Comments on the Federal Trade Commission's **Solar Electricity Project No. P161200**
Topic 4: Consumer protection issues, including how consumers get the information necessary to decide whether to install solar PV panels.

Information Asymmetries in the Dollars and Cents of Rooftop Solar Finance

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CertainSolar is a cleantech startup harnessing the power of big data and behavioral economics to make solar energy more affordable and accessible to American families and businesses. We have expertise in current, historic, and projected retail electric utility tariffs and rates, and we develop **innovative methods for cleantech adopters to consume these data to make informed energy-finance decisions**.

CertainSolar was founded by David Arfin, former VP of Customer Finance and Strategy at SolarCity and the inventor of the SolarLease®, Nalin Kulatilaka, Ph.D., a finance professor at Boston University, co-founder of FirstFuel, a commercial building energy efficiency analytics company, and co-director of the BU Clean Energy and Environmental Sustainability Initiative, and Adam B. Cohen, Ph.D., a former U.S. Department of Energy Science and Technology Policy Fellow and former Head of Data Science for Split Technology, a data-driven urban transportation platform.

CertainSolar was awarded a 2016 Department of Energy SunShot Incubator award to design and deploy next-generation solar finance products that reallocate the risks related to long-term electricity rate volatility from homeowners to professional investors.

Back to the Future, or Why Today's Solar Financing is Like Science Fiction

Back to the Future Part II was released in 1989, but was set in the then far off future: 2015. When Marty McFly first arrives, we see flying cars and an automated Texaco station in the town square. The price for gas: $6.85. This was, of course, a joke, but the idea was that we had no way to know how much fuel would cost in 20 or 30 years. As it turns out, the forecast was 300% off.

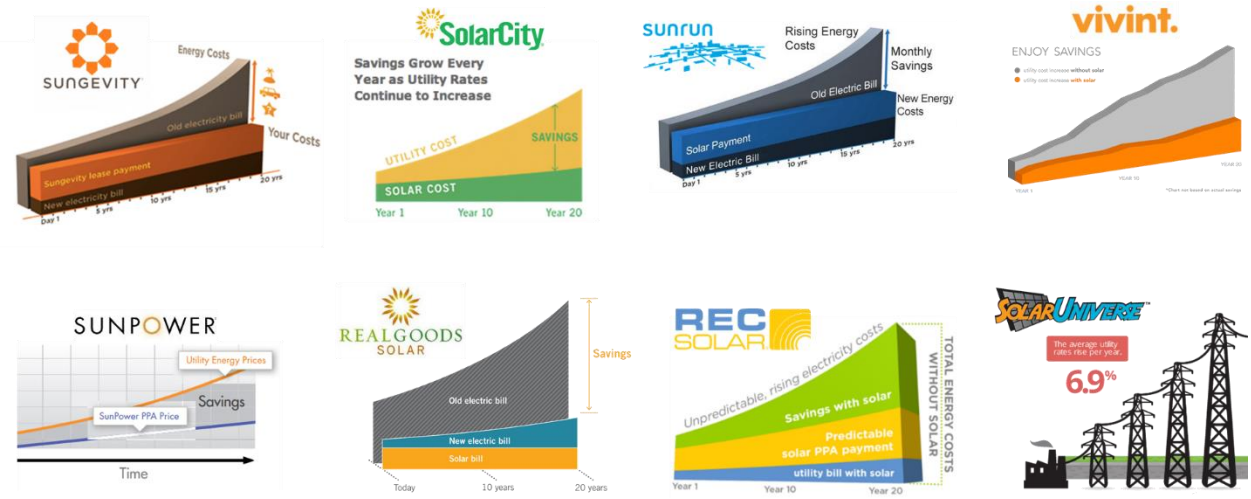
Today, we ask solar customers to try to make this same calculation. **Homeowners must guess what the cost of electricity will be over the next 20 or 30 years**. CertainSolar is crafting and launching novel strategies to simplify the solar sales process so that consumers don't need a time machine to calculate whether they are making a good financial investment

Today's Marketplace for Solar Energy Finance

The U.S. residential solar finance market originates $7 billion annually and is growing at 50% a year[1]. The revolution in third party financing, popularized by solar leases, power purchase agreements (PPAs), loans, and installment sales, made solar accessible to a broader portion of the population and has been a key driver in the growth of the industry over the past five years[2]. In 2014-2015, over 90% of consumers chose to finance their system rather than pay for their systems upfront.

Solar's Simple Story About Energy Rates

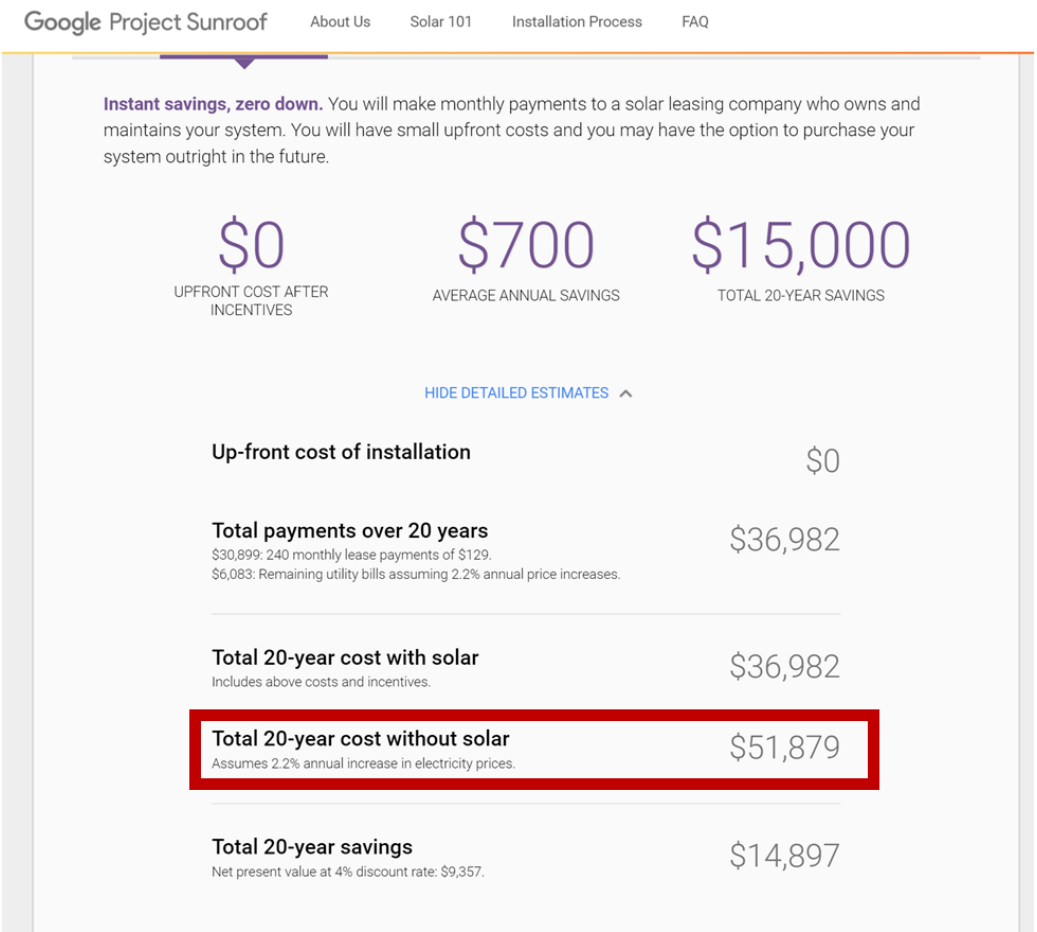
Conventional wisdom is that electricity prices always go up. Residential homeowners have been sold solar based on this assumption, with solar developers making the case that by securing a solar loan, PPA, or equipment, homeowners will **save money now, and save even more money in the future** when their contracted price for solar is much, much lower than grid electricity prices. This simple sales pitch is illustrated in the marketing materials of all leading solar installers:



[1] SEIA/GTM Research U.S. Solar Market Insight™ 2015 Q4, Solar Energy Industries Association.

[2] In E. Drury et al. (The Transformation of Southern California's Residential Photovoltaics Market through Third-Party Ownership, *Energy Policy* 42 [2012]), it's estimated leasing/PPA business models increased the addressable residential solar market by 13 million less-affluent Americans.

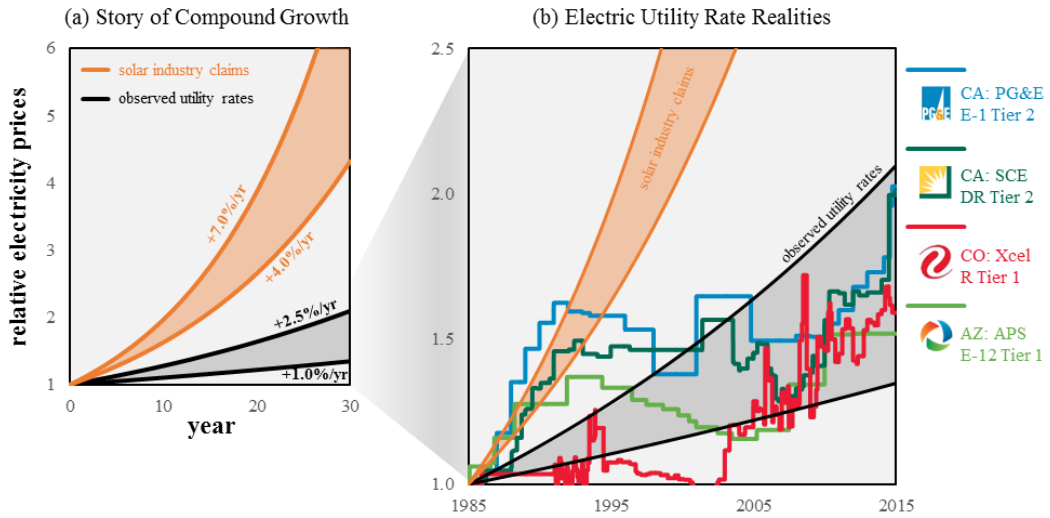
A similar assumption underlies the solar energy calculator provided by the trusted, third-party information provider, Google, with their Project Sunroof tool. In Google's case the compounding rate of utility price growth is explicitly presented as a 2.2% annual increase:



The Solar Story Contrasted with the Energy Rate Reality

This premise of steadily rising energy prices is simply not a true reflection of reality. The series of plots below show that the **solar industry's outlook for utility rates is in stark contrast with the actual movements of retail rate structures over the past 30 years**. Rather than rates continuously increasing, there have been long periods of decreasing or stagnating rates as well as changes to underlying rate structures such as the introduction and termination of usage-based tiers, increased fixed charges in lieu of increased marginal rates, and experimentation with alternative pricing strategies like demand charges and time-of-use rates. The power of compound growth means that

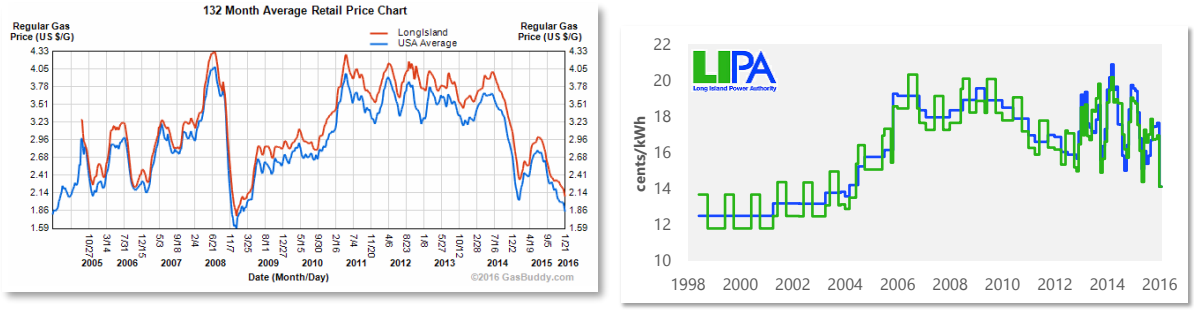
over the duration of a typical solar energy financing contract, a consumer's realized dollar savings may be significantly less than anticipated.



Contrast between the solar sales pitch and observed utility rate data

(a) Solar installation companies describe prices that compound at 4-7% each year

(b) 30 years of real utility rate data demonstrates much different behavior: slow long-term growth and periods of flat growth or rate reductions. Here, utility rate time-series are plotted for major utilities in California, Arizona, and Colorado



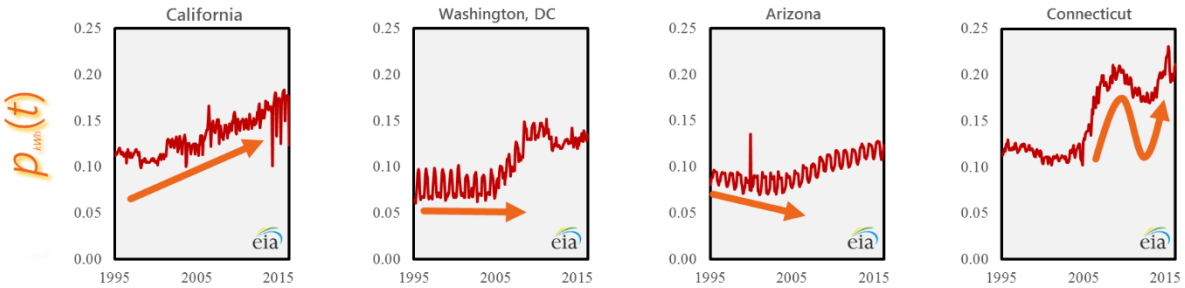
Electricity rate time-series behavior resembles gasoline price dynamics

(left) Consumers are price sensitive to movements in gasoline prices, and they understand that short- and long-term volatility exists. Here, the prices for gasoline in Long Island, New York, are plotted over the last 12 years. Source: GasBuddy.com

(right) Electricity prices have similar dynamics with periods of growth, reduction, and high-frequency volatility. However, these data are not easily accessed by consumers. Here, 18 years of Long Island electricity (LIPA) rates are plotted.

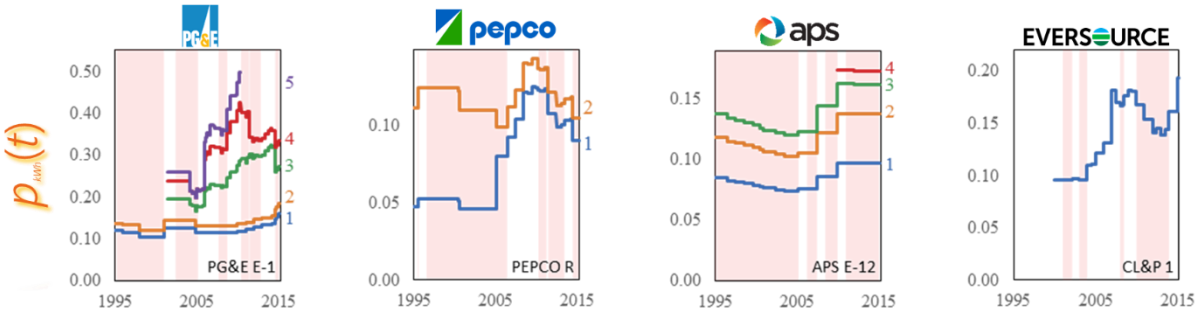
Averaged Prices Mask the Complexity of Real Energy Bills

Accessing information about the historical behavior of retail electricity prices is challenging, yet this is the **comparative data that solar customers require to make an informed decision when weighing their purchase and finance options**. Since 1990, the U.S. government's Energy Information Agency (EIA) has collected, organized, and hosted monthly residential, commercial, and industrial electricity price data:



These time-series are currently the energy industry's most frequency cited resource for quantifying the movement of retail prices at a state-level. In general, these data show that the last **decades of retail electricity price movements do not reflect the simple growth patterns** as broadly presented by the solar industry. For California, Washington, DC, Arizona, and Connecticut, we observed widely different types of behaviors.

While EIA data are valuable for drawing general conclusions about average electricity bills paid across a state, there are **critical limitations in applying these results at the specific, individual household level**. Tariff structures vary by utility and jurisdiction, including diversity in subcomponents. Base customer charges; tiered and seasonal structures; generation, transmission, and distribution charges; and taxes, fees, and riders can be complex. Pricing structures and overall prices for one electric utility in a state can be very different from another, especially when there is a mix of investor-owned, state- or municipal-managed, and cooperative utilities operating under separate regulations.



A Need for Truth in Energy Pricing

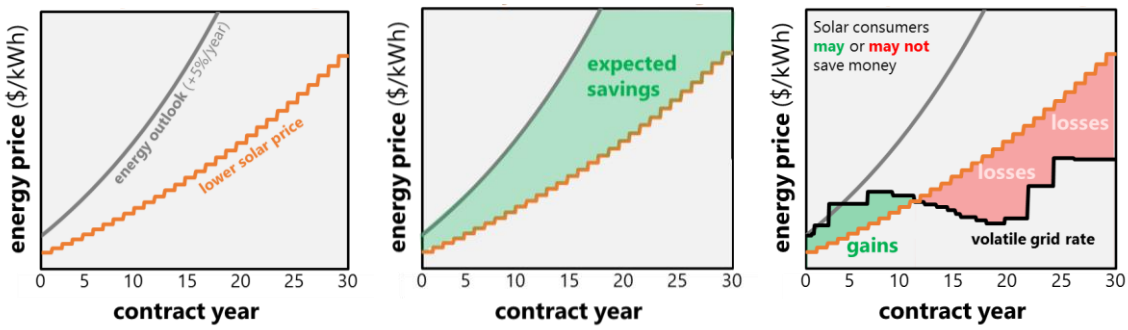
Distributed energy resource adopters (including solar energy customers, future energy storage customers, and energy efficiency customers) have insufficient information about how they have paid, pay, and will pay for energy from their electric utilities. Averaged EIA data does not capture how real consumers pay for electricity, because it lacks **household-level intelligence about tariff structures and rates**. As tariffs become more complex and customized over the next decades (including the introduction of time-of-use rates, demand charges, location-based marginal pricing, value of distributed generation, and incorporation of environmental externalities), **a new digital platform for retail consumers to access and understand their energy bills is required**. Such a national system will give ready ability to solar and other distributed energy customers to make informed financial decisions about their present and future energy expenses. Some essential elements of a practical energy pricing information portal are:

> **Open, comprehensive data**: Today's complex tariff data is buried in utility and utility regulator databases and file cabinets. Prior to the era of viable distributed energy resources, regulators (such as public utility commissions) acted on behalf of customers in setting reasonable prices in lieu of marketplace competition. Hence, the specific details of regulated pricing structures did not need to be transparent to retail customers. **Open digital utility pricing data** is now required by millions of Americans to make informed energy choices.
>
> **Historical data**: As with any financial decision, analysis of past data – while not a predictor of future performance – is a good way to understand patterns, assess risk premiums, and help make decisions. When solar and other distributed energy customers consider long-term financial contracts (20 to 30 years are common terms), comparative historical information about **utility prices for at least 20 to 30 years** should be available.
>
> **Apples-to-apples savings estimates**: For solar energy pricing and finance quotations, **standard assumptions and algorithms** for incorporating household-level energy tariffs and rates, energy usage, and solar generation estimates should be applied. Customers can then compare quotes, financing options, and the option to not get rooftop or community solar in a consistent way.

Today's Finance Structures Slow Solar Growth

The inability of energy customers to clearly quantify the potential for financial savings before a "go solar decision" has limited total marketplace appeal for distributed generation. The **behavioral economics concepts of risk aversion and loss aversion** suggest that consumers tend to prefer lower, more-certain returns rather than higher, riskier investments and that consumers overweight the potential for financial loses and underweight potential gains.

Typical solar financing structures (PPAs, leases, and loans) embed **risks and potential for financial losses**. This is depicted in the series of plots below. The left and center plots depict the story of financial gains (expected savings) by adopting a solar finance contract that has a fixed rate schedule that starts below the retail grid price and escalates more slowly than the projected grid prices (the typical escalator is 2.9%/year). On the right, a 30-year history of real utility prices is displayed. In this scenario, based on a real-world energy price trajectory, a short period of dollar savings is followed by a long period when the solar finance contract is "underwater" (meaning that the solar price is more than the utility price).



To **quantify energy consumers' willingness to accept long-term solar contracts under different expectations for the future direction of utility pricing**, CertainSolar performed a series of survey-based experiments. Consumers were given the two options: stay with the existing utility which has unknown future prices ("UtilityCo") or sign an energy contract that starts 10% below today's utility price and remains fixed (without any escalator) for the duration of the contract ("Level Energy"). Experimental results are presented and discussed below, under different test scenarios.

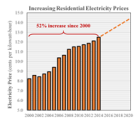
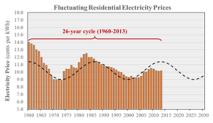
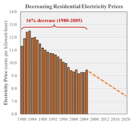
A SOCIAL EXPERIMENT ON UTILITY PRICING RISK

Contract duration	UtilityCo Default option is to stick with the **local utility**	LEVEL ENERGY Sign a contract for a **fixed electricity rate**
1 year	17%	**83%**
5 years	33%	**67%**
10 years	**57%**	43%
20 years	**62%**	38%

Risk aversion slows acceptance of long-term solar finance contracts

When the fixed-price energy contract duration was increased from 1 year to 5, 10, or 20 years, most consumers opted not to accept the new contract.

FRAMING EFFECTS ON UTILITY PRICING RISK

Rate History	UtilityCo	LEVEL ENERGY
	56%	44%
	**72%**	28%
	**74%**	26%
		(20-year contracts)

Expectations of future utility prices impact solar finance acceptance

A framing experiment was performed in which consumers were randomly selected to inspect recent historical electric utility price trends: one in which the prices continuously increase, one in which the prices fluctuate up and down, and one in which prices have been dropping. In the increasing frame, many more customers opted to sign a 20-year fixed-energy contract (44%) versus those in the fluctuating and decreasing frames (28% and 26%, respectively). **These results suggest that information about the direction of utility prices impacts how consumers make long-term energy-financial decisions**.

Conclusion

Back to *Back to the Future*: in an alternate space-time, the character Biff gets fantastically rich because he gets his hands on an almanac recording perfect information about the outcomes of future sporting events. When he bets in a game, he can't lose, as he already knows the final scores. Biff requires no skill, no training, and no luck to make the right choices.

Today, the solar industry implies that customers' utility prices will continuous increase, and there's a no- or low-risk opportunity to save money on future energy expenses. In reality, this information is imperfect and there's ample uncertainty about the potential for dollar savings.

Solar customers are exposed to energy pricing risk but are kept in the dark due to a lack of credible information. Current and historical utility pricing information is difficult to locate and even more difficult to understand. Customers are making long-term purchasing decisions without historical reference and typically rely on the projections presented by solar installers.

A **traditional market failure is brought on by this information asymmetry between uninformed customers and informed energy professionals**. A solution to this market failure is informing customers by offering transparent, open, accessible, and understandable data.

A similar problem existed in the used automobile industry and has been addressed with the aid of CarFax auto-history reports. In the solar industry, where sales are based upon dollar savings, utility rate historical data is an important part of the solution. While the EIA publishes monthly historic average electricity rates by state, these averages do little to understand the behavior of an individual's retail rates, as electricity rates can vary widely by utility and by customer usage, patterns, and territory.

By addressing this asymmetry in pricing information, the real and perceived risk of solar adoption will be decreased, thus increasing the proliferation of solar energy and other distributed energy resources.