GOING SOLAR IN AMERICA:

Ranking Solar's Value to Consumers in America's Largest Cities

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DISCLAIMER

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INTRODUCTION & EXECUTIVE SUMMARY

Most Americans are unaware of the true financial value of solar today. Seen by many as a technological luxury, solar energy is not seriously considered as an option by most homeowners in the U.S. However, our analysis shows that, in 46 of America's 50 largest cities, a fully-financed, typically-sized solar PV system is a better investment than the stock market, and in 42 of these cities, the same system already costs less than energy from a residential customer's local utility. Of the single-family homeowners in America's 50 largest cities, *we estimate that **9.1 million*** already live in a city where solar costs less than their current utility rates if they bought a PV system outright – and ***nearly 21 million*** (93% of all estimated single-family homeowners in those cities) do if low-cost financing is available.

So why aren't more Americans investing in solar? There is a clear information gap, and with this report, we intend to open the eyes of average homeowners by showing that solar can generate both significant monthly savings and long-term investment value, and not infrequently, cost less than energy from some of America's largest electric utilities. What's more, it is our hope that people will come away realizing that solar is now not just an option for the rich, but a real opportunity for anyone looking to take greater control over their monthly utility bills and make a long-term, relatively low-risk investment.

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EXECUTIVE SUMMARY: OVERALL CITY RANKINGS

#	CITY	#	CITY	#	CITY
1	New York, NY	18	Colorado Springs, CO	35	Milwaukee, WI
2	Boston, MA	19	El Paso, TX	36	Wichita, KS
3	Albuquerque, NM	20	Miami, FL	37	Sacramento, CA
4	San Jose, CA	21	Baltimore, MD	38	Portland, OR
5	Las Vegas, NV	22	Tucson, AZ	39	Nashville, TN
6	Washington, DC	23	Mesa, AZ	40	Jacksonville, FL
7	Los Angeles, CA	24	San Antonio, TX	41	Columbus, OH
7	San Diego, CA	25	Detroit, MI	42	Seattle, WA
9	Oakland, CA	26	Denver, CO	43	Virginia Beach, VA
10	San Francisco, CA	27	Minneapolis, MN	44	Memphis, TN
11	Phoenix, AZ	28	Chicago, IL	45	Cleveland, OH
12	Long Beach, CA	29	Kansas City, MO	46	Indianapolis, IN
13	Fresno, CA	30	Austin, TX	47	Omaha, NE
14	Philadelphia, PA	30	Raleigh, NC	48	Oklahoma City, OK
15	Arlington, TX	32	Atlanta, GA	49	Tulsa, OK
15	Dallas, TX	33	Houston, TX	50	Louisville, KY
15	Fort Worth, TX	34	Charlotte, NC		

In order to characterize how good of an investment solar PV is in America's 50 largest cities, we designed a ranking system based on a 0-30 point scale that scored each city on the following factors (for a 5 kilowatt, or kW, system):

- The immediate (first-year) average monthly savings (before a loan payment) customers could expect (10 pts);
- The relative value of investing in solar relative to a long-term investment indexed to the Standard and Poor's (S&P) 500 stock index (10 pts); and
- The "levelized cost" of the system, which can be compared to the cost of energy from a customer's local utility (10 pts).

We then ranked the cities (seen at left) based on their score, which was tied to their percentile ranking within each category.

PART I: SOLAR PV TODAY: POLICY AND MARKET DRIVERS IN AMERICA'S LARGEST CITIES

SOLAR PV TODAY: RESIDENTIAL CUSTOMERS' RATES & BILLS

While many states "deregulated" their energy markets in the 1990s, other regions chose to keep their utilities fully regulated and vertically-integrated. Since vertically-integrated utilities (particularly those in the South, Southeast and Midwest) can put more assets into the broader pool that they are allowed to recover in full from their customers through rates (called a "rate base"), they tend to build a significant amount of infrastructure upfront. In addition, even though a major tenet of utility regulation is to balance fair rates with reliable service *and* energy conservation*, utility regulators tend to push for residential rates at (what might be considered to be) artificially low levels relative to the utility's true costs.

Surprisingly, however, this practice tends not to protect the interests of residential customers, nor does it encourage more efficient use of energy. As the chart to the upper right shows, data from the U.S. Energy Information Administration (EIA) shows that customers in regions with the lowest rates tend to use the most energy and pay the highest monthly bills. This data strongly suggests that maintaining lower rates does not have the desired effect of consumer protection, or of promoting efficient energy use.

*See Bonbright, J. *Principles of Public Utility Rates.* (1961). Available at: http://media.terry.uga.edu/documents/exec_ed/bonbright/principles_of_public_utility_rates.pdf

Residential Electricity Usage and Cost/kWh by Region (2012)

Region	*Average Price (cents/ kWh)*	*Avg. Monthly Usage (kWh)*	*Avg. Monthly Bill ($)*	*Average Prices Relative to U.S. Average*	*Monthly Bill Relative to U.S. Average*
South Atlantic	11.4	1,079	$123	*Below*	**Above**
East South Central	10.3	1,185	$122	*Below*	**Above**
West South Central	10.3	1,171	$121	*Below*	**Above**
U.S. Average	11.9	903	$107	Exactly Average	
Middle Atlantic	15.3	701	$107	**Above**	*Below*
West North Central	10.6	942	$100	*Below*	*Below*
New England	15.7	634	$100	**Above**	*Below*
East North Central	12.0	803	$97	**Above**	*Below*
Mountain	10.9	874	$96	*Below*	*Below*
Pacific Contiguous	12.9	684	$89	**Above**	*Below*

Source: EIA Form 861 (2012 is most recent full year of vetted data)

Contrary to popular belief, customers in regions with lower utility rates than average ***tend to pay higher monthly bills than average.***

SOLAR PV TODAY: A TOOL TO OFFSET RISING RATES

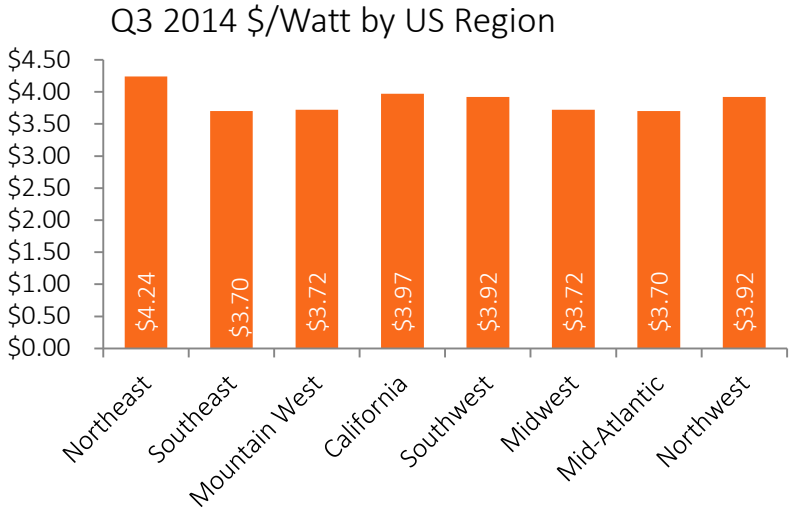
Selected Examples of Solar PV's Monthly Energy Usage (kWh) Offset Potential by City			
City	*Avg. Solar Production*	*Avg. Usage (kWh)*	*% "Offset" by Solar*
Fresno	660	832	79%
Boston	567	761	75%
Chicago	536	775	69%
Phoenix	735	1,077	68%
Raleigh	598	1,073	56%
Source: Calculations Using a 5 kW System on a "base" electricity usage home in each area using the NREL System Advisor Model			

To compound the high monthly utility bills customers pay now, it is very likely that customer bills will continue on a steeply increasing trajectory. As the map to the left shows, the EIA also forecasts that utility rates will rise between 33%-83% over the 25-year typical life of a solar PV system.

Many customers still mistakenly believe, however, that solar PV is not an option for them. This stems, in part, from a belief that they may not be able to afford it, and because their area does not have enough sunshine year-round. In fact, solar PV's value to a customer tends to be most closely related to the degree to which solar can offset their *typical use of grid energy*.

It may seem surprising, but as the table to the lower left shows, customers with a 5 kW system in Chicago and Boston, (known more for their extended cold, grey winters than for sunshine) can offset more of their energy (and thus their bill) than they could in Phoenix, a location with some of the best solar resource in the United States.

SOLAR PV TODAY: SHARPLY DECLINING HARDWARE COSTS



Data from EnergySage, 2014

Most importantly for rooftop solar economics, however, has been how rapidly the cost of residential solar PV has declined. According to *Tracking the Sun VII**, the most comprehensive and authoritative public report on solar pricing, the Lawrence Berkeley National Laboratory (LBNL) found that the median cost of residential solar has gone from approximately $12/Watt (W) in 1998 to about $4.70/W in 2013. These reductions have been driven by declines in the cost of manufacturing the "hardware" of a solar PV system.

Today, data from the online solar marketplace EnergySage reveals that the average cost of a 5 kW rooftop system (pre-incentives) in the third quarter of 2014 ranged from about $3.70/W to $4.24/W.

When the declining cost of solar is coupled with the rising cost of grid electricity, the financial case for solar (given the strong odds of future rate increases) can be quite persuasive, particularly for locales with higher than average electricity rates, such as California and the Northeast.

As we will describe in greater detail later, our analysis already shows that the average levelized cost of energy (LCOE) for a fully financed solar system in the country's largest cities ranges from only 3.1 cents/kWh to 14.4 cents/kWh. LCOE can be compared to a utility's electric rates to see how the cost of generating power from a solar array compares to the cost of buying it from the utility.

*The median cost of a solar PV system prior to incentives has declined from $12/W installed in 1998 to around $4.70/W installed in 2013, a 60%+ decline. By Q3 2014, **the price had declined even further to between $3.70/W-$4.24/W before incentives.***

*LBNL's Tracking the Sun VII is available at: http://emp.lbl.gov/publications/tracking-sun-vii-historical-summary-installed-price-photovoltaics-united-states-1998-20

SOLAR PV TODAY: POLICY & INCENTIVES

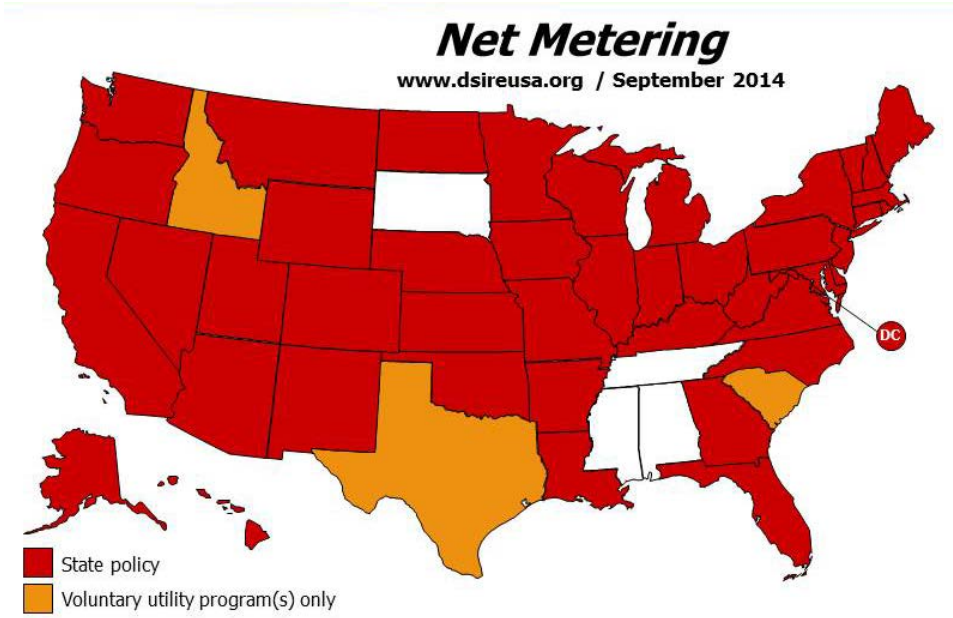
A major reason why these dramatic cost declines have resulted in more people investing in solar is the existence of supportive federal, state and local incentives and public policies. While some incentives are intended to "sweeten the deal" and jumpstart the local solar market, others are more basic policies that allow customer-generators to enter the market and receive a payment for the power they supply to the grid.

NET METERING

Net metering is one such policy that allows customer with solar PV systems to use the power that their system generates and receive a bill credit for unused excess power that is sent into the grid for other nearby customers to use.

"VALUE OF SOLAR" TARIFFS

An alternative policy that also allows solar PV owners to enter the market and receive a payment for the power they produce is a "value of solar" tariff. This special rate schedule lets PV owners sell all of the power generated by their system to their utility at a rate reflecting what the value of solar energy to the grid is determined to be. The PV owner then buys all of the power they consume from the utility.

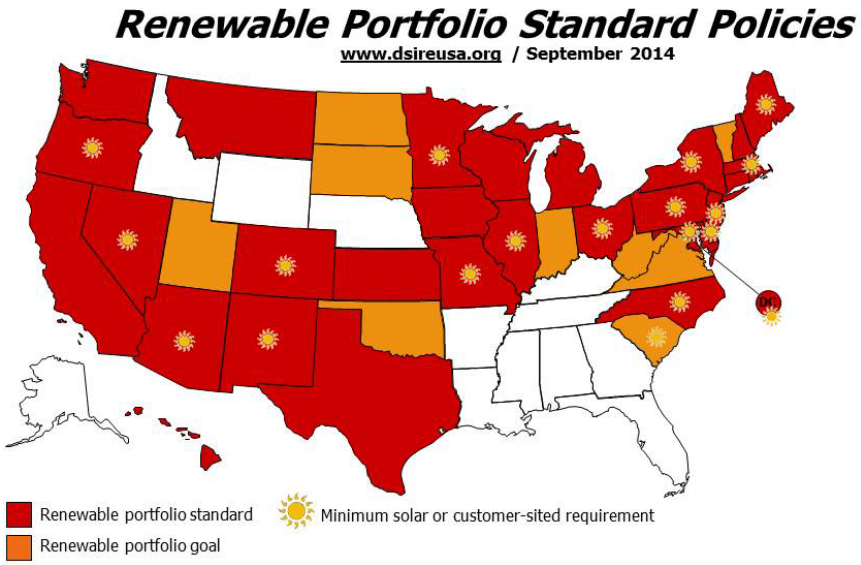


RENEWABLE PORTFOLIO STANDARDS & SOLAR CARVE-OUTS

As mentioned, other policies and incentives exist to spur solar market development. A renewable portfolio standard (RPS) is another policy type that more indirectly aids the solar market, by mandating that retail electricity suppliers obtain a certain percentage of their power from renewable sources.

Policies and incentives have played a major role in rooftop solar PV's success. ***For more information about solar PV policies and incentives, please visit*** *dsireusa.org*.

SOLAR PV TODAY: POLICY & INCENTIVES



Some states also include a solar "carve-out" in their renewable portfolio standards, requiring that a portion of the renewable generation requirement must come from solar exclusively.

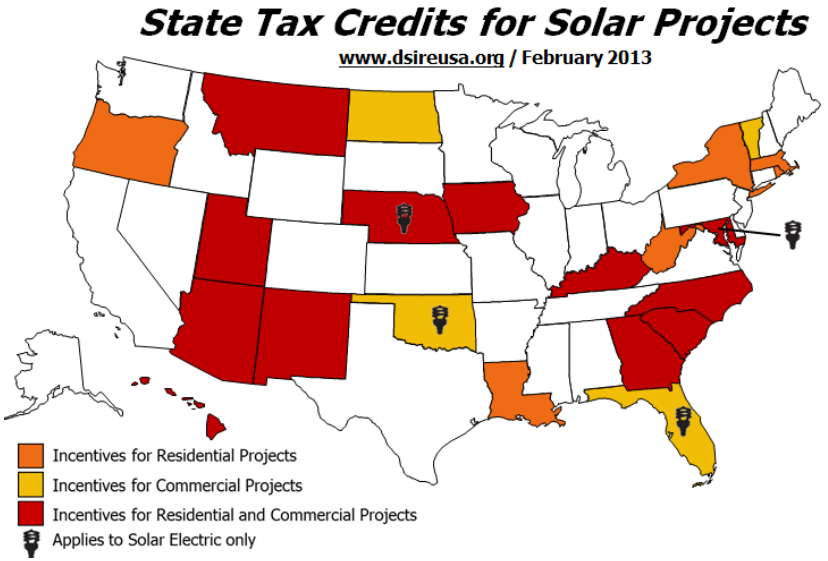
TAX INCENTIVES & REBATES

One type of incentive that helps bring down the upfront cost of solar is the Federal Investment Tax Credit, which provides an income tax credit equal to 30% of a solar PV system's installation costs. Some states also offer tax credits of varying amounts for solar PV installations.

Another type of incentive that is often available for solar is a state, local, or utility rebate. These incentives also help to either bring down the upfront cost of solar or increase the value of the energy produced. Some states also offer full or partial sales tax exemptions for solar energy equipment, as well as full or partial property tax exemptions.

AVAILABLE INCENTIVES IN AMERICA'S 50 LARGEST CITIES

The following pages contain a comprehensive list of incentives (many of which are derived from supportive policies like renewable portfolio standards). Each incentive identified in the table factored into our financial and economic analysis.



SOLAR PV INCENTIVES BY CITY (SOURCE: DSIREUSA.ORG)

City	Tax Credits (State)	Other Incentive (State)	Rebates/ PBIs (Utility)	Sales Tax Exemption	Property Tax Exemption
New York, NY	●	●		●	*
Los Angeles, CA			●		●
Chicago, IL		●			*
Houston, TX					●
Philadelphia, PA		●			
Phoenix, AZ	●			●	●
San Antonio, TX			●		●
San Diego, CA		●			●
Dallas, TX			●		●
San Jose, CA		●			●
Austin, TX			●		●
Jacksonville, FL			●	●	●
Indianapolis, IN			●	●	●
San Francisco, CA		●			●
Columbus, OH				●	●
Fort Worth, TX			●		●
Charlotte, NC	●				*
Detroit, MI			●		●
El Paso, TX			●		●
Memphis, TN			●	●	*
Boston, MA	●	●		●	●
Seattle, WA		●		●	
Denver, CO			●	●	●
Washington, DC					●
Nashville, TN			●	●	*

*Indicates Partial Exemption

City	Tax Credits (State)	Other Incentive (State)	Rebates/ PBIs (Utility)	Sales Tax Exemption	Property Tax Exemption
Baltimore, MD	●	●		●	*
Louisville, KY	●				
Portland, OR	●	●		No sales tax	●
Oklahoma City, OK					
Milwaukee, WI		●		●	●
Las Vegas, NV			●	*	
Albuquerque, NM	●		●	●	*
Tucson, AZ	●			●	●
Fresno, CA		●			●
Sacramento, CA			●		●
Long Beach, CA		●			●
Kansas City, MO			●		●
Mesa, AZ	●		●	●	●
Virginia Beach, VA			●		
Atlanta, GA			●		
Colo. Springs, CO			●	●	●
Raleigh, NC	●		●		*
Omaha, NE	●			●	
Miami, FL			●	●	●
Oakland, CA		●			●
Tulsa, OK					
Minneapolis, MN			●	●	●
Cleveland, OH					●
Wichita, KS					●
Arlington, TX			●		●

*Indicates Partial Exemption

PART II: SOLAR'S VALUE TO CONSUMERS IN AMERICA'S LARGEST CITIES

THE VALUE TO CONSUMERS: RANKINGS METHODOLOGY

Our rankings are based upon three major metrics, each weighted equally based on the following results for a 5 kW system in each city:

- Average monthly first-year savings;
- The net present value of investing in solar relative to a 25-year investment indexed to the S&P 500; and
- The levelized cost of energy (LCOE), adjusted for inflation.

Below is a description of how the score for each metric was calculated.

AVERAGE MONTHLY FIRST-YEAR SAVINGS

Each city was assigned a number corresponding to their percentile. This gave each city a number between 0 and 100. This number was then multiplied by 10 to give each city a score between 0 and 10.

NET PRESENT VALUE (NPV)

A score was given to each city for the NPV of a fully financed system (100% Finance) and of a system paid with cash upfront (0% Finance). As with monthly savings, each city was assigned a number corresponding to their percentile.

This number was then multiplied by 5 to give each city a score between 0 and 5 for both a 100% financed case and a cash upfront case.

LEVELIZED COST OF ENERGY (LCOE)

As with NPV, a score was given to each city for the LCOE of a fully financed system and of a system paid with cash upfront. Each city was first assigned a number corresponding to their percentile. One was then subtracted from this number in order to make it negative. This flipped the rankings in this category, as a lower value indicates a better value. This value was then multiplied by 5 to give each city a score between 0 and 5 for both the financed and cash cases.

	Monthly Savings Score	(0-10 points)
+	NPV 100% Financed Score	(0-5 points)
+	NPV 0% Financed Score	(0-5 points)
+	LCOE 100% Financed Score	(0-5 points)
+	LCOE 0% Financed Score	(0-5 points)

TOTAL SCORE (0-30 POINTS)

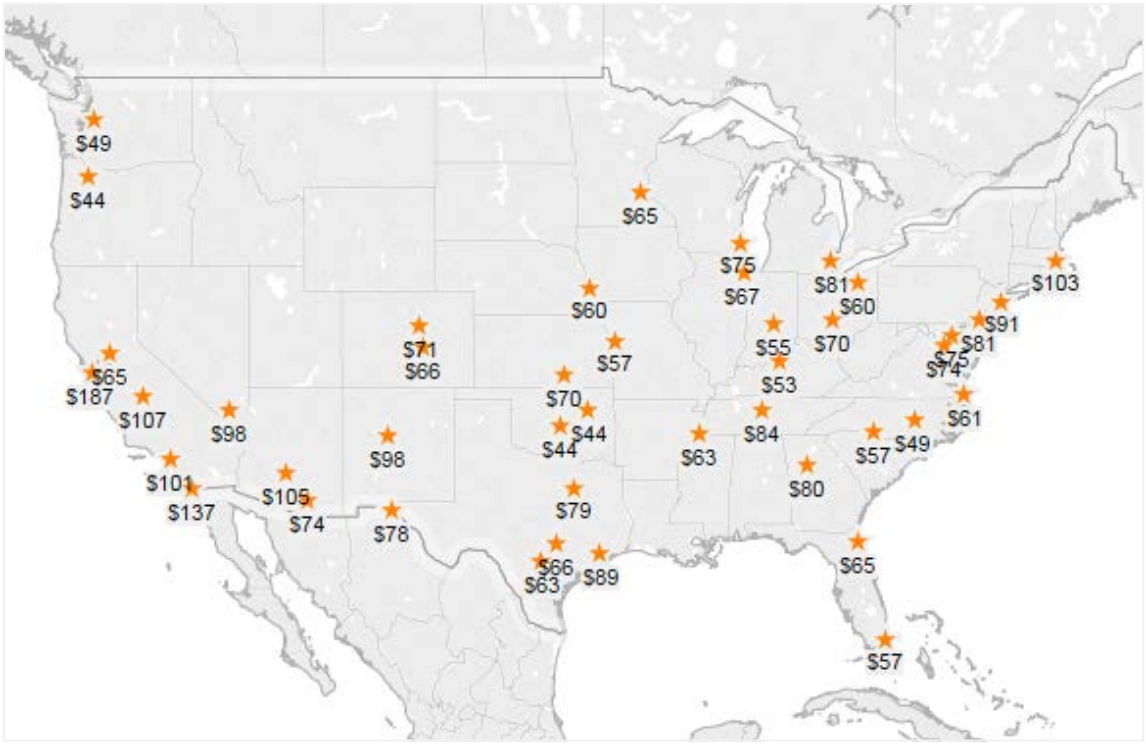
THE VALUE TO CONSUMERS: FIRST-YEAR MONTHLY SAVINGS

Monthly electric bill savings are calculated as the difference between an average customer's bill with solar and what the same customer's bill would have been without solar.

This calculation uses a 5 kW system, average energy usage data, and each utility's standard residential rate schedule.

Cities seeing the greatest monthly savings are concentrated in California: Oakland ($187), San Francisco ($187), San Jose ($186), San Diego ($137), and Long Beach ($131).

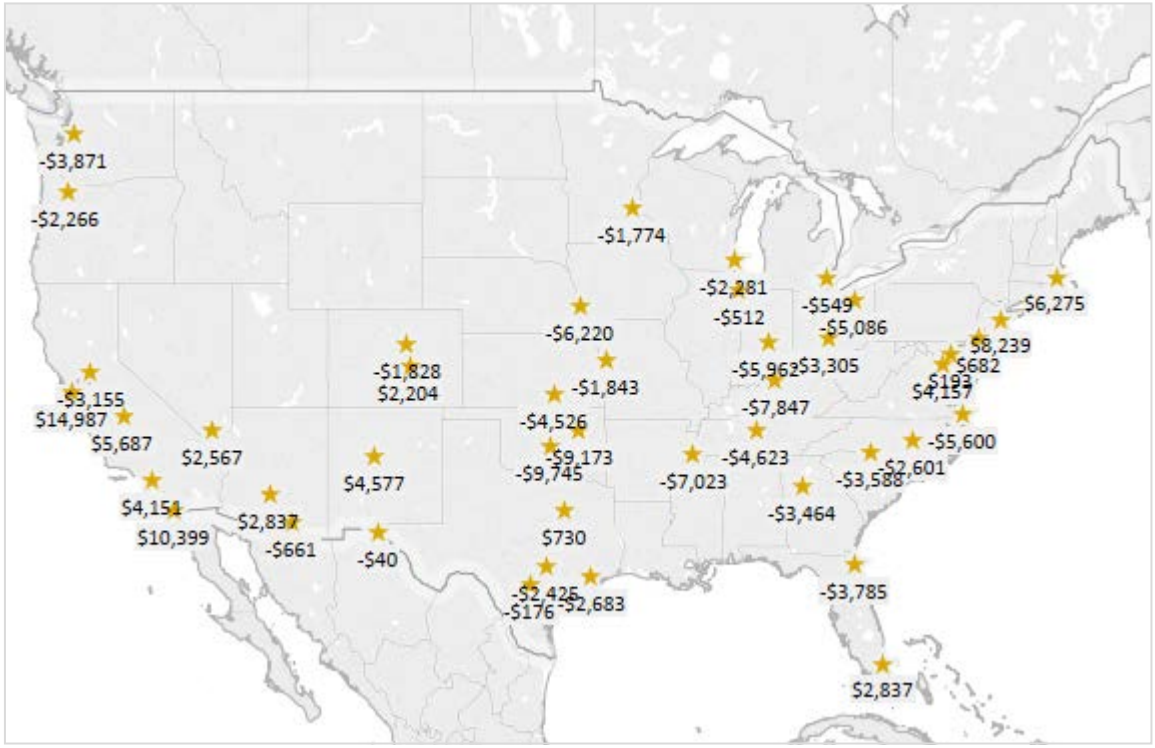
The utilities whose customers see the greatest monthly dollar savings are Pacific Gas & Electric, San Diego Gas & Electric, Southern California Edison, Arizona Public Service, and NSTAR, which serves Boston and some adjacent areas.



Note: Some cities are excluded from the map in order to avoid overlapping labels due to their sharing a metropolitan area with another city. For detailed statistics for each city, please see the appendix.

*Solar PV customers in America's 50 largest cities that invest in a 5 kW solar PV system **save an average of between $44 to $187 per month** (before a loan, lease, or PPA payment) during the first year that they own their system.*

THE VALUE TO CONSUMERS: BETTER THAN STOCKS?



NOTE: Some cities are excluded from the map in order to avoid overlapping labels due to their sharing a metropolitan area with another city. For detailed statistics for each city, please see the appendix.

*For customers in 20 of America's 50 largest cities, paying cash upfront for a solar PV system is **a better investment than the stock market over the 25-year life of a typical PV system.***

SOLAR OR THE S&P?

Net present value, or NPV, shows the value of solar as an investment by representing the future value of the investment in present-day dollar terms. In many of America's fifty largest cities, the net present value (NPV) of a dollar invested in solar yields a greater value than a dollar invested in the stock market.

In this analysis, the authors assumed a customer looking to save for the long-term would likely invest in stocks because stock ownership is a common and well-known discussion in wealth and retirement management. For comparison, the authors chose the Standard & Poor's (S&P) 500 stock index because it is one of most well-known and well-diversified representation of the U.S. equities market. Solar's NPV relative to investing in stocks was calculated by comparing the 25-year return of the Standard & Poor's (S&P) 500 stock index.

Even though past performance of stocks does not guarantee future performance, such a method is not unlike the methodologies used by major wealth and retirement management firms to arrive at a return projection for clients. Charles Schwab Investment Advisors, for example, uses 7.4% for U.S. equities when discussing allocation to equities. Other major firms have projections within about 1% range of this report's methodology. It is worthwhile to note that our methodology can be considered relatively conservative in that the comparison sets up solar, which has low risk variables in arriving at its returns (electricity price escalation rates), against the higher risk and more volatile projected returns of the S&P.

Top ranking cities for NPV of an unfinanced system are San Jose ($16,299), San Francisco ($14,987), and Oakland ($14,951), all of which are in Pacific Gas & Electric territory.

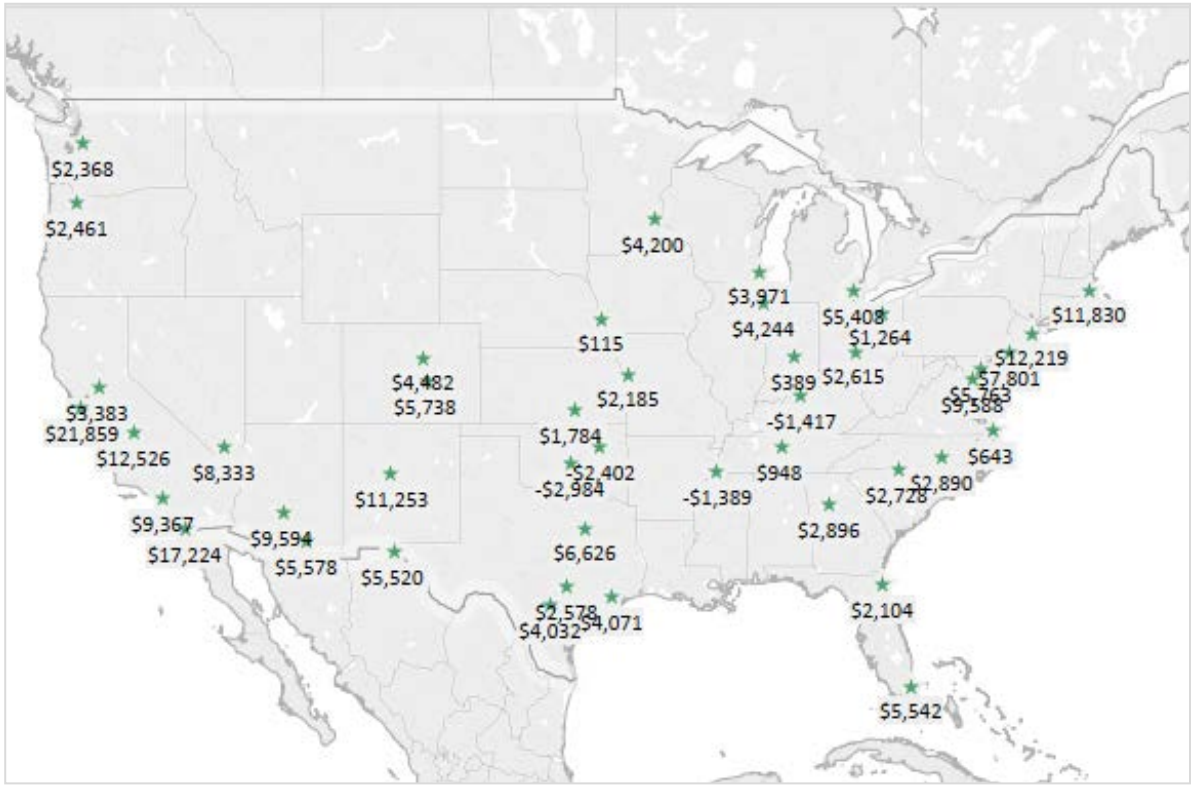
THE VALUE TO CONSUMERS: BETTER THAN STOCKS?

In every city, the net present value of investing in fully-financed 5 kW rooftop solar PV system is greater than for a system paid for in full with cash upfront.

This has largely to do the fact that the customer is still able to keep an increased amount of their income in the near term, due to the federal tax credit, while avoiding a large upfront payment for solar. Also contributing is the fact that the loan and interest payments made later in the investment's life are discounted.

Additionally, it is important to note that some cities where solar is not yet at grid parity (where the LCOE is less than the retail rate of electricity) have a positive NPV. This is due to the effect that anticipated future rate increases are likely to have.

Top ranking cities for NPV for a fully financed PV system are San Jose ($23,171), San Francisco ($21,859), and Oakland (21,839) - the same top three as for a 0% financed system.



Note: Some cities are excluded from the map in order to avoid overlapping labels due to their sharing a metropolitan area with another city. For detailed statistics for each city, please see the appendix.

*For customers in 46 of America's 50 largest cities, **100% financed solar is a better investment than the stock market!***

THE VALUE TO CONSUMERS: LEVELIZED COST (LCOE)

LEVELIZED COST OF ENERGY OF A 5 KW SYSTEM

The "real" levelized cost of energy (LCOE) is calculated by dividing the cost of the PV system by the total estimated output of the system over its life, as adjusted for inflation. This gives an average cost of the energy produced from a solar PV system in cents per kWh.

For each city/utility, LCOE was calculated for a solar PV system that was paid for in full with cash upfront (0% financed) and for a system that was financed in full with loans (100% financed).

Cities with the lowest LCOE for a 0% financed PV system are: Miami (8.8 cents/kWh), Washington, DC (9.5 cents/kWh), Colorado Springs (9.7 cents/kWh), New York City (10.9 cents/kWh), and San Antonio (12.4 cents/kWh).

The five cities with the lowest LCOE for a 100% financed PV system are: Washington, DC (3.1 cents/kWh), Miami (5.6 cents/kWh), New York City (5.7 cents/kWh), Colorado Springs (6.0 cents/kWh), and Raleigh (6.1 cents/kWh).

A full list of LCOE values is available in the Appendix.

Top 10 Cities With the Least Expensive Solar PV on an LCOE Basis (Assumes 5 kW System in Each City)

Rank	*City & Utility (100% Financed)*	*¢/ kWh*	*Rank*	*City & Utility (Upfront Purchase)*	*¢/ kWh*
1	Washington, DC (Pepco)	3.1	1	Miami (Florida Power & Light)	8.8
2	Miami, FL (Florida Power & Light)	5.6	2	Washington, DC (Pepco)	9.5
3	New York, NY (ConEd)	5.7	3	Colorado Springs (Colorado Springs Utilities)	9.7
4	Colorado Springs (Colorado Springs Utilities)	6.0	4	New York (ConEd)	10.9
5	Raleigh (Duke Energy Progress)	6.1	5	San Antonio (CPS Energy)	12.4
6	Albuquerque (PNM Resources)	6.8	6	Kansas City (Kansas City Power & Light)	12.6
6	Boston (NSTAR)	6.8	7	Raleigh (Duke Energy Progress)	12.7
8	Philadelphia (PECO)	7.4	8	Albuquerque (PNM Resources)	13.0
9	San Antonio (CPS Energy)	7.6	8	Las Vegas (NV Energy)	13.0
9	Dallas-Fort Worth-Arlington (Oncor)	7.6	10	El Paso (El Paso Electric)	13.3

THE VALUE TO CONSUMERS: RETAIL OR "GRID" PARITY

The inflation-adjusted levelized cost of energy can be compared to the per kWh cost of grid electricity to evaluate how close solar PV is to reaching "grid parity" in a particular location. Grid parity is achieved when the levelized cost of solar energy declines to the point where it equals the retail cost of grid electricity.

Distance to retail parity (in cents per kWh) was calculated for each city by subtracting their utility's retail rate of grid electricity from the LCOE of solar in that city. The graphs on the following two pages show distance to grid parity for each city.

20.7 million single-family homeowners in America's largest cities (93% of the estimated total) live in a place where financing brings solar's cost to parity.

PV Cost Relative to Utility Energy Cost (¢/kWh)	100% Financed Purchase (At 5% Interest)	Upfront Purchase
	Cities at Parity	Cities at Parity
7+ ¢/kWh Less Than Grid Energy	New York, San Diego, Boston, Washington DC, D/FW Metroplex (Dallas, Ft. Worth & Arlington), Bay Area (San Francisco, Oakland & San Jose), Fresno, Colorado Springs	New York
4-7 ¢/kWh Less Than Grid Energy	Albuquerque, Austin, Long Beach, Los Angeles, Miami, Kansas City, Denver, Minneapolis, Philadelphia, Raleigh, Las Vegas, Milwaukee, Phoenix, El Paso, Portland, Mesa	Boston
0-4 ¢/kWh Less Than Grid Energy	San Antonio, Charlotte, Atlanta, Tucson, Baltimore, Chicago, Houston, Detroit, Sacramento, Wichita, Jacksonville, Cleveland, Virginia Beach, Columbus	Washington DC, Colorado Springs, San Diego, Miami, Boston, D/FW Metroplex. San Jose, Kansas City, Austin, Los Angeles, Albuquerque
Total At Parity	42	14
Total Homeowners at Parity	20,748,418	9,110,729

Source for Homeowners: Owner Occupation Rate of One-Unit Detached Houses from the U.S. Census Bureau, 2013. This rate is then multiplied by the number of residential customers per utility measured in EIA Form 826,.

PART III: ADDRESSING THE SOFT COST CHALLENGE: WHAT LOCAL GOVERNMENTS (AND UTILITIES) CAN DO

SOLAR PV TODAY: "SOFT" COSTS' PERSISTENCE

SOLAR SOFT COSTS

While solar PV has experienced dramatic and beneficial cost declines, the bulk of those reductions have come as the result of hardware cost reductions. The cost of solar can be separated into hard costs (those of the hardware– panels, inverters, etc.) and soft costs (those associated with other fees and processes involved in going solar.). According to the National Renewable Energy Laboratory (NREL), soft costs were responsible for 64% of the total cost of residential PV systems in 2012.

The more that soft costs can be consistently reduced, the lower solar's upfront cost becomes. Furthermore, lower soft costs increase a system's net present value and reduce its levelized cost of energy without added incentives. In short, taking actions to reduce soft costs can increase the value of this investment and make it an option for a greater number of people.

Thus, it is not hyperbolic to say that the soft cost reduction challenge is at the heart of getting rooftop solar PV to a level of broad-based cost-effectiveness (and true, nationwide consumer acceptance).

U.S. DOE SUNSHOT INITIATIVE

The U.S. Department of Energy's SunShot Initiative aims to bring the cost of solar down to $0.06 per kWh by 2020, primarily by reducing these soft costs of solar. The Solar Outreach Partnership is a project under the larger SunShot Initiative to provide technical assistance to local governments looking to take actions that reduce soft costs.

The primary soft costs targeted by SunShot include:

- Installation Labor- Costs associated with paying each person involved in the installation process (may include contractors, engineers, electricians, etc.)
- Customer Acquisition- Costs involved with marketing, lead generation, performing site assessments, and meeting with customers
- Financing- Cost associated with interest on a loan or increased price charged by a third-party developer to make the investment more worthwhile to them
- Permitting & Inspection- Financial cost of fees associated with permits and inspections, as well as the cost of delaying the start of production from the system

While solar PV is poised to compete without incentives in several regions of the country, ***further action to further reduce soft costs is required for solar PV to compete nationwide in an incentive-free environment.***

SOFT COSTS: WHAT LOCAL GOVERNMENTS CAN DO

LOCAL GOVERNMENTS

Example of actions that local governments can take to reduce soft costs include:

- Updating/Enforcing Rules & Regulations
  - Streamline the solar permitting and inspection processes
  - Implement solar-ready building codes
  - Enact or revise local solar access and solar rights provisions
- Leading By Example
  - Install solar on government buildings and schools; use these installations as educational tools
  - Incorporate solar into an energy savings performance contract
- Making Solar Affordable
  - Engage local lenders to offer low-interest loans for solar
  - Support community bulk purchasing programs
- Organizing Local Solar Efforts
  - Include solar in city, county, and regional planning efforts
  - Establish targets for local solar development
- Leading Customer Outreach & Education
  - Educate citizens about the benefits of solar energy and the options available to them

MUNICIPAL UTILITIES

Examples of effective actions municipal utilities may take include:

- Improving Utility Policies
  - Adopt net metering and interconnection policy best practices
  - Limit rate designs that provide a disincentive for solar; consider rate reform to institute rates that fairly value solar
- Offering Community Solar
  - Provide community solar as an option to customers, whether through a subscription or purchase program
- Provide Customers with Options
  - Consider offering a "value of solar" tariff alongside net metering
- Harmonizing Government & Utility Procedures
  - Update and coordinate processes across departments, such as permitting, inspection, and interconnection (PII)

To learn more about actions that local governments and municipal utilities can take to cut soft costs, check out the U.S. DOE's Solar Powering Your Community guide for local governments (http://www4.eere.energy.gov/solar/sunshot/resource_center/sites/default/files/solar-powering-your-community-guide-for-local-governments.pdf).

LOOKING AHEAD: THE PATH TO ADOPTION & AFFORDABILITY

Within two years, residential rooftop solar PV technology is likely to continue to grow at a rapid pace. Nevertheless, this growth will likely face a series of policy and market challenges. These challenges include (but are not limited to):

- The expiration (under current law) of the 30% federal investment tax credit (ITC) by the end of 2016, and the market disruption that could occur as that deadline approaches;
- The continuing reduction and/or elimination of state, local, and utility incentives as costs continue to decline;
- An increased clip of legislative and regulatory debates related to the costs and benefits of net metering policies; and
- The continuation of a series of contentious international trade disputes that could impact the cost of solar PV hardware.

However, with targeted actions to reduce soft costs, local governments can help to make costs can come down even further and allow an even greater portion of the American public to choose solar energy if they so desire.

Photo Credit: SunShot Solar Outreach Partnership

APPENDIX: FULL RANKINGS AND RESULTS

APPENDIX: RANKINGS, SCORING & RESULTS BY CITY (1-25)

#	CITY	YEAR 1 MONTHLY SAVINGS	SAVINGS SCORE	NPV (100% FINANCED)	NPV (0% FINANCED)	NPV Score	LCOE (FINANCED) (¢/kWh)	LCOE (UPFRONT (¢/kWh)	LCOE SCORE	TOTAL SCORE
1	New York, NY	$91	7.75	$12,219	$8,239	8.87	5.7	10.9	9.50	26.12
2	Boston, MA	$103	8.57	$11,830	$6,275	8.67	6.8	13.9	8.27	25.51
3	Albuquerque, NM	$98	8.16	$11,253	$4,577	8.36	6.8	13.0	8.78	25.30
4	San Jose, CA	$186	9.59	$23,171	$16,299	10.00	10.3	17.5	4.60	24.19
5	Las Vegas, NV	$98	7.95	$8,333	$2,567	7.45	7.8	13.0	7.97	23.36
6	Washington, DC	$74	5.10	$9,588	$4,157	8.06	3.1	9.5	9.90	23.06
7	Los Angeles, CA	$101	8.36	$9,367	$4,151	7.85	8.5	14.1	6.74	22.95
8	San Diego, CA	$137	9.38	$17,224	$10,399	9.38	10.5	17.7	4.19	22.95
9	Oakland, CA	$187	9.79	$21,839	$14,951	9.59	10.9	18.5	2.87	22.25
10	San Francisco, CA	$187	9.79	$21,859	$14,987	9.79	10.9	18.4	2.66	22.24
11	Phoenix, AZ	$105	8.77	$9,594	$2,837	7.96	9.2	15.8	5.21	21.94
12	Long Beach, CA	$131	9.18	$16,759	$9,871	9.18	10.9	18.4	2.97	21.33
13	Fresno, CA	$107	8.97	$12,526	$5,687	8.77	10.8	18.3	3.48	21.22
14	Philadelphia, PA	$81	7.14	$7,801	$682	6.83	7.4	16.8	6.74	20.71
15	Dallas, TX	$79	6.12	$6,626	$730	6.63	7.6	14.3	7.66	20.41
15	Fort Worth, TX	$79	6.12	$6,626	$730	6.63	7.6	14.3	7.66	20.41
15	Arlington, TX	$79	6.12	$6,626	$730	6.63	7.6	14.3	7.66	20.41
18	Colo Springs, CO	$66	3.67	$5,738	$2,204	6.73	6.0	9.7	9.50	19.90
19	El Paso, TX	$78	5.91	$5,520	-$40	5.81	8.0	13.3	7.46	19.18
20	Miami, FL	$57	1.42	$5,542	$2,837	6.73	5.6	8.8	9.90	18.05
21	Baltimore, MD	$75	5.71	$5,763	$193	6.33	8.6	15.8	5.62	17.66
22	Tucson, AZ	$74	5.30	$5,578	-$661	5.61	8.3	14.2	6.74	17.65
23	Mesa, AZ	$73	4.89	$4,537	-$1,613	5.10	8.0	13.7	7.15	17.13
24	San Antonio, TX	$63	2.65	$4,032	-$176	5.00	7.6	12.4	8.78	16.43
25	Detroit, MI	$81	6.93	$5,408	-$549	5.41	10.8	19.0	3.07	15.40

RANKINGS, SCORING AND RESULTS BY CITY (26-50)

#	CITY	YEAR 1 MONTHLY SAVINGS	SAVINGS SCORE	NPV (100% FINANCED)	NPV (0% FINANCED)	VALUE SCORE	LCOE (FINANCED) (¢/kWh)	LCOE (UPFRONT (¢/kWh)	LCOE SCORE	TOTAL SCORE
26	Denver, CO	$71	4.69	$4,482	-$1,828	4.79	8.8	15.5	5.62	15.10
27	Minneapolis, MN	$65	3.26	$4,200	-$1,744	4.69	7.9	15.2	6.64	14.59
28	Chicago, IL	$67	4.08	$4,244	-$512	5.20	9.8	16.2	4.91	14.19
29	Kansas City, MO	$57	1.63	$2,185	-$1,843	3.26	7.7	12.6	8.27	13.16
30	Raleigh, NC	$49	0.61	$2,890	-$2,601	3.46	6.1	12.7	8.99	13.06
31	Austin, TX	$66	3.87	$2,578	-$2,425	3.26	8.9	14.7	5.93	13.06
32	Atlanta, GA	$80	6.73	$2,896	-$3,464	3.16	11.0	18.4	2.66	12.55
33	Houston, TX	$89	7.55	$4,071	-$2,683	3.87	12.7	21.5	1.03	12.45
34	Charlotte, NC	$57	1.83	$2,728	-$3,588	2.85	7.8	15.4	6.64	11.32
35	Milwaukee, WI	$75	5.51	$3,971	-$2,281	3.98	11.8	19.9	1.64	11.13
36	Wichita, KS	$70	4.48	$1,784	-$4,526	1.83	10.5	17.6	4.39	10.70
37	Sacramento, CA	$65	3.46	$3,383	-$3,155	3.47	10.8	18.2	3.68	10.60
38	Portland, OR	$44	0.20	$2,461	-$2,266	3.37	8.0	15.3	6.34	9.90
39	Nashville, TN	$84	7.34	$948	-$4,623	1.53	12.9	21.5	0.82	9.69
40	Jacksonville, FL	$65	3.06	$2,104	-$3,785	2.14	10.7	18.0	3.99	9.19
41	Columbus, OH	$70	4.28	$2,615	-$3,305	2.96	15.0	25.4	0.00	7.24
42	Seattle, WA	$49	0.81	$2,368	-$3,871	2.24	9.3	19.5	3.48	6.53
43	Va. Beach, VA	$61	2.44	$643	-$5,600	1.22	11.4	19.2	2.15	5.81
44	Memphis, TN	$63	2.85	-$1,389	-$7,023	0.61	12.4	20.7	1.23	4.69
45	Cleveland, OH	$60	2.24	$1,264	-$5,086	1.53	13.1	22.3	0.62	4.39
46	Indianapolis, IN	$55	1.22	$389	-$5,962	1.02	12.0	20.2	1.43	3.67
47	Omaha, NE	$60	2.04	$115	-$6,220	0.81	14.0	23.5	0.41	3.26
48	Okla. City, OK	$44	0.00	-$2,984	-$9,745	0.00	10.9	18.4	3.17	3.17
49	Tulsa, OK	$44	0.40	-$2,402	-$9,173	0.20	11.6	19.6	1.84	2.44
50	Louisville, KY	$53	1.02	-$1,417	-$7,847	0.40	14.4	24.1	0.21	1.63

APPENDIX: ASSUMPTIONS & DATA SOURCES

Savings and Rates Assumptions We assume most customers are on a utility's standard residential rate, and savings are based upon the assumption that the customer was previously on the same flat rate schedule prior to investing in solar. Savings are thus in relation to what the customer would be paying under the flat rate tariff with no PV system, all things being equal. Many rate records were culled from the Utility Rate Database, and were checked against current tariffs filed on utility websites, and modified as necessary in our models.

Solar PV Pricing Data ZIP code level pricing and system sizing data for July-September 2014 was generously provided to the authors by Vikram Aggarwal of EnergySage. Data was aggregated to "super-regional" levels to protect the sensitivity of the data.

Energy Usage in Average-Size Households Our analysis utilized the National Renewable Energy Laboratory's System Advisor Model (SAM), which uses simulated load data from various locations in the United States. We assumed, (given the findings in Hoen, et al. *Exploring California PV Home Premiums*. December 2013, Lawrence Berkeley National Laboratory (LBNL), Available at: http://emp.lbl.gov/sites/all/files/lbnl-6484e.pdf), that the average PV system owner would, if their market were more saturated, own a house similar to the "base" home in the set of simulated load data by city. Energy use (kWh) and monthly peak demand (kW) include monthly variation, but no annual variation. Future household energy use may decrease due to greater efficiency, or may increase due to new loads. As it is therefore uncertain in which direction energy use will move, constant usage and demand are assumed.

Escalation of Future Utility Rates cost escalator is assumed for utility rates. The escalator used for each city (save Austin and Atlanta) comes from performing a percent change calculation on the U.S. Energy Information Administration (EIA)'s Annual Energy Outlook 2014 by grid reliability region of the United States. The escalator used for Austin & Atlanta's tariff comes from EIA's natural gas price data, as the value of solar is tied strongly to the avoided cost of the displaced marginal generating unit, which is commonly assumed to be natural gas.

Physical System & Financial Assumptions We assumed a PV system of 5 kilowatts in nameplate Direct Current (DC) capacity. The cash purchase scenario assumes that the system was purchased in full with cash upfront (no loan). The 100% financed scenario assumes that the system was purchased fully with a loan at 5% interest over 25 years. The assumed PV system life is 25 years. Tilt in all cases is forced to latitude.

Other SAM Assumptions We left all SAM default parameters in place (which include the 25-year, 5% interest rate loan for our financing case), except that we 1) used a 6.61% inflation-adjusted discount rate which represents our calculation of the 25-year annual growth rate with dividends reinvested for the Standard and Poor's 500 (data maintained by Robert Shiller of Yale University) and 2) used a 0.84 DC to AC derate factor is assumed, on the advice of our engineering staff's assessment of the inverter marketplace.

Data for Policies, Incentives and Rebates We utilized the Database of State Incentives for Renewables and Efficiency (DSIRE) for the details on all net energy metering (NEM) policies, and assumed that the programs on the site as of late September that do not have specific plans to be unavailable in the next year would be available in the next year for customers.

Data Visualizations All data visualizations and maps were created with the free software program Tableau Public or Microsoft Excel.