramatic global growth of solar PV
- Driven by dropping installed costs
 - solar panels , system installation
- Large utility grade systems and smaller building mounted systems
- NEM (Net Energy Metering) Aggregation or Aggregated Net Metering

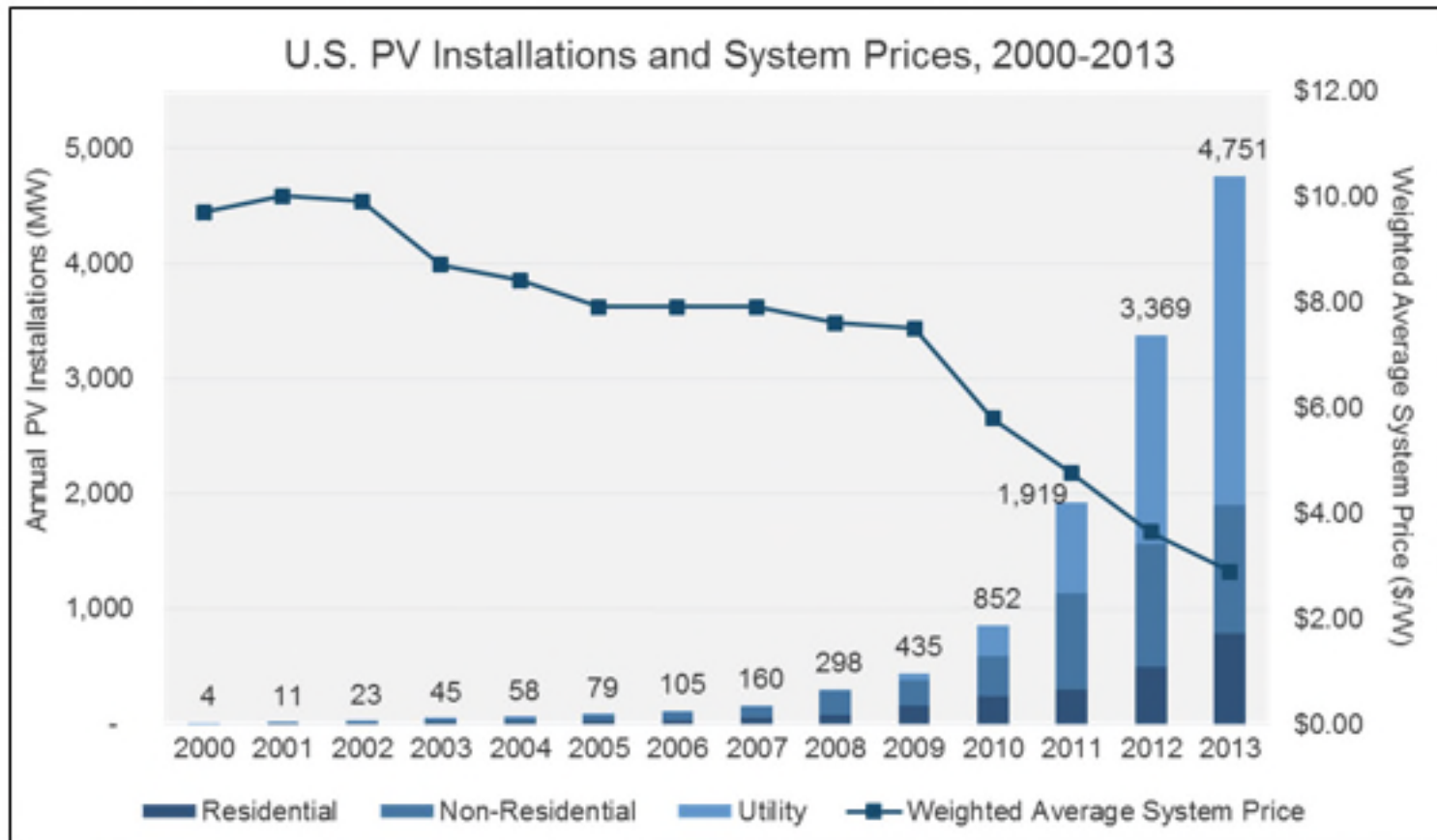


Worldwide growth



US Solar PV growth

FIGURE: U.S. PV Installations and Average System Price, 2000-2013



Source: *GTM Research/SEIA U.S. Solar Market Insight: 2013 Year-in-Review*

Citi GPS report



ENERGY DARWINISM

The Evolution of the Energy Industry

Citi GPS: Global Perspectives & Solutions

October 2013



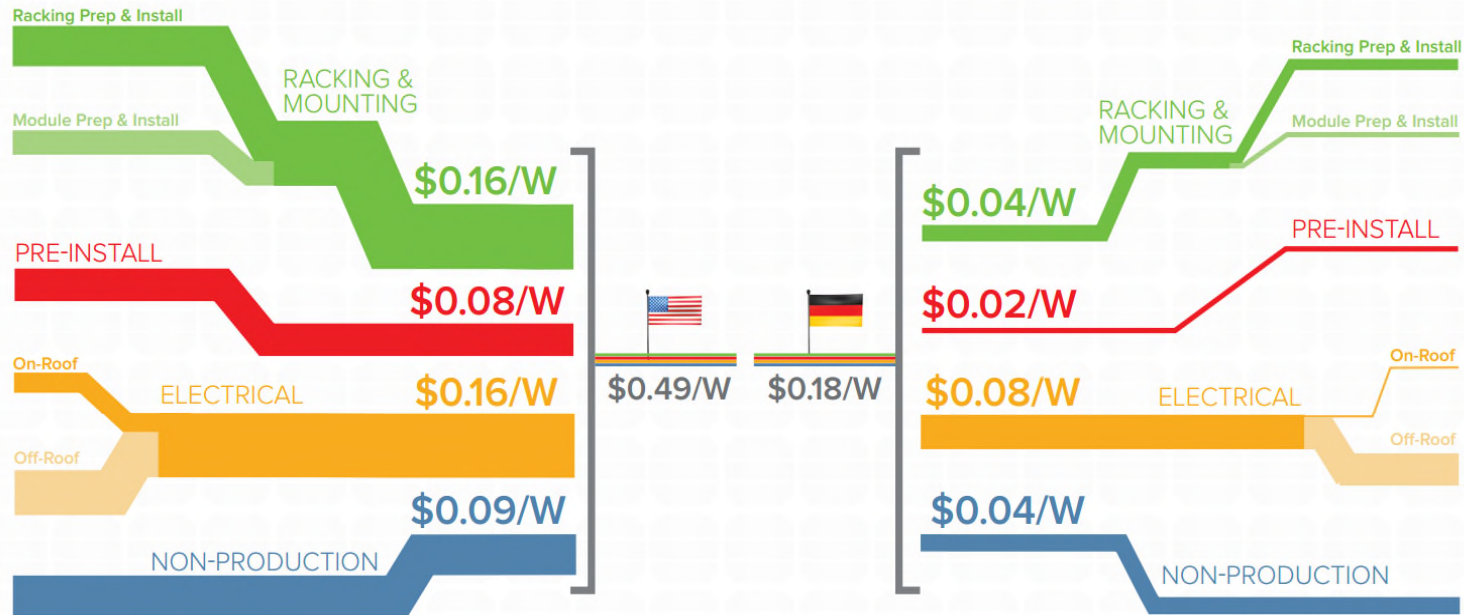
Jason Channell
Sofia Savvantidou

Heath R Jansen
Edward L Morse

Alastair R Syme
Anthony Yuen

US vs Germany solar PV install cost

FIGURE ES1: U.S. AND GERMAN ROOFTOP INSTALLATIONS COMPARED



PRE-INSTALL

- Travel*
- On-Site Prep
- Off-Site Prep*

RACKING & MOUNTING

- | | |
|-----------------------------------|----------------------------------|
| Racking Prep & Install | Module Prep & Install |
| Base Prep | Module Prep |
| Rail Prep | Module Attach |
| Base Attach | |
| Rail Attach | |
| Other Hardware Install | |

ELECTRICAL

- | | |
|-----------------------|---|
| On-Roof | Off-Roof |
| Homerun Install | Electrical Equipment & Inverter Install |
| Grounding Install* | Conduit Install |
| Combiner Box Install* | Disconnect Install* |

NON-PRODUCTION

- Meals & Breaks
- Clean-up
- Unavoidable Delay
- Avoidable Delay

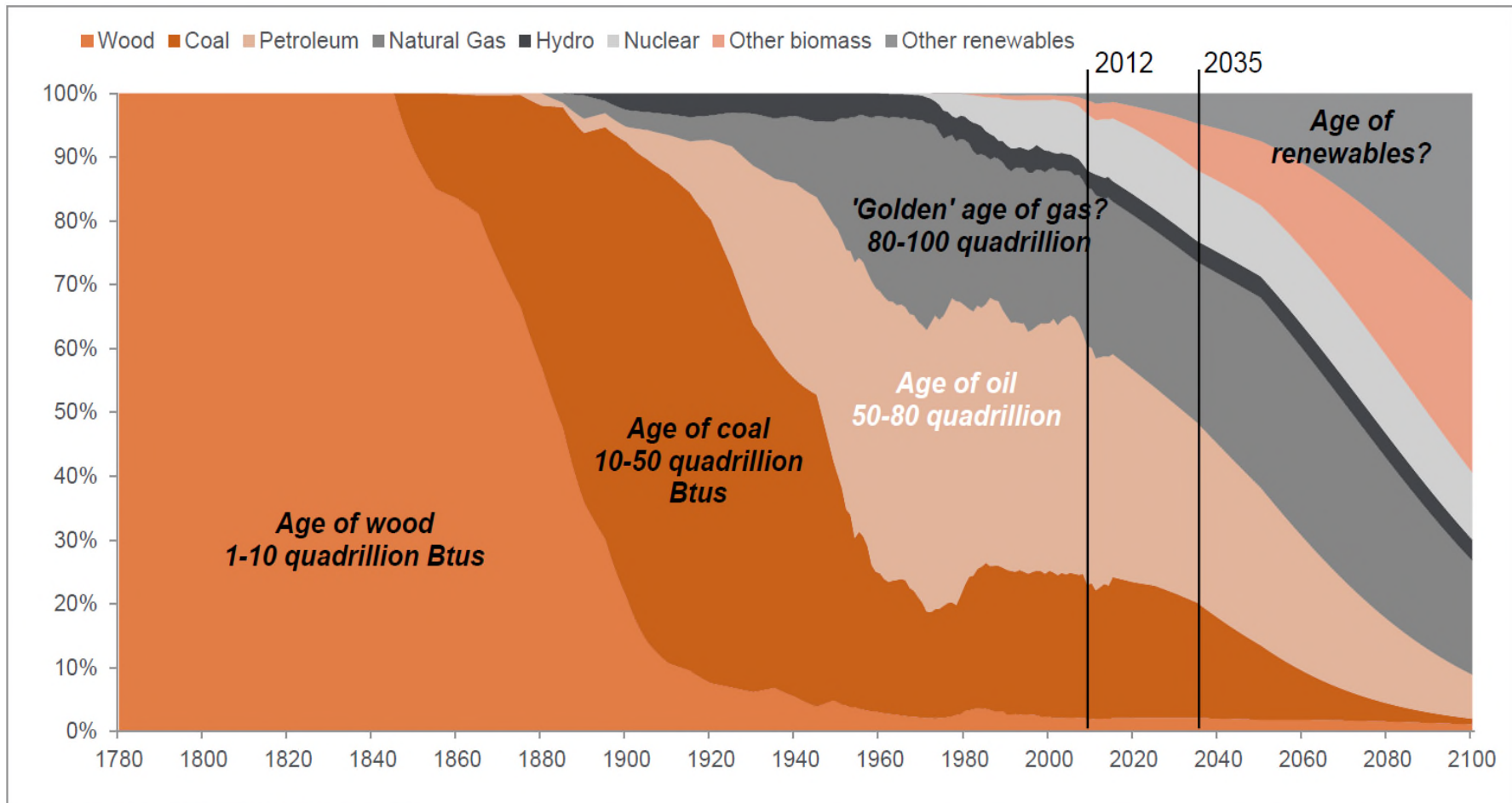
*denotes U.S. only



Reducing Solar PV Soft Costs
Rocky Mt Institute, Georgia Tech Research Inst, December 2013

Fuel Transition History

Figure 4. The ages of energy: History suggests a process of substitution

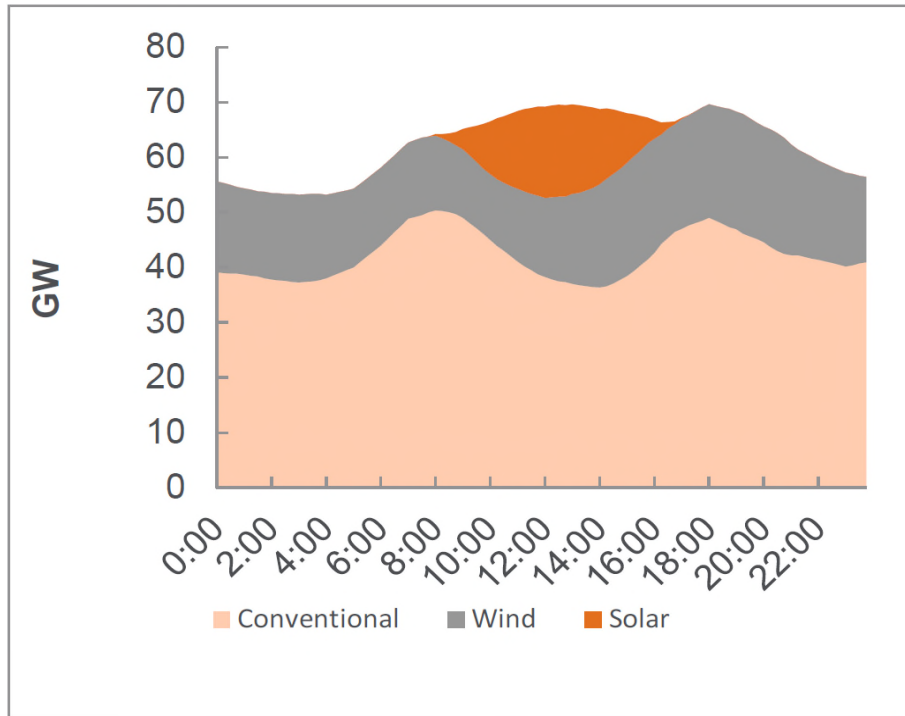


Source: IEA, EIA, Citi Research

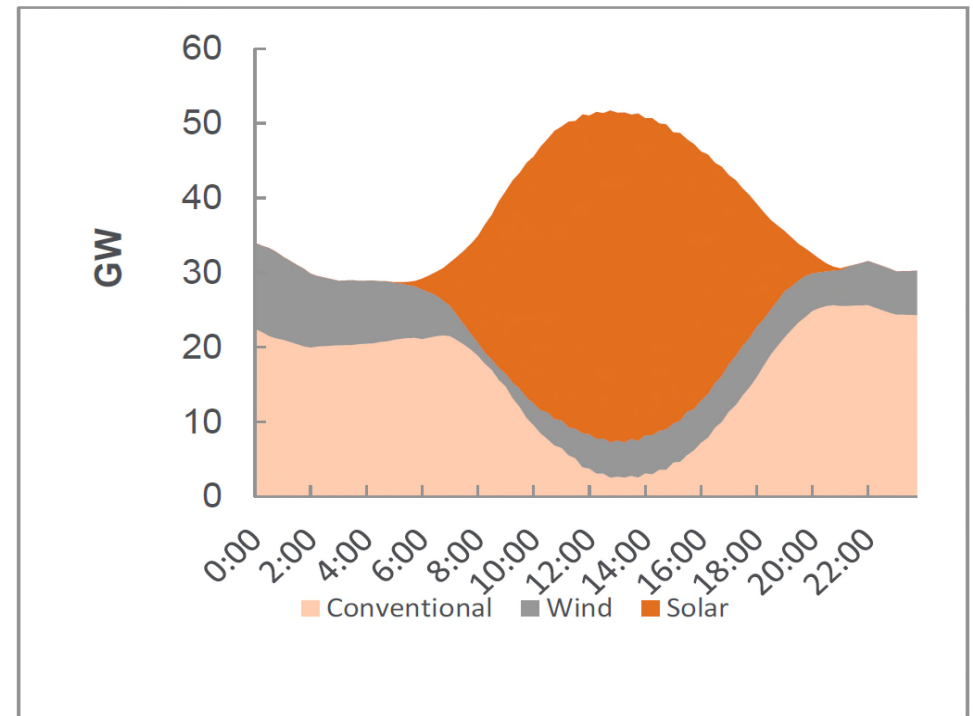
Energy Darwinism – The Evolution of the Energy Industry, Citi GPS: Global Perspectives & Solutions, Jason Channell, et al , October 2013

Solar PV disruption of baseload: Germany

Assumes double current wind and solar



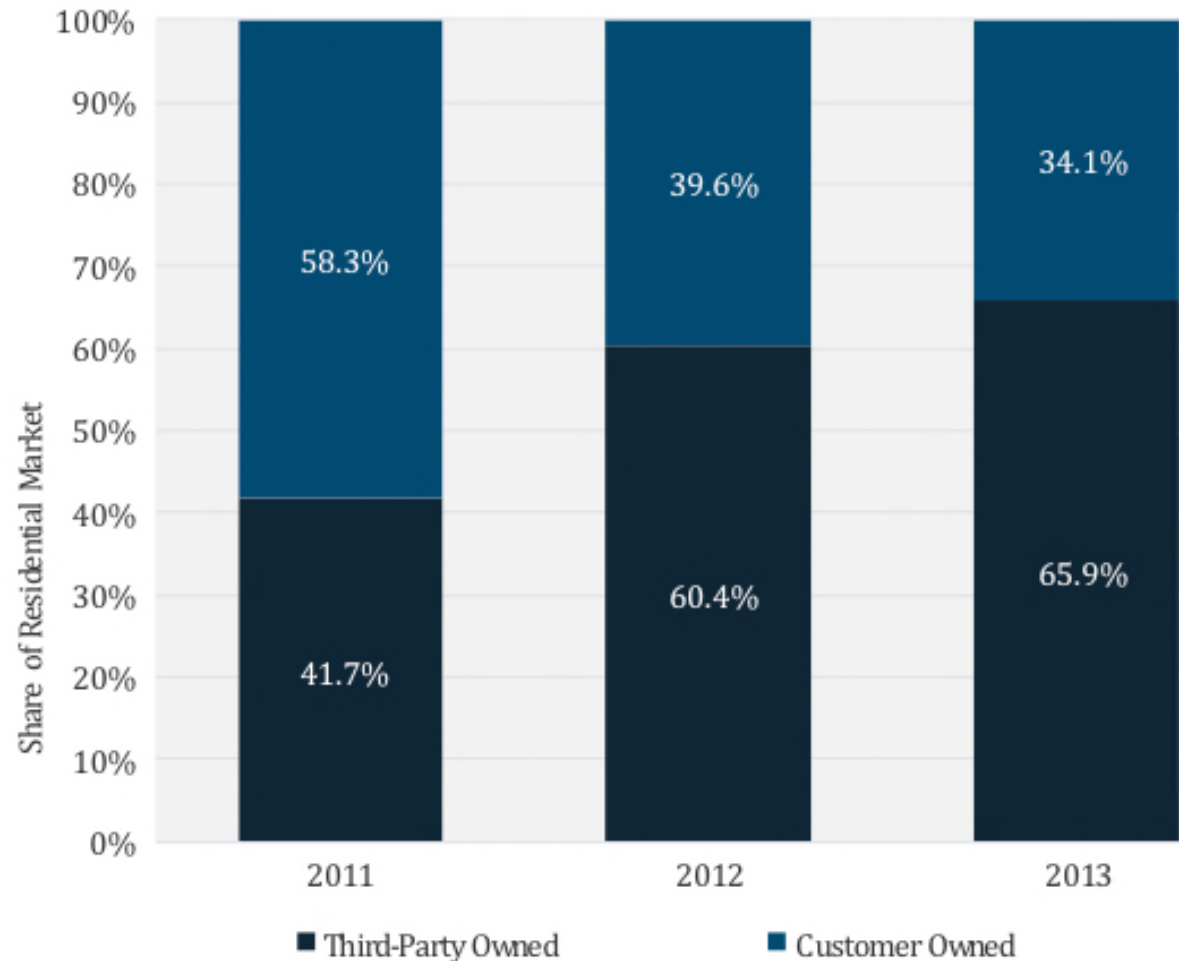
Winter workday Feb 2/2012



Sunny weekend May 26, 2012

Customer Owned vs 3rd Party Owned

FIGURE: National Share of Third-Party vs. Customer-Owned Residential Solar




Source: GTM Research

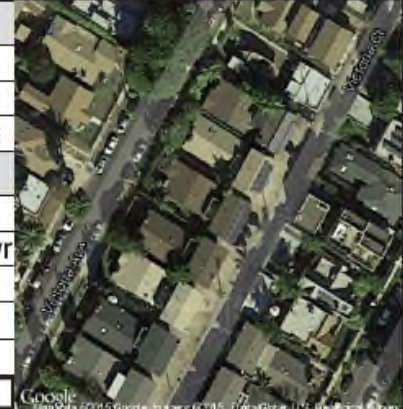
U.S. Residential Solar Financing 2014-2018, JUNE 24, 2014

Traditional DCF solution

Project title: Student housing				Annual Cash flow - Without Depreciation (all cash, no debt)					Annual Savings		Total	Annual Net			
City, State, Zip: Small college town, CA 90001									Simple Sum	Yr of	NPV	Multiplier	Cash back	Savings	
				Depreciation	Solar Output	Price per	Energy Cost	Expenses	Annual	Simple	NPV	Multiplier	plus	Multiplier	
				Cash Out	Tax Benefit	kWh/yr	kWh	Offset	Cash flow	Reversion	Value	NPV	Reversion	Value at Sale	
Annual Solar PV output year 1				233,859	kWh										
Average kWh utility rate				\$0.22240	/kWh										
Solar PV savings year 1 Pro Forma				\$52,010	year one										
Annual est. electricity rate increase				3.0%	/year										
kW DC output				172.02	kW										
Gross Cost of PV System				\$673,712											
Net Cost of PV System after rebates				\$465,450											
CPI cost escalator				3.0%											
Inverter Cost per kW				\$711											
Solar panel output decrease per year				-0.5%	per year										
System maintenance cost factor															
maint. Factor				0.25%	Gross sys cost	\$673,712	Annual maint est	\$1,684							
inflation / CPI				3.0%											
Inverter Replacement cost calculation															
1.00% annual inverter price change															
3.00% CPI															
-0.5% PV output change															
kW DC inverter input					cost per kW DC										
1	172.02	\$711.00	\$122,306												
2	171.16	\$718.11	\$122,912												
3	170.30	\$725.29	\$123,517												
4	169.45	\$732.54	\$124,129												
5	168.60	\$739.87	\$124,742												
6	167.76	\$747.27	\$125,362												
7	166.92	\$754.74	\$125,981												
8	166.09	\$762.29	\$126,609												
9	165.26	\$769.91	\$127,235												
10	164.43	\$777.61	\$127,862												
11	163.61	\$785.39	\$128,498												
12	162.79	\$793.24	\$129,132												
13	161.98	\$801.17	\$129,774												
14	161.17	\$809.18	\$130,416												
15	160.36	\$817.27	\$131,057												
16	159.56	\$825.44	\$131,707												
17	158.76	\$833.69	\$132,357												
18	157.97	\$842.03	\$133,015												
Sinking fund replacement cost															
Yearly Rate of Return				4.0%											
Yr 30 Replacemnt term in years				\$0											
Annual pmt				\$0											
NPV remaining energy savings															
Net Present Value starting in Year 1				\$134,203											
Net Present Value starting in Year 2				\$562,747											
Net Present Value starting in Year 6				\$576,243											
Net Present Value starting in Year 9				\$574,377											
Net Present Value starting Year 13				\$547,158											
Annual Savings Multiplier															
Net Saved Multiplier				\$50,326	Year 1										
10				\$503,260	\$500,000										
11				\$553,586	\$550,000										
13				\$654,238	\$650,000										
18				\$905,868	\$910,000										
20				\$1,006,520	\$1,010,000										
Simple Direct Capitalization															
Effective Savings Yr 1				\$52,010											
Maintenance				-\$1,684											
Net Annual Savings				\$50,326											
OAR - Cap Rate				7.00%											
Value of solar PV				\$718,943											
Rounded				\$719,000											
DCF Assumptions, Remarks															
Discount rate				10.00%											
Inverter replacement in year 15															
Maintenance costs escalate per CPI															
End of life reversion = 0, no equipment replacement															
Value Conclusions															
Net-Effective Cost				\$560,000	with profit										
DCF Year 2				\$560,000	10.00%										
Direct Cap Year 1				\$719,000	7.00%										
Annual Savings Multiplier				\$705,000	14										


Owned PV Systems

		Beta Version 0.8.1	File #:	Appraiser Indicated Value:	\$8,236.80	\$2.64 /watt
		05/07/15 12:18:43 AM	NA	Report Prepared By:	James Finlay	
Subject Property Data						
Address:	612 Victoria Ave					
City:	LA	State:	CA	Zip Code:	90291	
Property Type:	Residential	PV Project Type:	Existing	PV Ownership:	Owned	
Cost Approach Method Physical Age / Life Depreciated Cost						
Source:	ESF 5-7-15 CA	Gross Replacement Cost New:	\$0.00	\$0.00 /watt		
Life:	25	Straight Line Depreciation:	\$0.00	\$0.00 /watt/yr		
Age:	3	Accumulated SL Depreciation:	\$0.00	\$0.00 /watt		
Additional Depreciation:	None		\$	\$ /watt		
Additional Depreciation:	None		\$	\$ /watt		
Estimated Depreciated Value	Cost Approach:	\$0.00	\$0.00 /watt			
Income Approach Method Energy Value DCF						
Solar Resource		O & M Expense		Utility Rate		
System Size Watts:	3,120	Inverter Size Watts:	4,000	NREL Utility Co:	Los Angeles Dept of Water & Power	
Module Warranty Yrs:	25	Inverter Warranty Yrs:	15	NREL Utility Rate:	13.03 ¢/kWh	
System Age Yrs:	3	Inverter Age Yrs:	3	User Provided Utility Rate:	14.58 ¢/kWh	
Remaining Yrs:	22	Inverter Replaced:	No	Utility Rate Used:	14.58 ¢/kWh	
Derate Factor:	0.77	Inverter Replacement Cycle Yrs:	15	EIA Escalation Rate:	2.06% CAGR	
Degradation Rate:	0.50%	Inverter Replacement Cost		User Provided Esc Rate:	- % CAGR	
Array Tilt:	14 °	Survey Data:	75 ¢/W	Escalation Rate Used:	2.06% CAGR	
Array Azimuth:	120 °	User Provided:	- ¢/W	Comments:		
Annual kWh Est:	4,165	Replacement Cost Used:	75 ¢/W			
		O & M Exp (future):	\$2,340.00			
		O & M Exp (discounted):	\$1,334.68			
Cost of Capital						
WACC Used + Risk Premium = Discount Rate →				Estimated Energy Value / Income Approach		
Fannie Mae Date:	May 6, 2015	200 Basis Points	5.54%	\$7,640.74	\$2.45 /watt	
Fannie Mae Rate:30 Yr90 day	3.54%	125 Basis Points	4.79%	\$8,241.99	\$2.64 /watt	
User Provided Interest Rate:	- %	50 Basis Points	4.04%	\$8,908.93	\$2.86 /watt	




<https://www.pvvalue.com>

Appraisal Institute

 <p>Form 821*</p>	Client File #:		Appraisal File #:	
	<h2>Commercial Green and Energy Efficient Addendum</h2>			
	Client:			
	Subject Property:			
	City:		State:	Zip:
<p>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</p>				

The appraiser hereby acknowledges 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
- 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

 <p>Form 820.04*</p>	Client File #:		Appraisal File #:	
	<h2>Residential Green and Energy Efficient Addendum</h2>			
	Client:			
	Subject Property:			
	City:		State:	Zip:
<p>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</p>				

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

Selling Into the Sun:

Price Premium Analysis of a Multi-State Dataset of Solar Homes

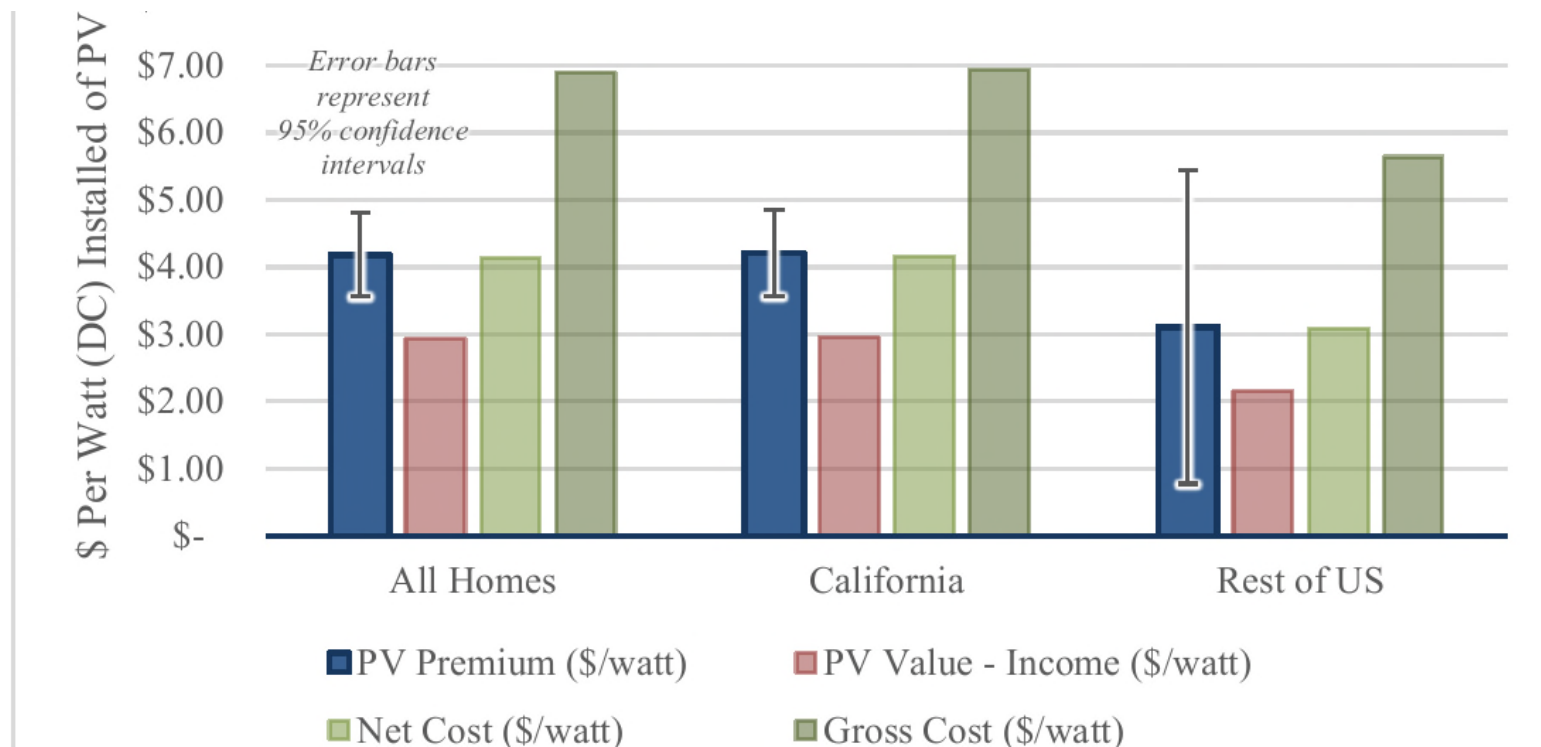
Ben Hoen, Sandra Adomatis, Thomas Jackson, Joshua Graff-Zivin,
Mark Thayer, Geoffrey T. Klise, Ryan Wiser

Lawrence Berkeley National Laboratory



Recent Landmark Solar PV home value Impact Study

- Lawrence Berkeley National Labs
- 3,951 homes with solar, eight states
- New home and existing homes same value
- Net cost best proxy for value, also income



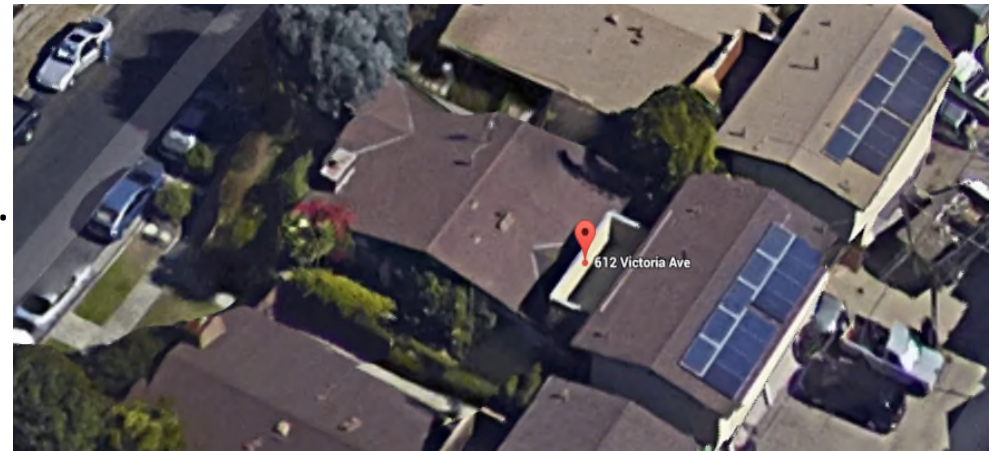
My System

100% Prepaid lease, 3.12kW system

- 1Block Off the Grid vendor / SolarCity installer, maintenance
- Went into operation October 11, 2012, pre-paid 20 year lease
- \$2,312 (including \$50 discount), \$500 credit or (iPad)
- 3 friends @ \$400 = \$1200 ; plus \$400 allocation roof replacement
- Net system cost to me today \$1,012

Operation

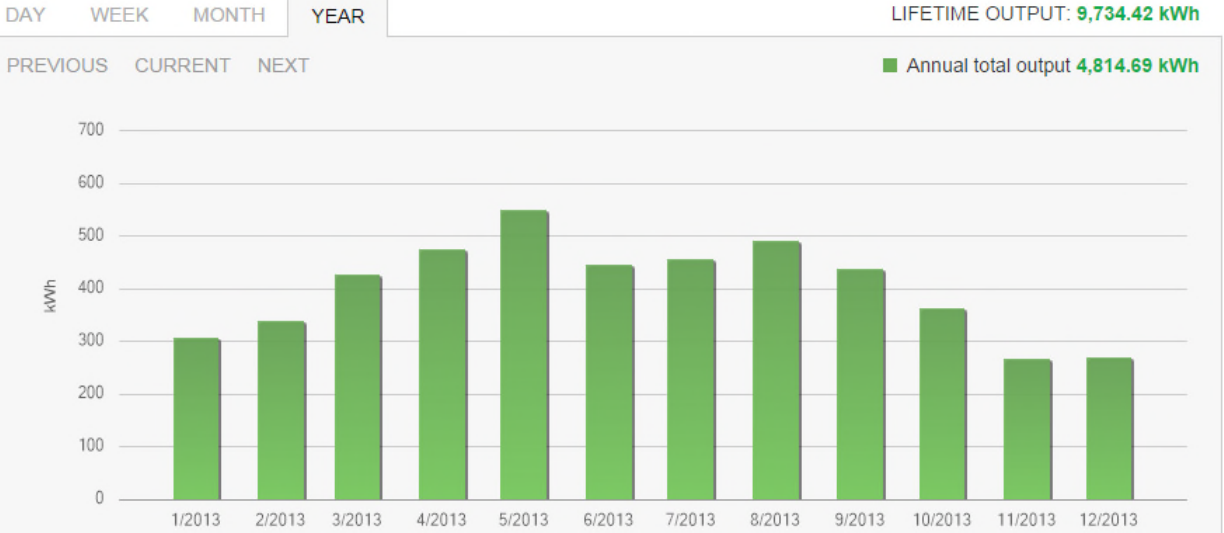
- Low electricity use, about \$70/mo.
- Killed phantom loads
- switched from Tier to Time of Use
- Tilt check for energy and \$ output
- I clean panels every 3 months (14% loss from dust @ 6 months)
- SolarCity monitors output, repairs including inverter replacement



Solar PV Sample Reports – My House

2013

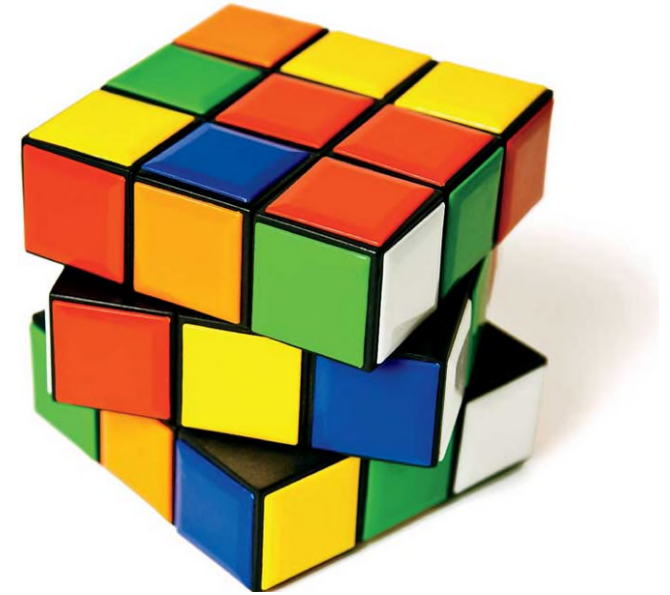
612 Victoria Ave, #A Venice - 3.120 kW



Solar PV Lease Clause Variables

Lease Payment variables

- Lease Term
- Day One initial payment
- Lease payment start rate
- Lease payment escalation rate
- Lease payment duration
- Lessee credit score



Energy cost off-set assumptions

- Electricity market price estimate at commencement date
- Electricity rate escalation rate

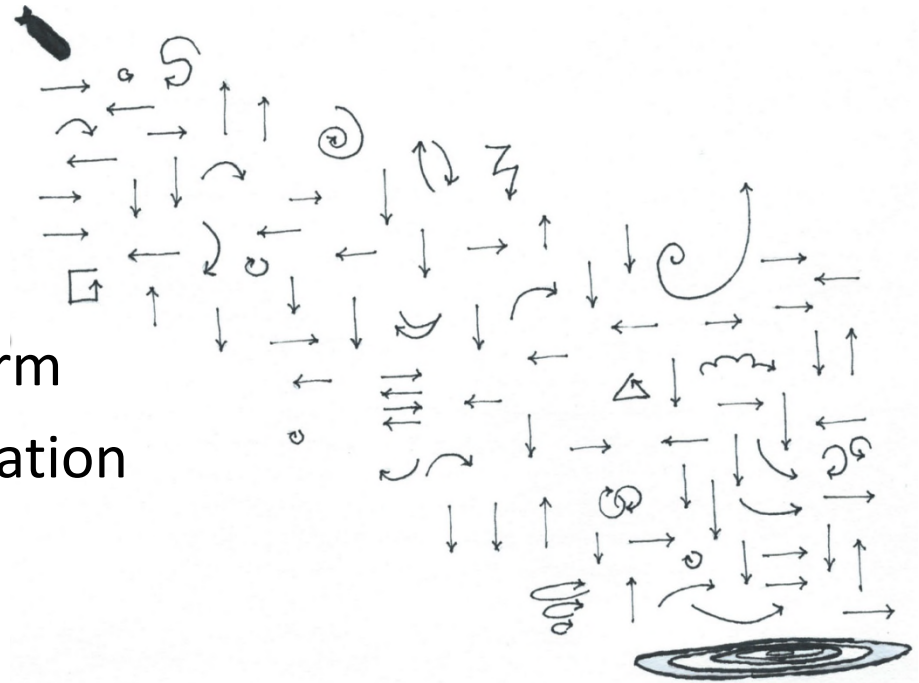
Solar PV Lease Clause Variables

Maintenance & Operations

- Maintenance, repairs – by array owner
- Inverter replacement (year 15) – by array owner but going away due to panel mounted micro inverters
- Output monitoring, reporting, analysis – provided by array owner
- Solar PV output assumptions

Lease termination

- Buyout option during lease term
- Buyout option at lease termination

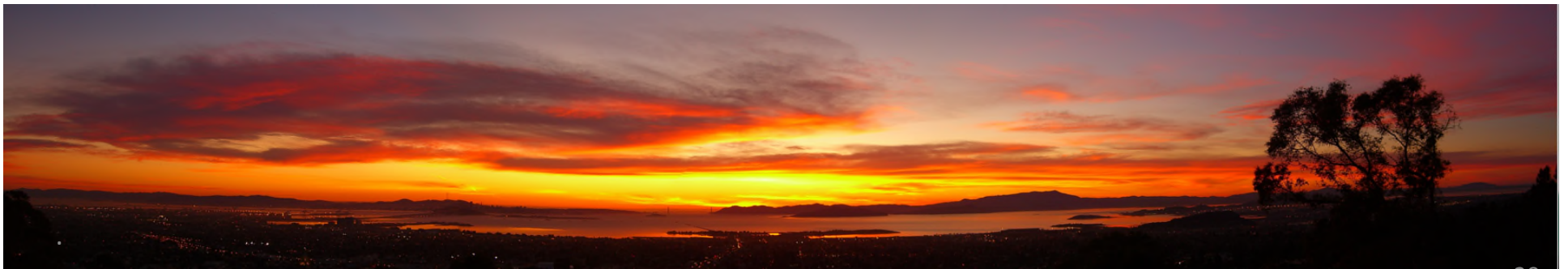


Solar PV Lease Variables

- Discount rate – negatively impacted by added risk layer of lease
- Solar PV OAR – direct cap not applicable due to erratic NOI
- Average annual subject \$/kWh : impacted by local utility pricing
Tier vs. TOU (Time of Use) pricing

Also:

- Solar PV is a wasting asset – value decreases with time
- SREC [Solar Renewable Energy Certificate] – retained by array owner
- Accelerated depreciation – tax deduction retained by array owner
MACRS –Modified Accelerated Cost Recovery System



Solar PV Leases – Other Variables

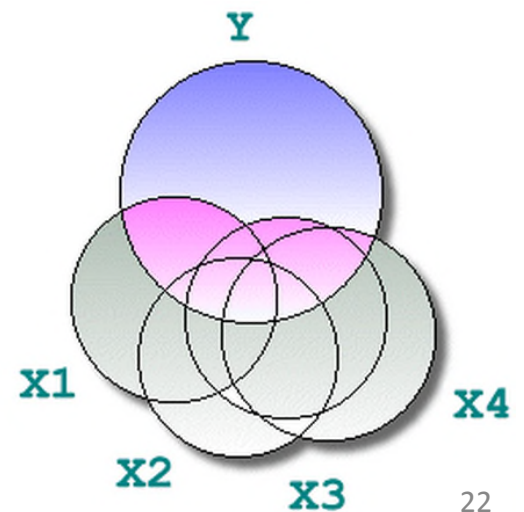
Other Risks, Conditions, Lease Options

- Roof condition – remaining life must be sufficient
- Transfer to new building owner – saving documentation
- Rooftop only rental – someone else owns, controls PV array; utility
- Solar PV PPA (Power Purchase Agreement)
 - electricity costs pre-determined, obligation to buy 100% of power
- Solar PV lease scams, fraud – high quality installer team
- Lease Alternatives :
 - PACE (Property Assessed Clean Energy) - lease alternative
 - On-Bill Repayment [OBR] – repay loan on utility bill

Solar PV Market Value

Conclusion: *It's complicated !!*

- Global solar PV growth will continue
- Simple DCF analysis OK by competent appraisers
- Complex analysis better by expert 3rd parties
- Buy vs lease option are complicated
- More market research data all the time



Thank you !

James Finlay, MRICS

PDCWeb

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Venice, CA 90291

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310-821-8111



Solar PV - Future Risks, Opportunities

- Battery storage, electric car charging
- Load reduction
 - LED lighting, lighting controls, induction ranges
- Load Management, demand response
- Building performance management systems
 - Net Zero & beyond energy – water, waste, IEQ, carbon
- Resiliency: microgrid, nanogrid (<100kW or <5kW remote)
 - distributed generation (on all the time) vs back-up power