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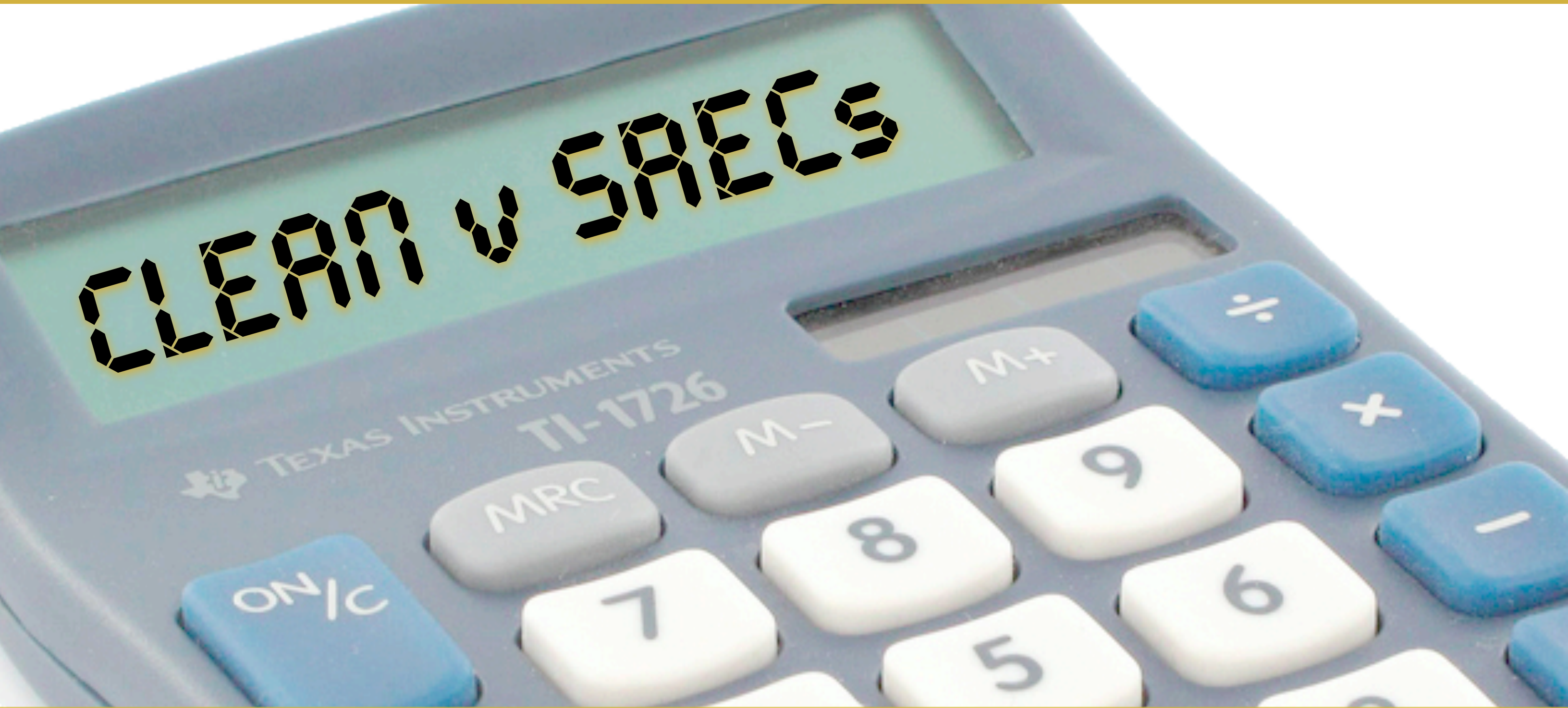


Finding the More Cost-Effective Solar Policy

John Farrell
jfarrell@ilsr.org
twitter: johnffarrell

ILSR

Institute for Local Self-Reliance
1313 5th St. SE, Suite 303
Minneapolis, MN 55414

612-276-3456
www.ilsr.org

Executive Summary

In choosing policies to finance solar power, U.S. states have chosen between two major options: solar renewable energy credits (SRECs) and CLEAN Contracts. But few legislatures have been armed with data on the cost-effectiveness of these strategies.

The result is a mix of state and local policies with varying levels of efficacy. Neither program has a clear edge in installing more solar, and no one knows which states have acquired solar at lower cost.

Galvanized by the recent collapse in state SREC markets, this report examines the relative cost-effectiveness of these two solar financing policies. It reveals that the transparency, certainty, and low risk of CLEAN Contract Programs makes them more cost-effective than SRECs for financing solar power projects. In other words, **CLEAN means more solar at less cost**.

Solar Renewable Energy Credits = SRECs.
SRECs put a price on the supply of solar relative to state-mandated demand.

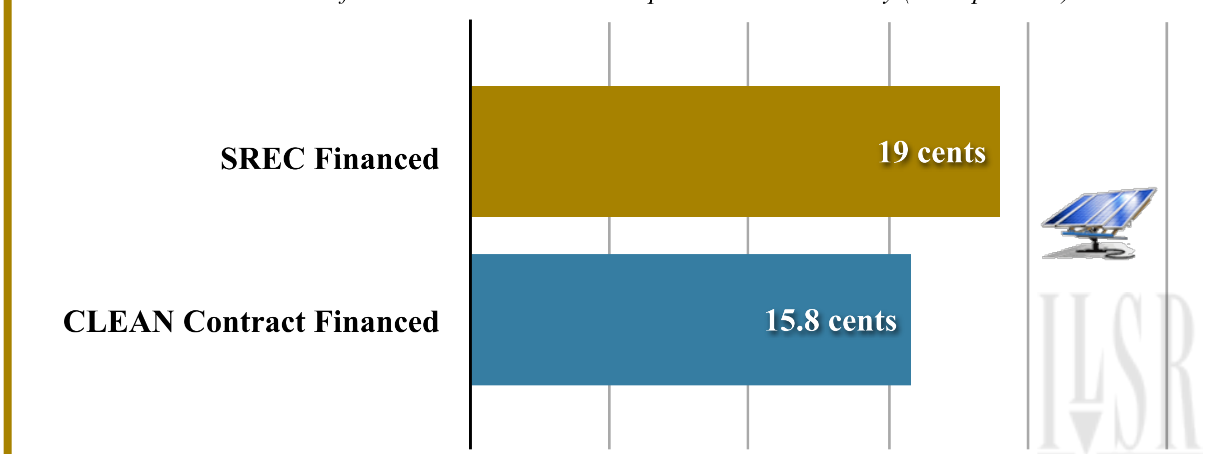
Clean Local Energy Accessible Now = CLEAN.
CLEAN Contracts provide a long-term contract for solar electricity based on the cost of producing solar power.

Findings

- SREC markets are subject to significant volatility, creating a high risk atmosphere where developers require higher rates of return and increasing the ratepayer cost of solar by 10 to 30%. The recent collapse of five state SREC markets highlights this volatility.
- CLEAN Contracts provide developers with transparency, certainty, and low-risk financing for solar projects, reducing developer cost of capital and required rates of return and decreasing the ratepayer cost of solar power. The ability of Germany's CLEAN Contract Program to more accurately price New Jersey solar than the state's own SREC market highlights this advantage.
- A model of identical solar PV systems installed at $4.00 per Watt in New Jersey finds that **CLEAN Contracts deliver solar at a lower levelized cost than an SREC policy due to the transparency, low transaction cost and low risk of a CLEAN Contract Program**.

Solar is Cheaper Using Low-Risk CLEAN Contracts Instead of SRECs

Levelized cost of solar PV installed at $4.00 per Watt in New Jersey (cents per kWh)



Acknowledgments

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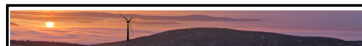

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A program of ILSR, the New Rules Project helps policy makers to design rules as if community matters.

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Introduction

Sixteen states have policies supporting distributed generation, such as solar energy mandates, solar renewable energy credit (SREC) markets or CLEAN (Clean Local Energy Accessible Now) Programs. The interest is obvious: distributed solar power delivers new renewable electricity quickly and cost-effectively during periods of peak electricity use. In addition, distributed generation can enable greater levels of local economic development and ownership.

However, not all policies are equal. Even as states set numerical targets for electricity from solar, the mechanisms for financing solar are very different.

In many states, utilities add financial incentives such as rebates to drive third parties to develop solar power projects. Alternatively, CLEAN Contract programs provide low-risk contracts to solar developers. CLEAN Contracts are standardized, financially attractive long-term agreements for solar electricity based on the cost of production. These programs induce a wide variety of market participants to produce solar power because of the simplicity and transparency of contract prices. CLEAN Contracts can work as a finance tool within a state solar mandate or as a stand-alone energy policy.

Clean Local Energy Accessible Now = CLEAN. *CLEAN Contracts provide a long-term contract for solar electricity based on the cost of producing solar power.*

Solar Renewable Energy Credits = SRECs. *SRECs put a price on the supply of solar relative to state-mandated demand.*

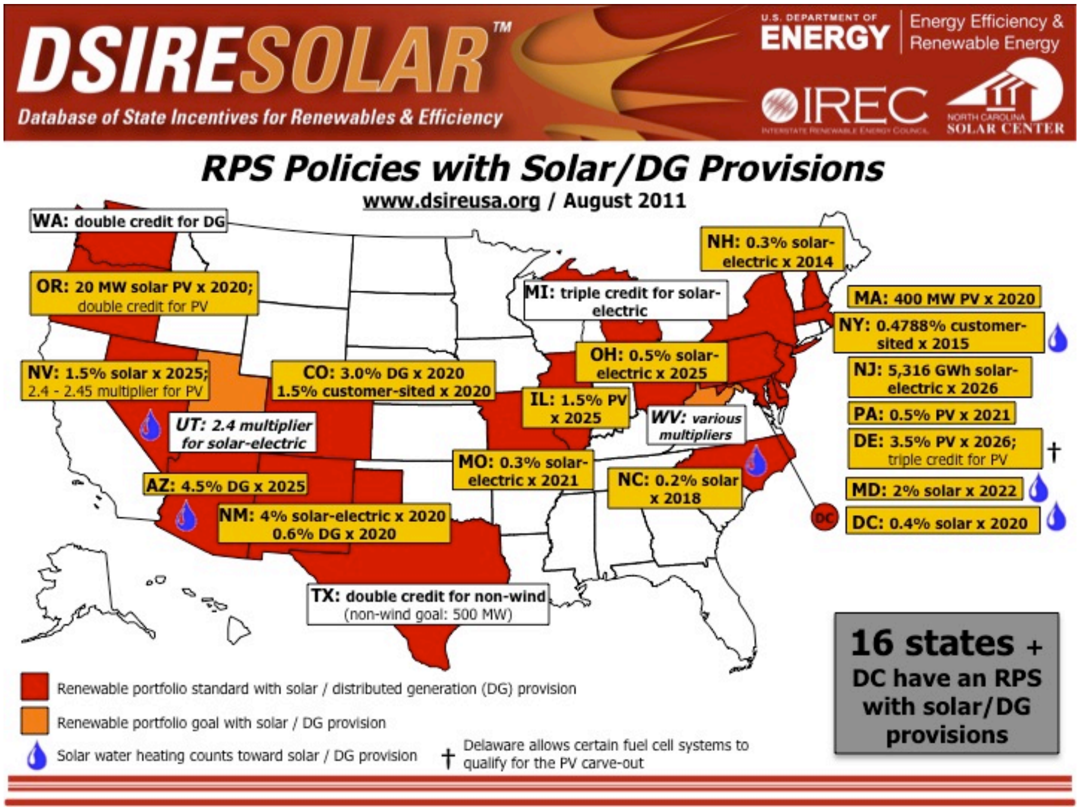
SRECs fall in between utility incentives and CLEAN Contracts. An SREC represents the environmental and grid value of one megawatt-hour (MWh) of solar power. The are sold via short-term contracts or on a spot market rather than an upfront payment (e.g. rebates) or long-term contract. They are only used in concert with a state solar mandate and their price is set by the difference between the supply of solar and the state-mandated demand. When there's a shortage of solar electricity, SREC prices rise. When there's a surplus of solar electricity, SREC prices fall, often precipitously. Further rules for SREC markets can provide a modicum of price predictability.

CLEAN Contracts and SRECs offer very different mechanisms for financing and developing solar power. This report examines the two policies, their status in the United States, and their relative cost-effectiveness.

State Solar Policies

A total of sixteen states plus the District of Columbia have laws that specifically support solar or distributed generation. Most states support solar via a solar set-aside or "carve out" within the state renewable energy standard. The following graphic from the Database of State Incentives for Renewable Energy (DSIRE) illustrates the extent and style of state support for solar power.[1]

State Mandates Supporting Solar PV Deployment (DSIRE)

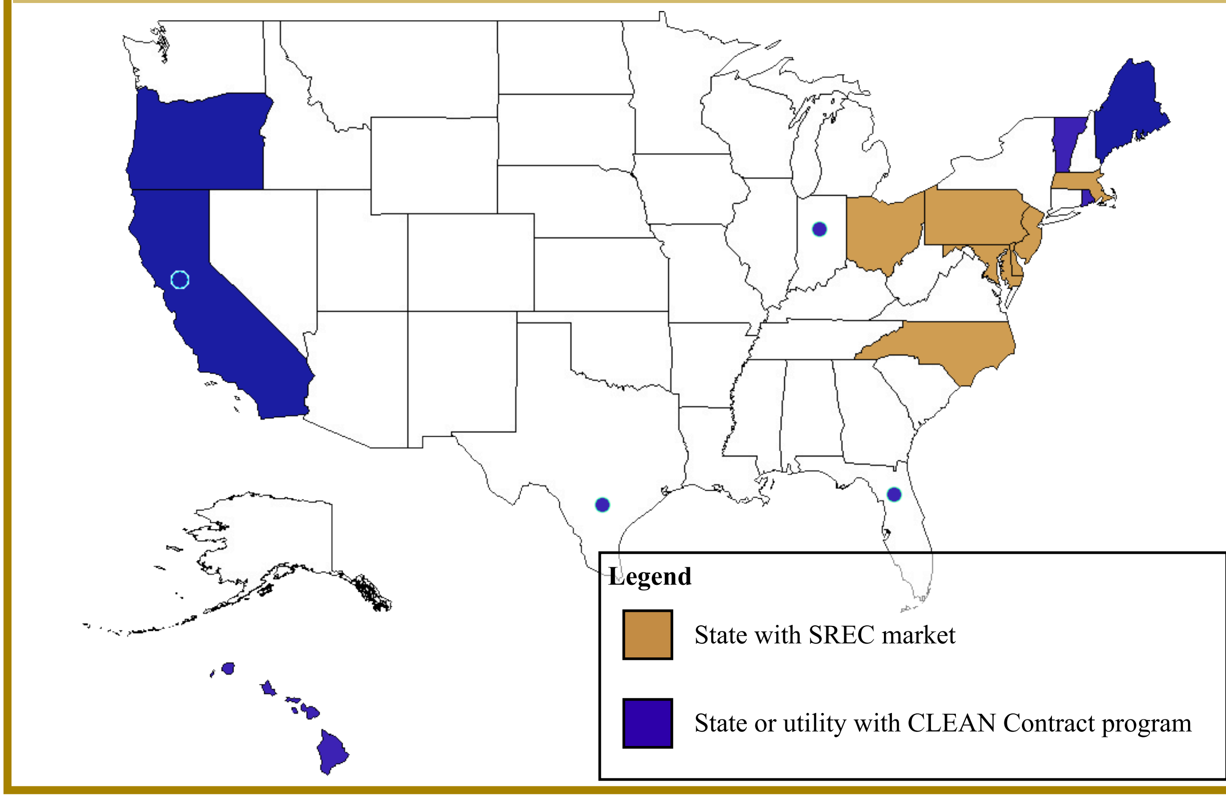


Eight states with a solar set-aside have active markets for SRECs, all with an accompanying state solar mandate.[2] The market-based incentive provides solar developers with the financial wherewithal to meet the state mandate.

CLEAN Contracts can work with or without a state solar mandate. Three states – Vermont, Hawaii, Rhode Island – and three municipal utilities have CLEAN Contract programs for solar PV, none in a state with a state solar mandate. Other states and utilities have performance-based incentives for solar that do not quite fit the definition of CLEAN Contracts.

The following map summarizes the availability of SREC and CLEAN Contract Programs in the fifty states.

Map of States/Localities with SREC or CLEAN Contract Programs



The State of SRECs

A solar renewable energy certificate (SREC) represents the environmental attributes of 1 megawatt-hour (MWh) of solar electricity. The revenue from these sales can help solar projects get financing and increase their rate of return. In 2007, for example, the Colorado Solar Rewards Program used SRECs as a primary financing tool. Of the various revenue streams, the solar RECs provided 42% of the net present value (NPV) of cash flow for a Colorado solar project. In New Jersey, it provided half the installation cost.[3]

Generally speaking, utilities in states with solar mandates must purchase sufficient SRECs to comply with the state mandate, usually expressed as a percentage of retail sales. The following table lists the solar electricity target for each state with a solar mandate and SREC market, and its year of expiration.

State Solar Energy Mandates

State	Solar Mandate (% of Retail Sales or MW)	Target Year
Delaware	3.5%	2026
District of Columbia	0.4%	2020
Maryland	2%	2020
Massachusetts	400 MW	2026
New Jersey	3.9%	2026
North Carolina	0.2%	2018
Ohio	0.5%	2025
Pennsylvania	0.5%	2021

While there is consistency in the basic definition of an SREC, there is a lot of variation in details between the various markets. For example, SRECs have a legal life beyond the year in which they are generated. In New Jersey, SRECs can be used in the year of generation or the year following (2 years) while in Ohio an SREC has value for five years.[4] The following table shows the variation.[5]

The Lifespan of State SRECs

State	Life of SREC
Delaware	3 years
District of Columbia	3 years
Maryland	3 years
Massachusetts	2 years
New Jersey	2 years
North Carolina	2 years
Ohio	5 years
Pennsylvania	3 years

Furthermore, not every state uses a calendar year to define the year of generation. The "energy year" differs from the calendar year in Pennsylvania, New Jersey, and Delaware, where it runs from June to May (similar to a fiscal year) rather than January to December.

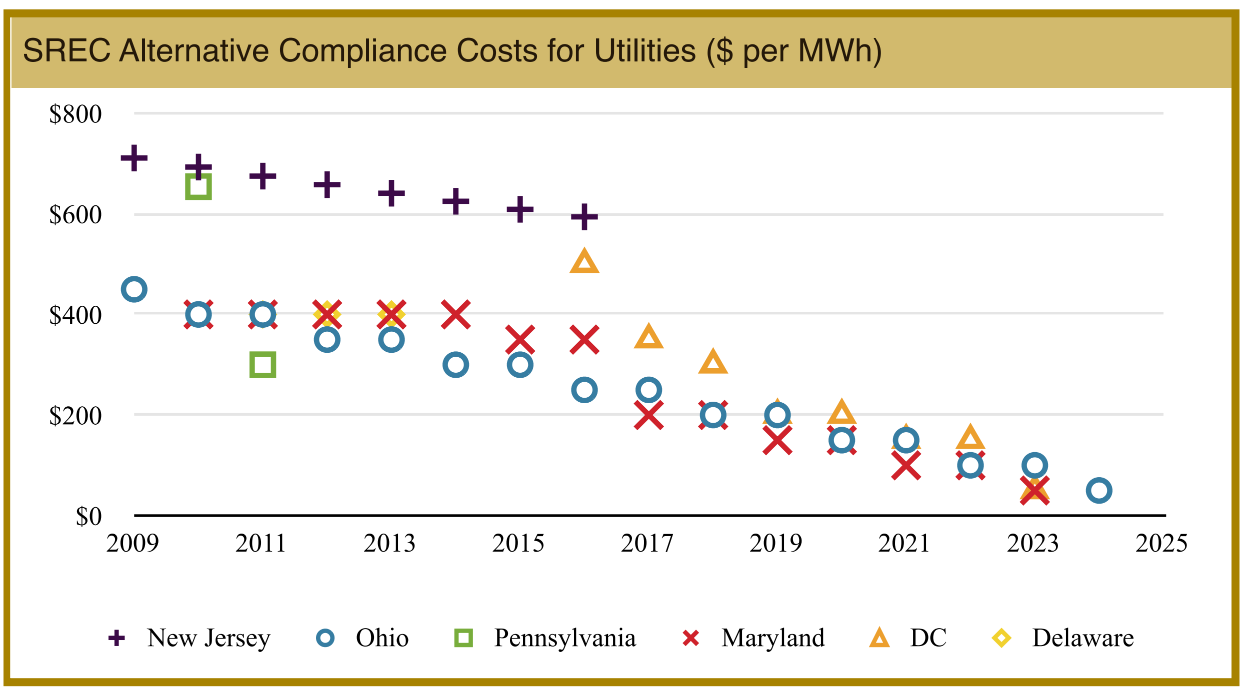
The difference in the definition of SRECs contributes to broad differences in pricing. While the eight states with SREC markets are in close geographical proximity, there's little continuity in the prices. Solar producers in Pennsylvania receive as little as $10 per SREC while producers selling into the Massachusetts market can get spot market prices as high as $525.

SREC Prices in States with SREC Markets (Sept. 2011)[6]

State	Year of SREC	Price
Delaware	2011-12	$85
District of Columbia	2011	$85
Maryland (in-state only)	2011	$189
Massachusetts	2011	$525
New Jersey	2012	$167
North Carolina		*forthcoming*
Ohio (in state)	2011	$401
Ohio (out of state)	2011	$45
Pennsylvania	2011	$10

The prices for solar RECs are typically far higher than RECs for other renewables. In states with a renewable portfolio standard (RPS) policy and a REC market, non-solar RECs typically have a value of $3 to 22 (2008 data).[7]

In each state with a solar mandate and an SREC market, there is also an alternative compliance payment (ACP). This acts as a price cap on the solar REC market, allowing utilities to pay the ACP in lieu of buying an SREC. The level of this price varies widely, from $400 to $700, with most states setting a declining schedule for the ACP (Delaware at $400 and DC at $500 are the notable exceptions).

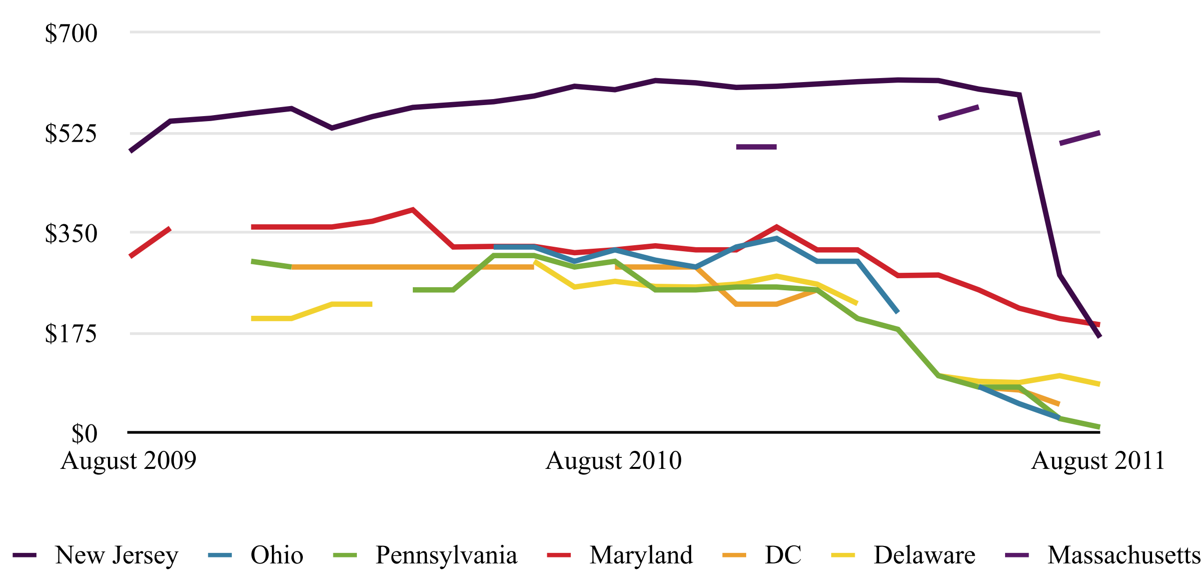


However, as discussed next, alternative compliance payments are virtually meaningless in most states in 2011, as oversupply has caused SREC prices to plummet.

Issues in State SREC Markets

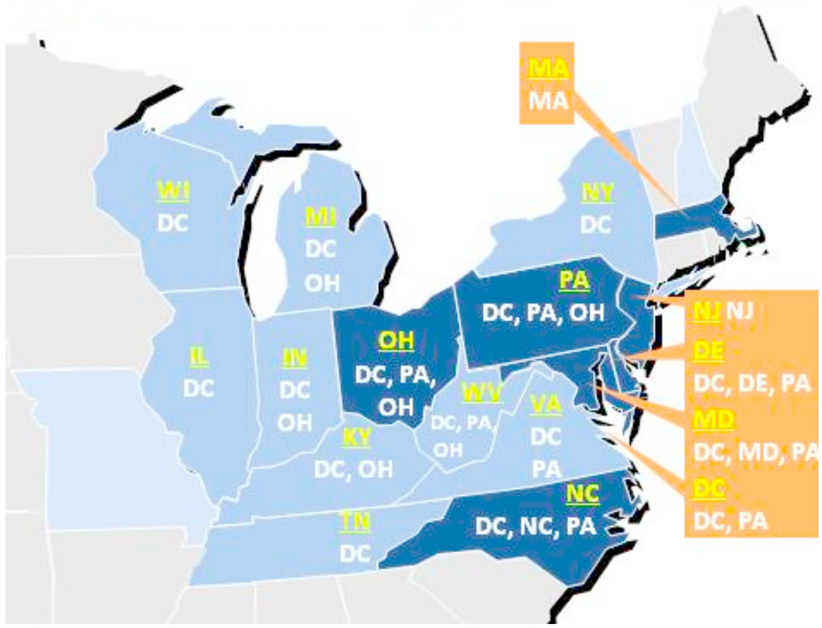
The major issue for SREC markets is uncertainty. With the exception of the price ceilings (ACPs) shown previously, the price of SRECs is entirely reliant on relationship between SREC supply and state mandated demand. This can lead to spectacular price volatility. While prices for SRECs were relatively stable throughout 2010 in most states, prices in nearly every state market have plunged in recent months.

SREC Price Volatility (SREC Prices August 2009-11, $ per MWh)



A major factor in price volatility is the interconnection of state SREC markets. While each state has its own market, they are interconnected. The following graphic from SRECTrade.com shows how most states with solar mandates accept SRECs from at least one other state market.[8] Thus, when Pennsylvania's SREC market was recently oversupplied, the surplus SRECs spilled into other state markets, oversubscribing their state mandates. Exacerbating the problem are the many states (in light blue) who have no internal market for SRECs but whose solar projects may sell their SRECs in states with SREC markets. Thus, a solar developer in Michigan can sell SRECs in Ohio (and probably will, since they have more value in that state).

States with SREC markets and Eligible Sellers in Those Markets (SRECTrade.com)



States with SREC markets: RPS, solar requirement and SACP

States eligible to sell into other state SREC markets

States with an RPS solar requirement but no SREC market yet

Long-term Contracts

The price volatility in SREC markets can be modestly mitigated by "long-term" contracts of three, five, or even ten years. Prices are typically lower for long-term contracts, reflecting lower alternative compliance payments and expectations of lower solar power costs. Spot markets can maximize short term profit, but may leave the seller vulnerable if the market becomes saturated.[9]

Even as spot prices varied, five-year SREC contracts in Pennsylvania sold at a 10% discount to spot market prices or 80% of the alternative compliance fee.[10] In Delaware, the spot market for SRECs in 2010 was $275 but a 5-year contract could be obtained for $250.[11] Contracts of 10 years have been awarded to some New Jersey solar developers, at a price of $340 to $450 per MWh (around April 2010, when the spot price was $616 – a 25% to 45% discount).[12]

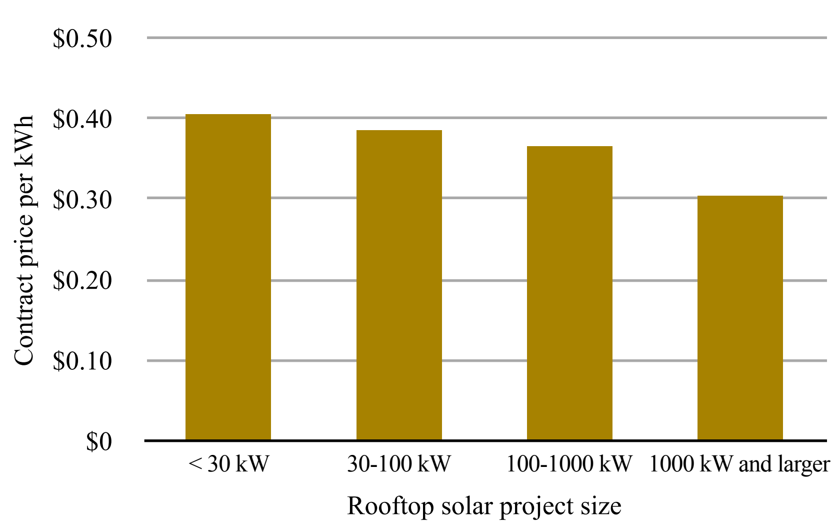
A number of brokerages have sprung up to serve the long-term market, aggregating SRECs from many solar projects through contracts to sell either on the spot market or bank for future use.

Other Issues for SRECs

Other than the price uncertainty, SREC markets can affect the market for solar in two additional ways, market participation and stranded costs. On the participation front, SREC markets can make it difficult for small or rooftop projects to succeed. With no price differentiation by project size or placement, SRECs tend to provide the best economics for solar projects using open space on the ground, and large enough to capture most economies of scale. The adjacent chart shows the price differentiation of the Germany solar CLEAN Contract Program, with lower prices paid to larger projects based on lower anticipated installed costs. An SREC, in contrast, pays the same for a MWh of solar regardless of the source.

This is particularly an issue for medium-scale projects that exceed state net metering* limits. Such projects may not have the scale and economics to compete with the largest solar projects (especially in the utility bidding process), but can't use the net metering policy for interconnection and the favorable buyback rate.

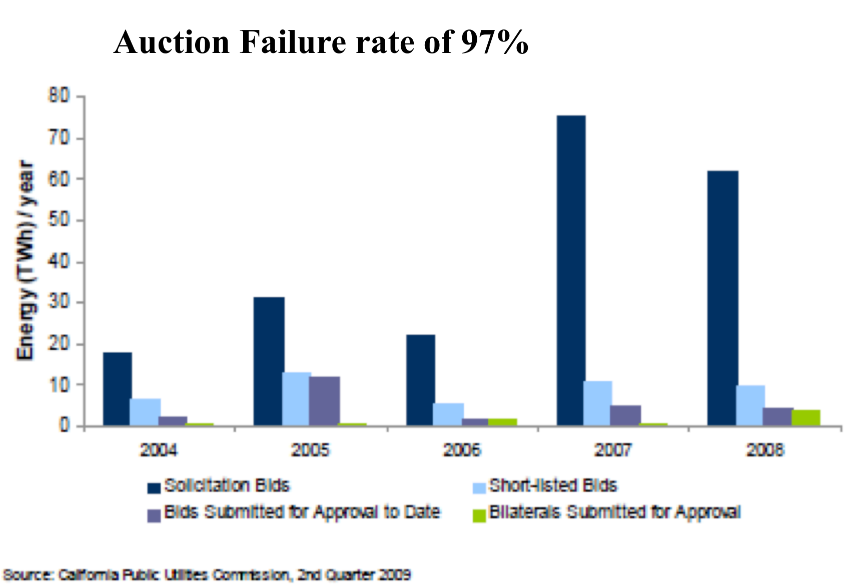
German CLEAN Contract Rates Vary With Project Size



The problems with market participation are reinforced because SRECs are intended as revenue in addition to federal tax incentives (the 30 percent tax credit and accelerated depreciation) that reduce project costs by nearly half. For individuals who can't use federal depreciation or non-taxable entities (e.g. cities, schools, churches), SRECs may prove insufficient financial incentive to make projects worthwhile.

Stranded costs are a further problem in states with SREC markets but utility-mediated contracts for grid connection. The utility bidding process, with few winners and many losers, leads to millions of dollars invested in site acquisition and project planning for solar projects that do not win a utility contract. For example, as many as 97 percent of distributed generation projects (20 megawatts and smaller) do not win contracts in the bidding process to meet California's renewable portfolio standard, leaving millions of dollars stranded (see chart).[13]

Auctions for Renewables Cause High Stranded Costs

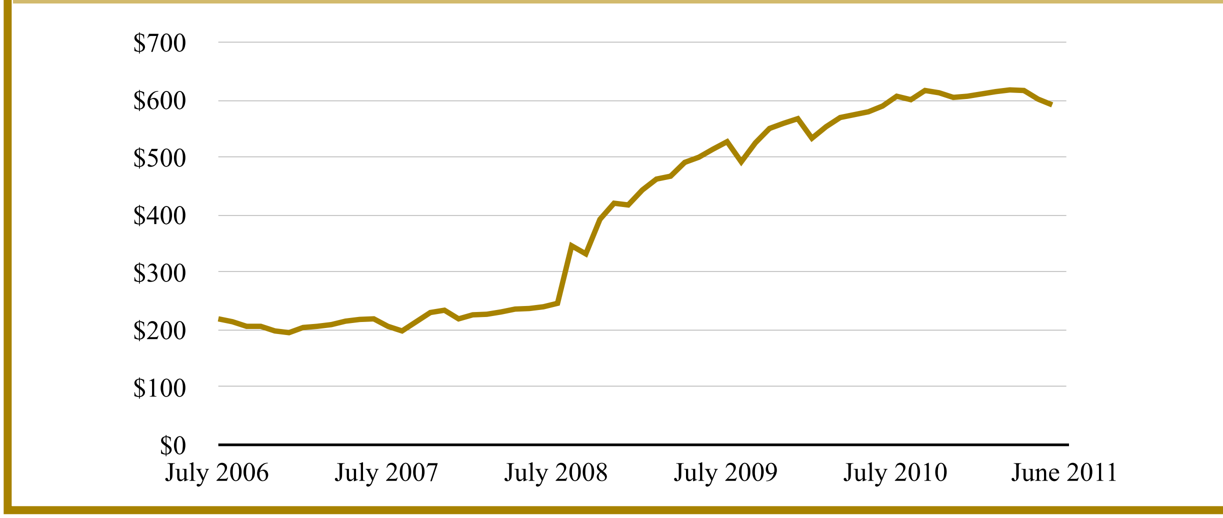


Case Study: New Jersey's SREC Market

New Jersey has one of the longest-running SREC markets in the United States and the price of SRECs has been relatively stable for nearly five years. As such, it makes a good test-bed for evaluating the success of state SREC policies.

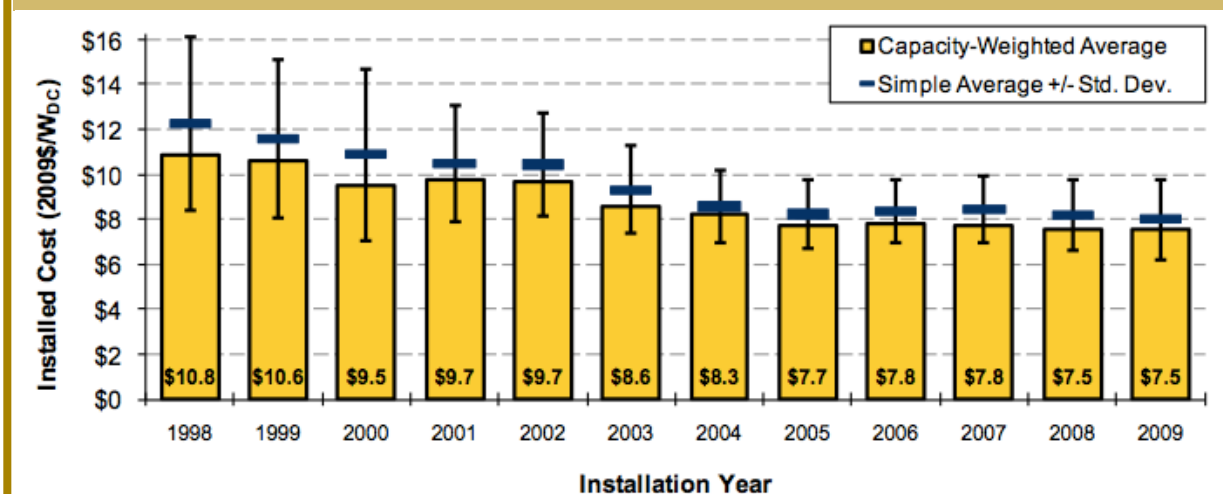
The following chart shows the value of SRECs from June 2006 to June 2011 in New Jersey.

New Jersey SREC Price 2006-11 ($ per MWh)



Interestingly, the value of SRECs have not tracked the installed cost of solar PV projects, as reported by the National Renewable Energy Laboratory in *Tracking the Sun III*. While the New Jersey market SREC prices have slowly increased from $250 to over $600 since July 2008, the installed cost of solar has fallen. The following chart shows the long term trend in U.S. installed costs.

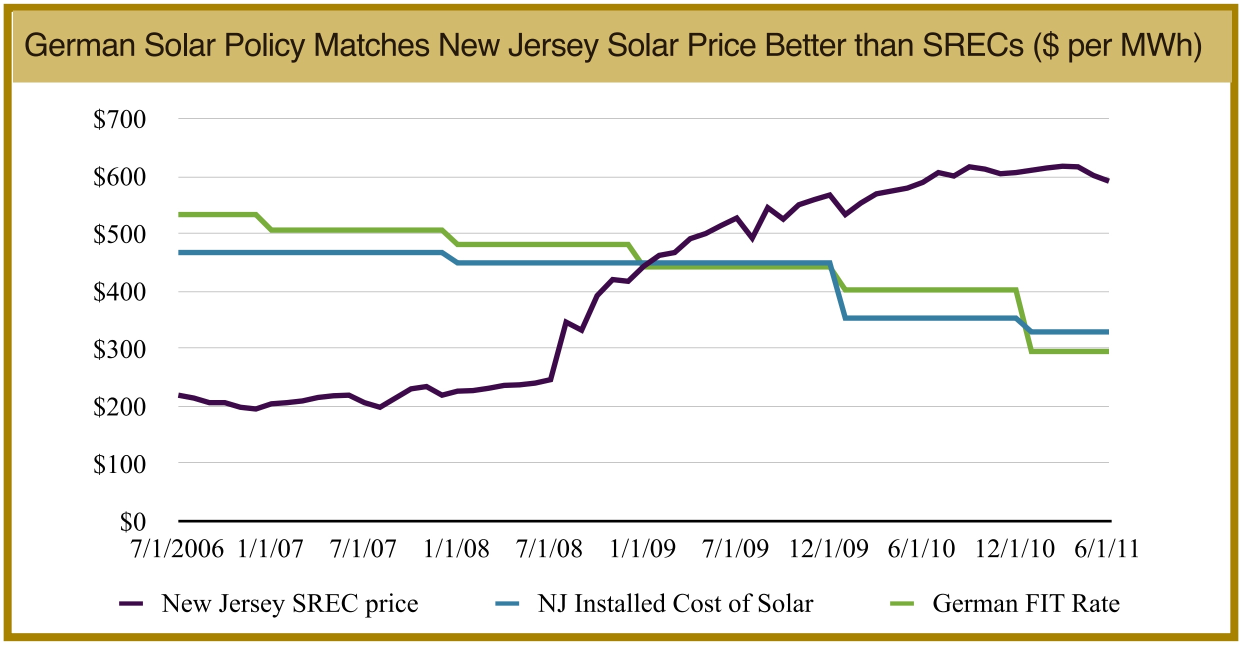
U.S. Installed Cost for Solar PV 1998-2009



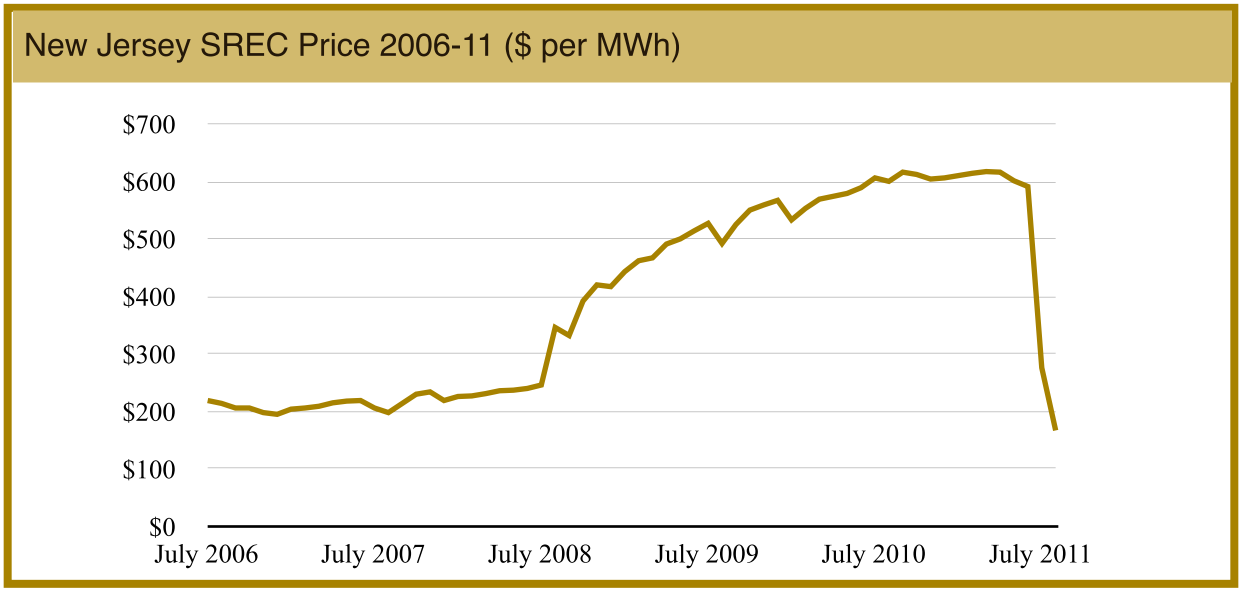
Costs have dropped rather steeply in the past two years (not shown in the previous chart), with average installed costs for solar in New Jersey falling from $7.10 per Watt in 2009 (already better than the U.S. average) to $5.90 per Watt in 2010.

Of course, the key to SREC markets is that they are not meant to accurately price the cost of solar power. Rather, SREC prices indicate whether the supply of solar electricity is too high or too low to meet the state mandate.

That's why the German feed-in tariff (a.k.a. CLEAN Contract Program) is – remarkably – a better measure of the cost of solar power in New Jersey than the New Jersey SREC market. The following graphic shows how the German feed-in tariff price for small rooftop solar (green) has matched the installed cost of solar in New Jersey (blue) much closer than the SREC price (purple).



The next chart shows what happens when the SREC market works as intended. updating the previous chart of New Jersey SREC prices with the latest data. A shortage of solar power relative to the state's mandate pushed SREC prices near to the legal price ceiling by mid-2011. But in July, it became clear that the 2012 contract year would provide the first solar surplus, causing prices to drop precipitously. Clearly, New Jersey's SREC market did support the development of solar, with nearly 140 MW installed by the end of 2010. But it's hard to see how it would be consistently cost effective for ratepayers.



For example, the 5-year net present value of a 1-kW solar project installed in July 2009 (assuming the sale of SRECs via a 5-year contract at a 10% discount to the spot price) would have been around $76. But the same project built a year later, when average installed prices had fallen to $5.90 per Watt, would have been $1,028, more than 10 times higher. Ratepayers would be paying 10% more for solar that was 20% cheaper to install.

A project built after the price crash in August 2011 would have a 5-year net present value of -$538, even if it could be installed at just $4.00 per Watt. But what developer would finance a solar project that wouldn't pay back?

Net Present Value and Ratepayer Cost of Solar in New Jersey (Three Examples)

Date of Install	Installed Cost per Watt	SREC 5-year Contract	5-year NPV	Ratepayer cost per kWh of solar (NPV)
July 2009	$7.50	$474 per MWh	$76	$0.47
July 2010	$5.90	$545 per MWh	$1,028	$0.51
August 2011	$4.00	$150 per MWh	-$538	$0.14

Ultimately, the state mandate means solar installations will continue. But the issue for New Jersey is whether the discontinuity between SREC values and the installed cost of solar means higher costs for ratepayers and an unsustainable boom-and-bust cycle for solar installers.

CLEAN Contracts in the States

A number of states have implemented limited CLEAN Contract policies, with varying levels of success. No state has replicated the full-scale policy or success of Germany's renewable energy program, with over 43,000 megawatts of installed wind and solar power.

The most robust statewide CLEAN Contract Program in the U.S. is in Vermont, where a 50 megawatt (MW) program offers 20-year contracts for hydro, landfill gas, farm methane, wind and biomass and 25-year contracts for solar power. The program, supplying up to 2 percent of total state electricity capacity, is fully subscribed. The following table illustrates the contract prices.[14]

Prices for Vermont CLEAN Contract Program (Vermont SPEED)

Technology	1st year price (per kWh)	Inflation adjustment
Solar PV	$0.240	0
Hydro	$0.119	0.5%
Landfill gas	$0.869	0.5%
Farm methane	$0.136	0.5%
Wind 1.5 MW	$0.113	0.5%
Wind 100 kW	$0.208	0.5%
Biomass	$0.121	0.5%

The Gainesville, FL, municipal utility offers one of the most robust solar CLEAN Contract programs in the United States, offering 20-year contracts for solar PV. Systems are limited to 1 MW or 300 kW for ground- and roof-mounted, respectively. The program has already interconnected 4 MW of solar PV and will accept an additional 2.7 MW in 2011. The following table shows the prices paid for projects connected in 2011.[15]

Prices for Gainesville Regional Utility CLEAN Contract Solar Program

System size or location	Contract price (per kWh)
< 10 kW	$0.320
10-300 kW building or pavement mounted	$0.290
10-25 kW ground-mounted	$0.290
25-1000 kW ground-mounted	$0.240

Indianapolis Power & Light (IPL), adopted a very modest CLEAN Contract for solar PV in 2010. The program is capped at 1% of IPL's electric sales (125 MW) and is available for commercial solar PV projects 20 kW to 10 MW. The 10-year contract has two prices, $0.24 per kWh for solar 20-100 kW and $0.20 for solar projects 100 kW and larger. The prices are reasonable, but the contract duration may be too short. Solar projects installed at the world-leading price of $3.50 per Watt would require $0.17 over 20 years to make a reasonable return. Since installed costs in Indiana are likely a minimum of $1 per Watt higher, the 10 year contracts at these prices are likely insufficient without lower solar prices.

Prices for Indianapolis Power & Light CLEAN Contract Solar Program

System size or location	Contract price (per kWh)
< 10 kW	n/a
20-100 kW	$0.240
100 kW to 10 MW	$0.200

CPS Energy, the municipal utility serving San Antonio, TX, recently launched a very limited CLEAN Contract program for solar, but with good pricing. The program is capped at 10 MW of solar PV and offers a single price, 20-year contract for solar PV projects in a 2-year pilot. The price of $0.27 per kWh is sufficient for a good return on investment for solar with an installed cost as high as $6.40, assuming the project can use federal tax incentives. It may be that the utility found this price too attractive, as CPS Energy recently ordered 400 MW of solar PV contracts in a traditional request for proposal process, based on attractive prices for larger scale solar.[16]

Prices for CPS Energy (San Antonio) CLEAN Contract Solar Program

System size or location	Contract price (per kWh)
< 25 kW	n/a
20-100 kW	$0.270
> 500 kW	n/a

Hawaii also has a CLEAN Contract program for solar with good rates. The program is differentiated into two size classes with attractive prices. The following table illustrates the size categories and rates for Oahu (the other islands have smaller project size caps).

Prices for Hawaii CLEAN Contract Solar Program

System size or location	Contract price (per kWh)
< 20 kW	$0.274
20-500 kW	$0.238
> 500 kW	n/a

Unfortunately, Hawaii's program has attracted little interest thus far, with applications for just 2.6 of the 80 available MW in the program. The problem is that the utility claims it can curtail – or refuse to purchase power – from any solar project in the program, at their discretion.[17]

The following table summarizes the program size and installed capacity for the existing CLEAN Contract Programs in the U.S.[18] Rhode Island's program is still awaiting regulatory rule-making and is not listed.

Summary of CLEAN Contract Programs in the United States

Locality	Program Size	Installed Capacity (2010)
Vermont	50 MW	2.9
Gainesville, FL	4 MW per year	4
Indianapolis Power & Light	125 MW	1.8
CPS Energy (San Antonio, TX)	10 MW	n/a
Hawaii	80 MW	2.6

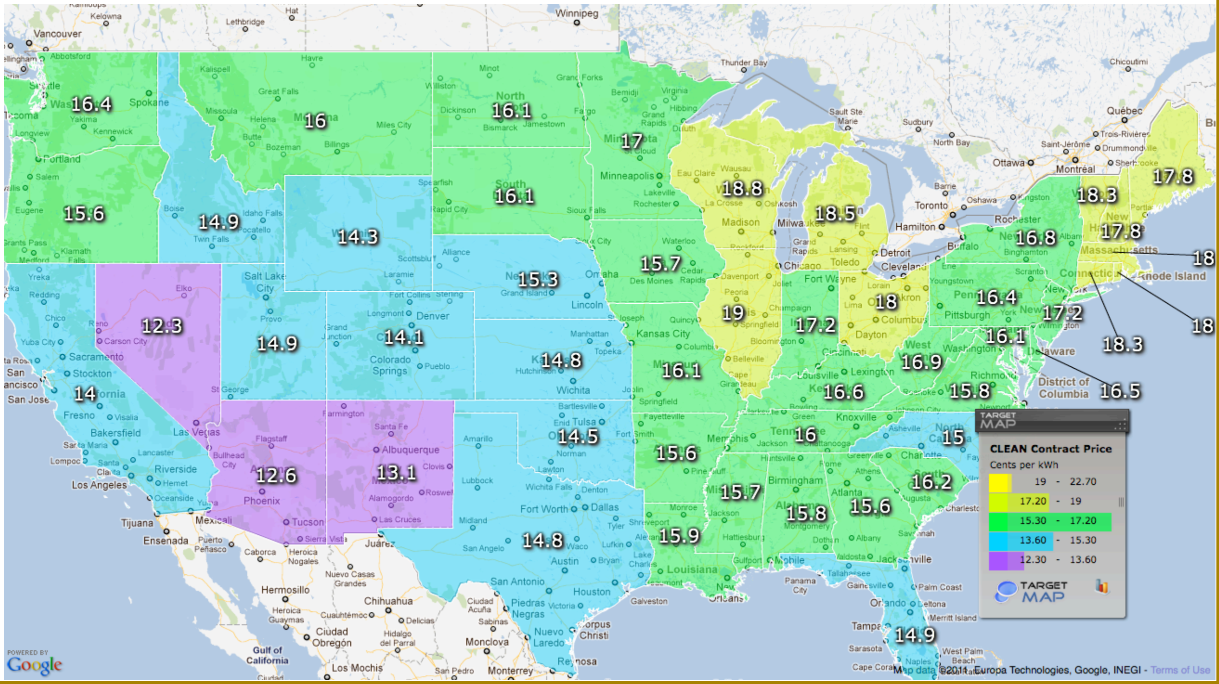
In general, prices for CLEAN Contracts for solar PV are between 24 and 32 cents per kilowatt-hour (kWh) on top of the federal tax incentives (tax credit and depreciation). Because of significant differences in solar insolation, the prices imply very different assumptions about the installed cost of solar power. Assuming 20-year contracts and rates of return similar to the German CLEAN Contract Program, the prices offered in each program correspond to installed costs between $3.80 and $7.50 per Watt.

Implied Cost of Solar PV from CLEAN Contract Prices in the United States

Locality	Highest Contract Price ($ per kWh)	Implied Installed Cost ($ per Watt)
Vermont	$0.24	$4.60
Gainesville, FL	$0.32	$7.50
Indianapolis Power & Light	$0.24	$3.80
CPS Energy (San Antonio, TX)	$0.27	$6.40
Hawaii	$0.27	$7.00

While historical prices for solar PV suggest that Vermont and IP&L's programs were too cheap, average commercial solar prices have fallen to $5.20 per Watt in the U.S and are falling rapidly.[19] To provide some perspective on the near-term price for solar, the Germans already install solar PV at an average of $3.50 per Watt for commercial rooftop projects less than 100 kW. The following map illustrates the CLEAN Contract rate for state for solar at that price. Prices are 12-14 cents in the sunny Southwest, and 14-16 cents in the Midwest and Southeast, and 17-18 cents in the Northeast (whose expensive electricity makes that a bargain). In the U.S., prices for megawatt-scale solar are averaging $3.75 per Watt in mid-2011, suggesting that this map is an accurate picture of aggressive CLEAN Contract pricing.

CLEAN Contract Prices at $3.50 per Watt



States or Localities with Near-CLEAN Contracts

Some areas in the U.S. have programs that mimic the production-based or long-term contract philosophy of CLEAN Contract Programs, but lack a key component such as cost-based pricing (note: while all advocates agree CLEAN Contracts must include standardized, long-term contracts for power sales, some think that avoided-cost pricing is a reasonable method to persuade utilities to adopt CLEAN Contract Programs).

Maine's CLEAN Contract program is limited to locally owned renewable energy projects 1 MW and smaller. Projects receive the lesser of a 1.5 REC multiplier or a fixed $0.10 per kWh payment over a 20-year contract, regardless of size or technology. The program size cap of 50 MW limits the state's program to 1 percent of generation.[20] As of August 2011, only three wind projects and one anaerobic digester had been certified as community-based by the state public utility commission (only one is currently operational).[21]

The state of California has a program for renewable energy systems 1.5 MW and smaller that is called a feed-in tariff (a.k.a. CLEAN Contract), but while it offers long-term contracts and prices based on the kWh produced by projects, it's not a true CLEAN Contract program. The process is mediated by utility request for proposals rather than open to any interested generator and the prices are set based on a combination of the time-of-day of electricity production and the "market price referent," the cost of proxy combined cycle natural gas generator.[22] Similarly, the Sacramento Municipal Utility District has offered an avoided-cost (rather than cost-of-generation) based CLEAN Contract program since 2010. The expected price of $0.17 per kWh seemed low at the time, but the entire 100 MW program has been subscribed with 93 kW operational through August, 2011.[23]

Oregon's CLEAN Contract program offers a premium price for solar in addition to net metering. Excess electricity generation is forfeit and payments are made for just 15 years. Rates are differentiated by project size (< 10 kW, 10-100 kW, and over 100 kW). The largest projects competitively bid for contracts.

Room for Debate: CLEAN Contract Programs?

Locality	Limitation
Maine	Only pays $0.10 per kWh
California	Price based on a combination of time-of-day production and market price referent
Sacramento, CA	Price based on avoided cost
Oregon	Price only paid for electricity used on-site, and is reduced by net metering

Other CLEAN Contract Programs have ended or are yet to begin. Consumers Energy in Michigan had a two-year CLEAN Contract pilot program with attractive prices on 12-year contracts, but the 2 MW program has ended. Other U.S. locations with active or forthcoming CLEAN Contract programs include Rhode Island, the Palo Alto, CA, municipal utility[24] and the Northern Indiana Public Service Company.[25]

Issues for CLEAN Contracts

CLEAN Contract pricing is the key issue. In communities where the price is too low, solar development will lag as developers struggle to make projects pencil out. If prices are too high, then solar developers will make out-sized returns. The major difference between CLEAN Contracts and SRECs is the longevity of those prices. SRECs may fluctuate significantly while CLEAN Contract prices are fixed for 20 years by contract, and the new contract prices are typically adjusted once or twice per year.

One strategy employed to insulate ratepayers from potentially high prices in U.S. CLEAN Contract Programs is a size cap. If prices are too high, the overall ratepayer impact will be limited because the program is restricted. Every U.S. CLEAN Program has a numerical cap, ranging from 4 MW per year in Gainesville to 125 MW for the complete IP&L program.

Another issue – also in common with SRECs – is the reliance on federal tax incentives. Every U.S. CLEAN Contract Program assumes that the developer will be able to use the 30 percent federal tax credit and accelerated depreciation. As shown in the following table, developers would have to achieve remarkably low costs without federal incentives to make a reasonable return on investment at the CLEAN Contract price.[26]

Implied Cost of Solar PV from CLEAN Contract Prices in the United States

Locality	Highest Contract Price ($ per kWh)	Implied Installed Cost ($ per Watt)		
		With fed. tax credit and depr.	No depreciation	No incentives
Vermont	$0.24	$4.60	$3.50	$2.71
Gainesville, FL	$0.32	$7.50	$5.70	$4.39
Indianapolis Power & Light	$0.24	$4.90	$3.72	$2.87
CPS Energy (San Antonio, TX)	$0.27	$6.40	$4.86	$3.75
Hawaii	$0.27	$7.00	$5.32	$4.10

As mentioned previously, this reliance on federal money may make residential solar more difficult (no access to depreciation) as well as place burdens on solar projects by non-taxable entities like cities or schools (no access to tax credits).

There can also be issues with avoiding federal pre-emption of state-based CLEAN Contract Programs. Federal law generally prohibits states from requiring utilities to pay greater than their avoided cost for electricity. CLEAN Contract Programs established by utilities do not face this challenge as they are voluntary, and state-based programs have to design to avoid issues with the federal rules. More information on this issue can be found in *Adopting State Feed-in Tariff Laws without Federal Preemption* and *Available Paths for Designing Strong State Feed-in Tariffs*, published by the Environmental Law Alliance Worldwide.

CLEAN Contracts have a couple of advantages over SRECs. One advantage is that CLEAN Contracts can be differentiated by project size, taking into account the differing economies of scale for smaller projects. Such a practice may slightly increase the total cost of the program while opening participation to smaller projects such as residential solar. CLEAN Contract programs also tend to avoid the stranded cost and high risk issues with SRECs, since the standardized contract and interconnection rules significantly reduce the risk of planning a project without getting a contract. Furthermore, the projects under a CLEAN program generally do not compete against one another in a bid process, but rather compete to generate a better return by getting ahead of the annual contract price reductions.

Comparing CLEAN and SRECs

CLEAN Contracts and SRECs are similar in two respects. Both provide revenue streams for solar project developers to help make solar projects easier to finance. Both can work inside of government-created markets for solar, or in the case of SRECs, only work in cooperation with a government solar mandate. But which works better (and by what criteria)?

Political expediency is certainly a consideration (e.g. which is more likely to be enacted by a state legislature), but our criteria is which solar policy can most cost-effectively deploy the greatest capacity to generate solar electricity.

This section compares SRECs and CLEAN Contracts, starting with a brief overview of the size of markets and cost of solar in the states with existing programs, a discussion of the comparative risks for developers under each program, and the resulting cost-effectiveness of the two policies. We conclude with a projection of cost effectiveness of SREC and CLEAN Contracts for the state of New York.

Installed Capacity

When it comes to solar power in the United States, neither policy has an advantage in actual deployment. The eight states with SREC markets have a combined solar capacity of 240 MW, although a significant portion of that total was developed prior to the SREC markets. The three CLEAN programs have a total capacity of around 50 MW, with the same caveat regarding Hawaii's solar capacity. The following table illustrates, and also compares programs by per capita solar installations.

Installed Solar Capacity in States with SREC Markets and CLEAN Contract Programs (2010)

State	Policy	Installed Capacity (MW)	Installed Capacity (MW per million persons)
Delaware	SREC	6.0	6.8
District of Columbia	SREC	0.6	1.1
Maryland	SREC	6.3	1.1
Massachusetts	SREC	n/a	n/a
New Jersey	SREC	137.0	15.6
North Carolina	SREC	31.0	3.3
Ohio	SREC	15.6	1.4
Pennsylvania	SREC	47.0	3.7
		243.5	
Vermont	CLEAN	2.9	4.8
Hawaii	CLEAN	44.7	32.8*
Gainesville, FL	CLEAN	4.0	32.2

**Most of Hawaii's solar PV capacity was installed prior to the adoption of the CLEAN Contract Program*

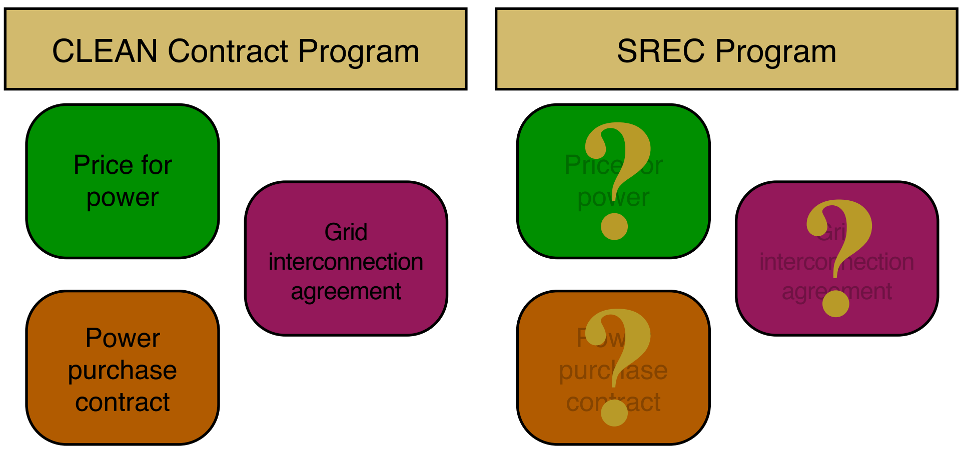
The comparison lacks real force, however, because unlike CLEAN Contract Programs in Germany, Ontario, and elsewhere, every U.S. CLEAN Contract Program has a cap on the total program size and the programs in Vermont and Gainesville have already hit their caps. Hawaii's program is limited by the utility's assertion that it can curtail and refuse to pay for solar power at its discretion.[27] With SREC markets also capped by state mandates, this comparison has limited value.

Transparency

A hallmark of CLEAN Contract Programs is their transparency, in stark contrast to SREC programs. CLEAN Contracts have a publicly set and published long-term price for power on a standardized contract, while the price of SRECs changes daily. Solar producers are guaranteed a grid interconnection and power purchase contract if they enter a CLEAN Contract Program, whereas solar projects under an SREC regime must compete for these contracts under a utility bidding process.

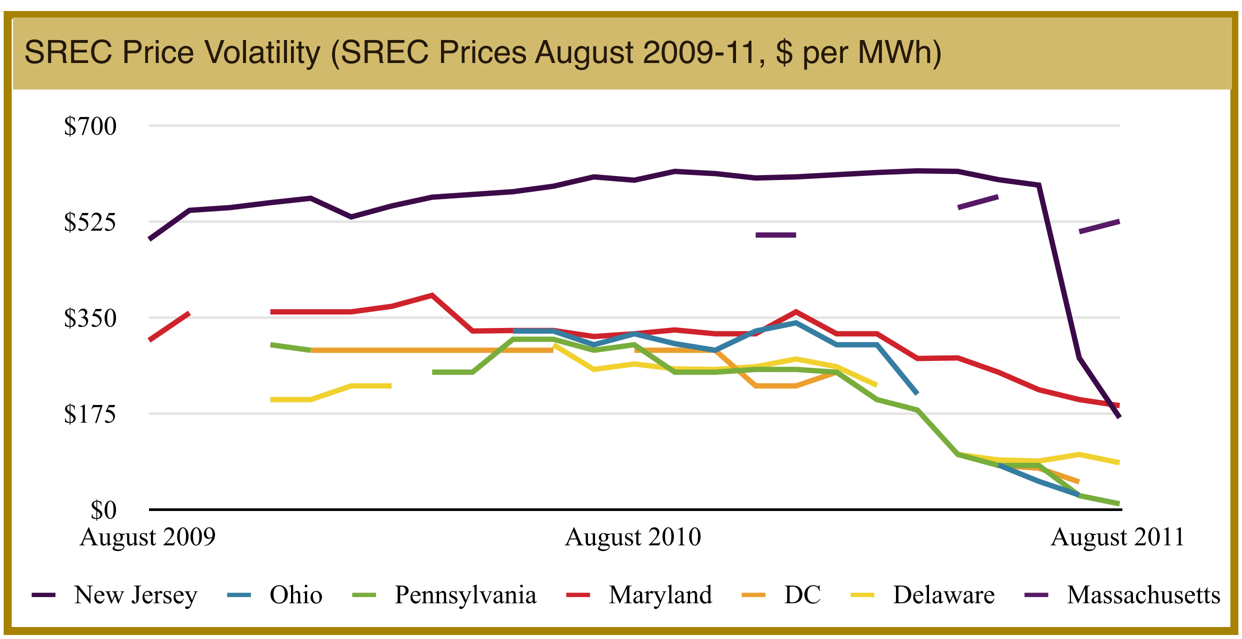
The following diagram illustrates the difference in transparency between CLEAN Contract Programs and SREC Programs.

CLEAN Contract Programs Offer Much Greater Transparency for Solar Developers



Market Consistency

CLEAN Contracts provide substantial market certainty, with completely transparent incentive levels and long-term contracts. Projects lock in 20-year contracts and contract prices for new contracts typically change only once or twice per year. SRECs provide much less certainty. The following chart, seen before, illustrates the price volatility in the seven operating SREC markets in the United States.



In the last year, prices for SRECs have crashed in nearly every state solar market. The most dramatic decline is New Jersey, but significant declines have also occurred in Ohio, Pennsylvania, DC, and Delaware. The price volatility reveals the hidden secret of "market-based" SRECs – they do not represent the marginal cost of installing solar. Rather, they represent a price on the gap between the actual capacity of installed solar and the state's solar energy mandate. If the gap is large, the SREC price is high to stimulate demand. If the gap is small or – as has happened in New Jersey and Pennsylvania – has vanished, the price of SRECs collapses, as does the solar market.

> *"SREC price volatility can turn a relatively profitable investment into a wash for the investors backing the project."*
>
> *- Daniel Yonkin, Director of Regulatory Affairs at SREC aggregator Sol Systems.*

In response to the price collapse across state SREC markets, the solar industry has encouraged legislation in both New Jersey (S. 2371) and Pennsylvania to accelerate solar mandates and revive the market.[28]

Risk

Solar project developers face many risks in development related to the uncertainty of project development and performance, financing, and many others. SREC policies differ strongly from CLEAN Contracts in the level of risk, due to several components of the two policies.[29]

CLEAN Contracts Have Significantly Less Risk for Solar Developers

Risk Mitigation Factor	SREC	CLEAN Contract
Transparency	Utility solicitation process may be obscure, reducing certainty of project success. SREC prices are not known in advance, though some history may provide guidance.	Project is guaranteed interconnection and a contract as long as they are within the program size cap and meet published program criteria. Contract price is known and certain for entire length of contract, e.g. 20 years, before project is constructed.
Longevity	SREC contracts are of limited length, e.g. 5 years, and prices may vary widely in that timeframe.	CLEAN Contracts typically last 20 years at a fixed price.
Certainty	Over 90% of projects in utility solicitation process do not get contracts. SREC prices provide little revenue certainty.	CLEAN Contracts are available on a first-come, first serve basis. Contract price is fixed for 20 years.

The significantly higher risk for project developers with SRECs causes them to demand a higher return on equity and to pay a higher cost of financing solar projects. For example, in comparing California (with a combination of federal tax incentives and state production incentives) and the United Kingdom (with a tradable renewable credit market) to Germany, researchers at Ecofys found that the risk reduction impact of CLEAN Contracts in Germany lowers developer return on equity requirements to 9%, less than the 12% required in the California wind and solar market, and 15% required in the United Kingdom.[30]

The researchers also found that the stability, reliability and predictability of CLEAN Contracts contributed to higher confidence of market actors, reduced regulatory risks, and hence, significantly reduced the cost of capital and overall societal cost of solar power.[31] For example, the weighted-average cost of capital for solar power in German was 4.2%, compared to 6.2% in the United States.[32] The difference in financing costs is substantial: if New Jersey solar developers operated in a low-risk environment like Germany, it would reduce the levelized cost of solar power by as much as 20 percent.

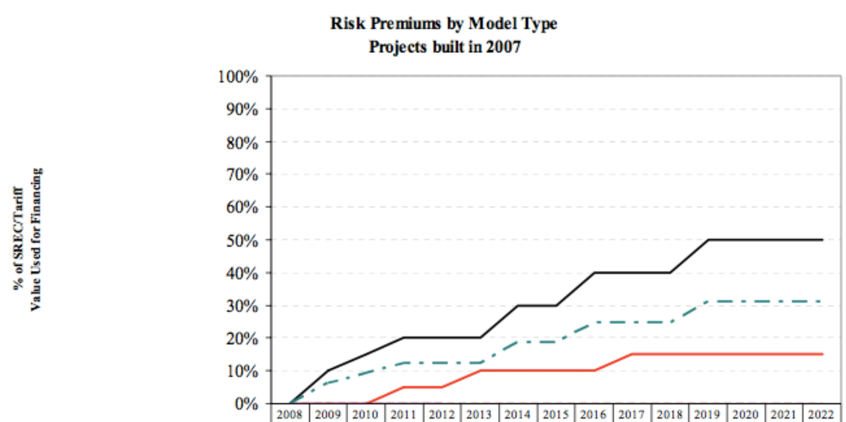
If New Jersey solar developers operated in a low-risk environment like Germany, it would reduce the levelized cost of solar power by as much as 20 percent

This finding is reflected in a 2011 study that found the average cost of solar to be 30 percent higher for California ratepayers than German ones, accounting for the difference in solar resource intensity. Californians pay between $0.33 and $0.38 per kWh for solar power, in comparison to average CLEAN Contract rates of $0.24 per kWh in Germany.[33]

This fits with the findings from international energy consulting firm KEMA, which reported that, "studies have suggested that cost savings of 10-30% may be possible from maximizing investor certainty."[34]

Summit Blue also found significantly higher risk in an SREC model compared to a CLEAN Contract model, when they provided analysis for transitioning the New Jersey solar market from rebates to a "market-based" approach.[35] The adjacent chart illustrates the rising risk premium for projects financed with variable incentives like SRECs.

SRECs Have Highest Solar Policy Risk Premiums



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Base Case/SREC-Only/Commodity	0%	10%	15%	20%	20%	20%	30%	30%	40%	40%	40%	50%	50%	50%	50%
Underwriter	0%	0%	0%	5%	5%	10%	10%	10%	10%	15%	15%	15%	15%	15%	15%
Auction Model	0%	0%	0%	0%	0%										
15 Yr Tariff Model	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Hybrid-Tariff Model	0%	6%	9%	13%	13%	13%	19%	19%	25%	25%	25%	31%	31%	31%	31%

Bankability

The combination of obscurity, volatility and risk significantly decrease the bankability of SRECs in comparison to CLEAN Contracts. Not only is the predicting the actual revenue stream significantly more difficult, but the inherent risk in SRECs actually increases finance costs for projects of identical characteristics compared to projects financed under CLEAN contracts.

Transaction Costs

For CLEAN Contracts and SREC-financed solar projects, there are two levels of transaction costs. At the time of project construction, CLEAN Contracts have minimal transaction costs because the project developer is assured a long-term contract, grid interconnection, and fixed, transparent price for their electricity.

SRECs, however, create significant transaction costs. Solar projects in an SREC regime, particularly those that are larger than net metering thresholds, must participate in a utility bidding process for a contract. The contract must be negotiated and may include bundling the SRECs (and an additional negotiation over the price) or not. For projects that do not bundle the SRECs with the sale of electricity (or projects that net meter), then the project developer must sell their SRECs on the market.

The following table illustrates transaction costs for auctions at one SREC trading firm that automates the sale for customers based on their desired price.[36]

Transaction or Facility Size	Seller Fee	Buyer Fee
< 50 SRECs	2.0%	$5
50+ SRECs	1.5%	$5
250+ SRECs	1.0%	$5
500+ SRECs	0.5%	$5
1,000+ SRECs	0.0%	$5

Transaction costs are lower at other SREC buying firms, but often require more of the seller's time to complete the transaction.

The second level of transaction costs applies to both CLEAN Contracts and SRECs. All the existing programs in the U.S. of either finance mechanism assume that projects will take advantage of one or both of the federal tax incentives for solar (the 30% tax credit and depreciation). Since many prospective owners (individuals, non-profits, cities) can't effectively use one or both incentives, they may have to purchase the solar project through third party financing. Such financing is very inefficient, costing federal taxpayers far more per unit of renewable energy than would cash-based incentives.[37]

Efficient Pricing

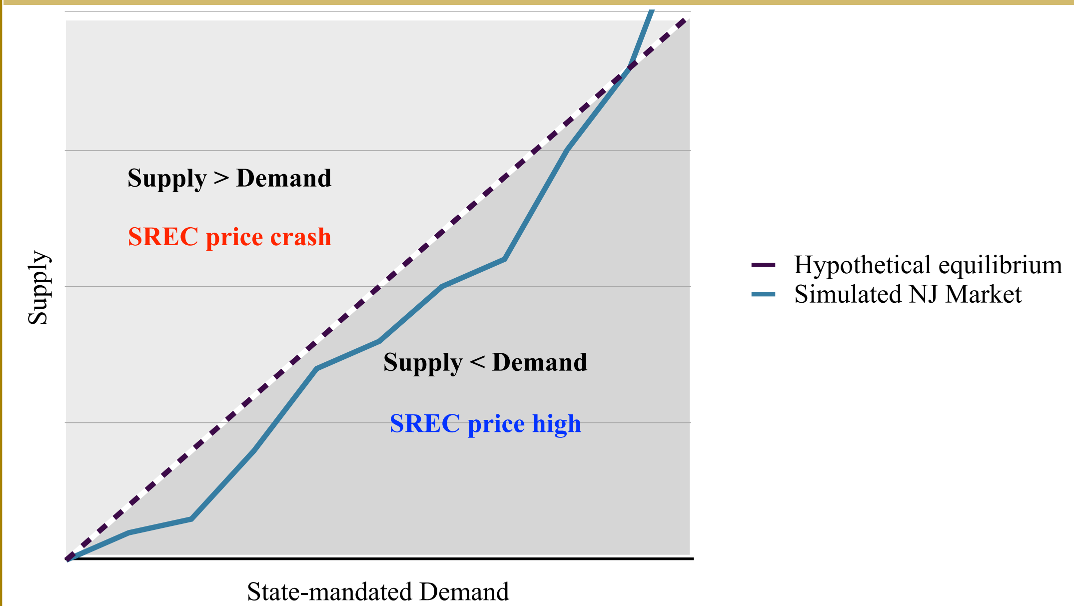
Both CLEAN Contracts and SRECs provide the financial incentive to construct solar. If either is priced too low in the absence of a solar power mandate, none will be built. If either is priced too high, ratepayers effectively overcompensate solar developers. The goal of either policy is to most efficiently price solar, providing just enough to attract investment without over-rewarding solar developers and costing ratepayers.

The key difference is that CLEAN Contracts are priced administratively with the purpose of identifying a sweet spot of developer return on investment for building solar power generation. Overpricing the contract will result in more solar development than expected and unexpectedly high returns for solar developers. Underpricing will result in minimal solar investment.

SRECs, on the other hand, represent the state-mandated demand for solar power at a given time. If utilities are short on their solar power obligations, the SREC price will be limited only by whatever alternative compliance payment the state has allowed (e.g. New Jersey's SREC market price of over $600 per MWh in mid-2011). If the solar market overheats, the price of SRECs will crash immediately in response (e.g. New Jersey's SREC market price of $160 per MWh in mid-2011). The SREC price fell by 75% in a month.

The following chart illustrates the challenge with finding an optimum SREC price. If supply and demand are not in virtual harmony, the market price swings wildly.

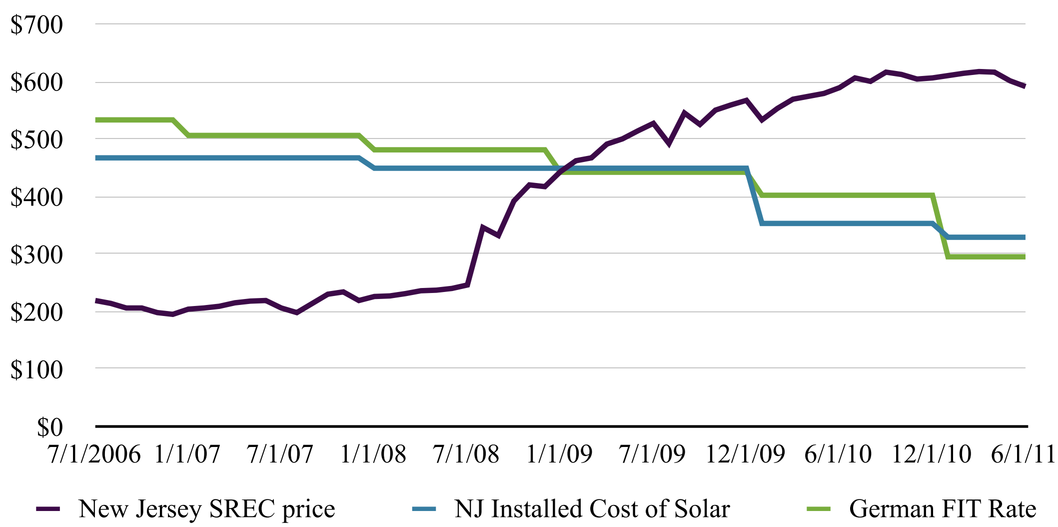
SREC Market Has Razor-Thin Balance Between Supply and Mandated Demand



The razor-thin equilibrium in SREC markets means that they do not closely follow the actual cost of installing solar.

The following chart illustrates how – despite the difference in solar resource and currency – the German CLEAN Contract Program (called a feed-in tariff) was much more effective at mimicking the actual cost of solar in New Jersey over than past five years than was the SREC market price.

German Solar Policy Matches New Jersey Solar Price Better than SRECs



The chart indicates that solar costs were falling, but that New Jersey utilities faced a growing gap between actual solar installations and their state mandate. Thus, compensation for solar projects via SRECs rose even as costs were falling. In contrast, the German CLEAN Contract program followed its schedule price decreases, quite accurately pricing the cost of developing solar projects in New Jersey.

Ratepayer Impact

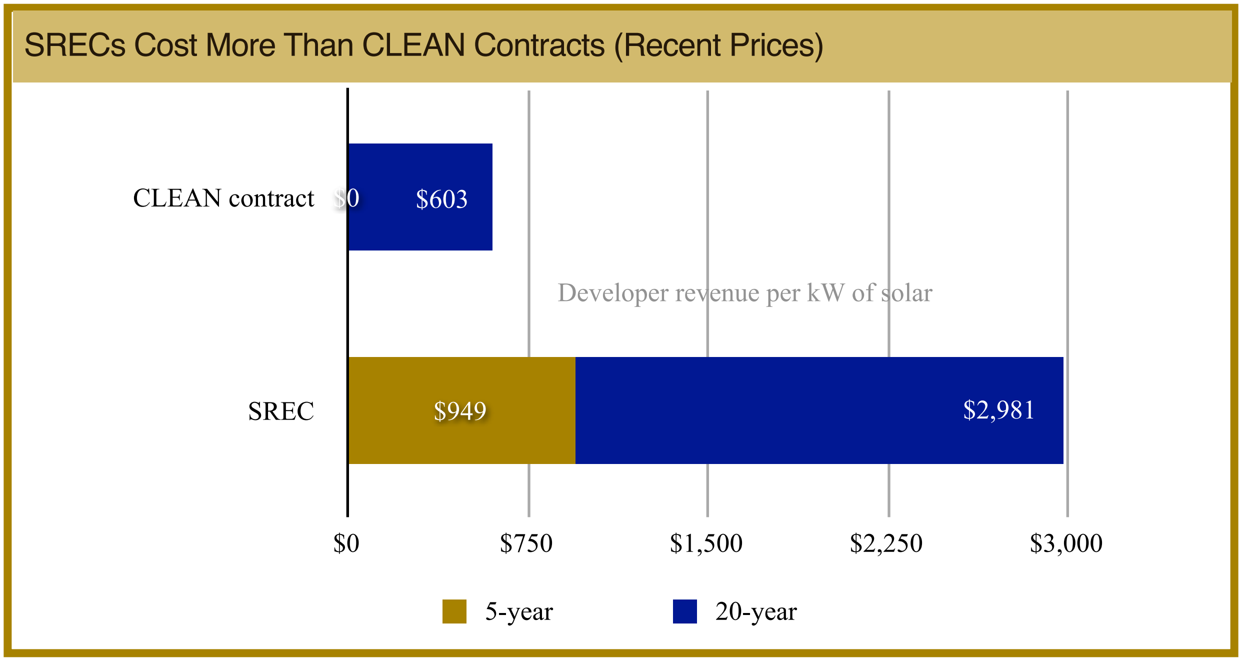
What does each solar financing strategy mean for developers and ratepayers? The following analysis compares the net present value of two identical solar projects, one installed under an SREC regime and the other under a CLEAN Contract Program. The table lists our assumptions about the two projects.

Basic Assumptions for SREC v. CLEAN Analysis

Project Parameter	Assumption
Installed cost per Watt	$5.90
Project size	1 kW
Total installed cost	$5,900
System output (annual)	1,205 kWh AC 0.5% annual degradation
Federal Incentives	
Nominal value of federal tax credit	$1,770
Nominal value of depreciation (30% tax rate)	$1,501
Project Finances	
Portion debt	80%
Debt term	10 years
Interest rate	5% CLEAN Contract 7% SREC
Revenue Stream	
Initial SREC value ($ per MWh)	$531
SREC contract length	5 years
Change in SREC value at contract renewal	88.1% of initial
CLEAN Contract price	$0.29
Real discount rate (rate less inflation)	2%

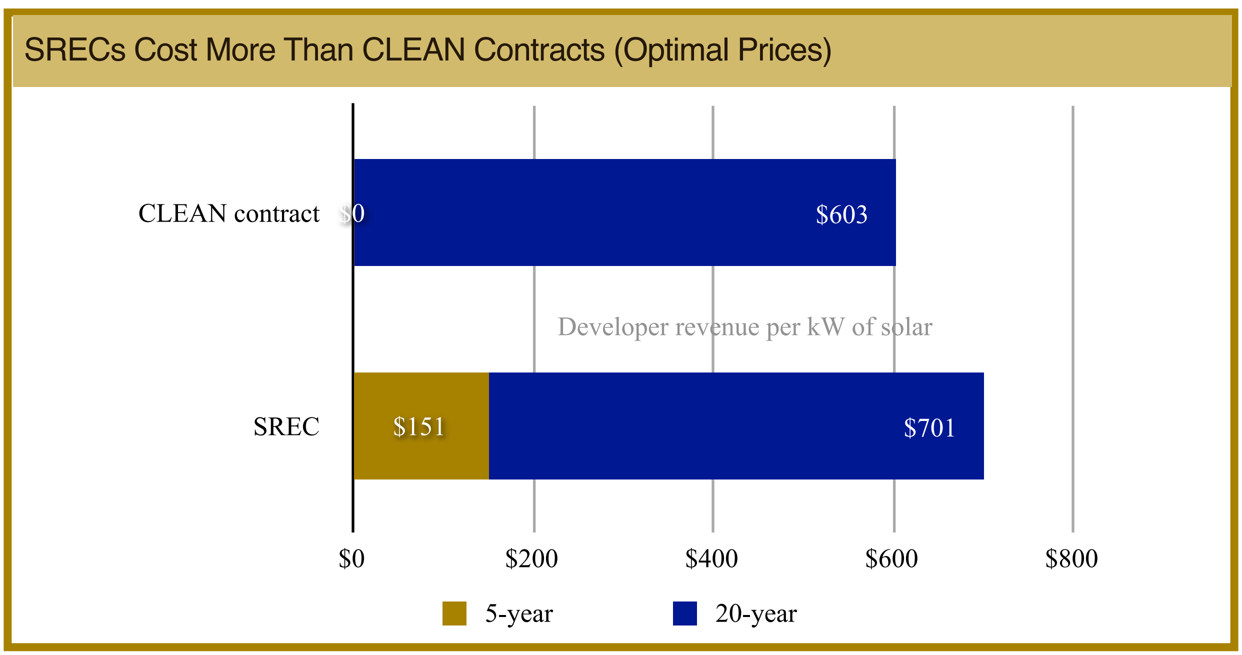
With these parameters, we can illustrate the net present value of project revenues over 5 years and 20 years, and illustrate the ratepayer cost of the electricity from the two systems over the same timeframe.

The first chart shows the net present value (NPV) of net project revenues over 5 and 20 years for projects funded by a CLEAN Contract versus SRECs. SREC-funded projects receive over 50% more revenue (based on recent prices in New Jersey representing market under-supply).
The cost differential also spills over into ratepayer cost. Over the first 5 years, ratepayers in New Jersey pay 83% more for the solar electricity from the SREC-funded project ($3,167 versus $1,730), and 54% more over the 20-year contract ($10,238 versus $6,665).



Ultimately, the difference is the risk-return calculation. A CLEAN Contract is very low risk for the developer, lowering the cost of capital and required rate of return. The SREC is high-risk and requires a higher investor return to stimulate investment.

If the prices seem high for the SREC, it's because the recent market prices were high. The next analysis switches from an actual SREC market price to a hypothetical optimal price, dropping the SREC price down the minimum required for a 10% internal rate of return for the solar investor – $389 per MWh – likely a minimum to induce investment given the risks in an SREC market.



Even at optimal prices, the SREC provides more net revenue to the developer (to offset higher borrowing costs and risk), and the SREC-funded project costs the ratepayer 12% more over 20 years than a CLEAN-funded solar project.

SRECs simply cannot deliver lower cost solar power than CLEAN Contracts while still inducing investment. A lower SREC price would cause the potential return on investment to fall too low to induce development. Furthermore, because SRECs are front-loaded, with costs intended to decline over time, the net present value of their cost (and the ratepayer impact) are higher than CLEAN Contracts that pay a fixed rate over time.

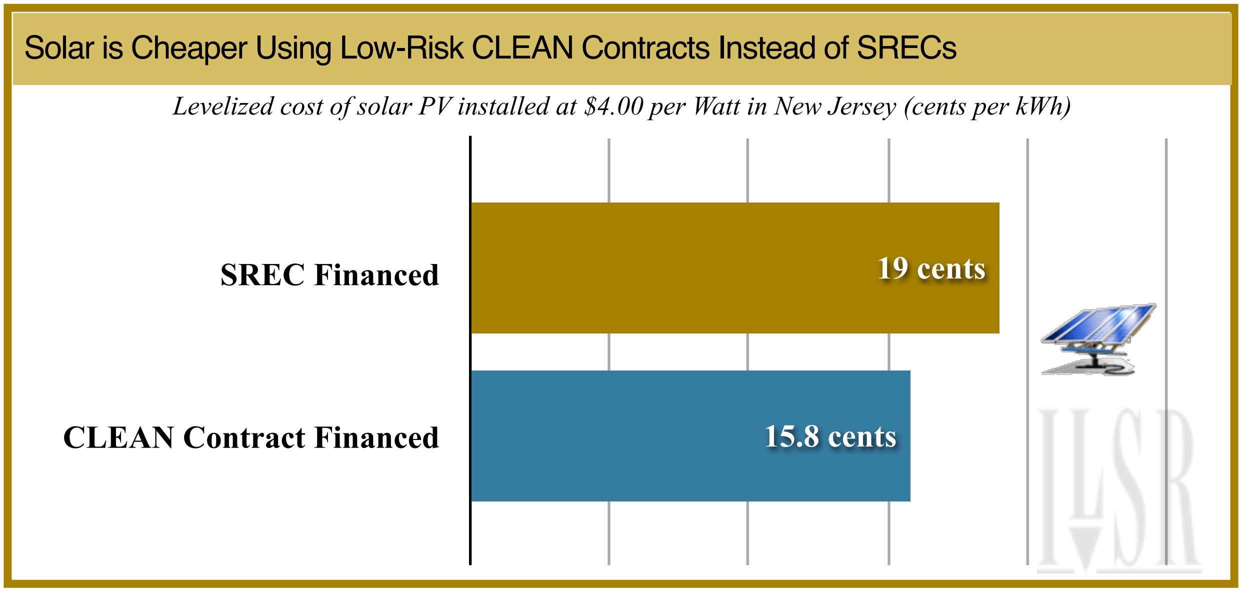
Even at optimal prices, the SREC provides more net revenue to the developer (to offset higher borrowing costs and risk), and the SREC-funded project costs the ratepayer 12% more over 20 years than a CLEAN-funded solar project.

Although the net present value analysis provides a solid understanding of the total costs, a simpler analysis looks at the levelized cost of solar from two otherwise identical solar projects, on financed by SRECs and the other by CLEAN Contracts.

Assumptions for the Solar Cost Shootout

Project Parameter	Assumption
Installed cost per Watt	$4.00
Project size	1 kW
Total installed cost	$5,900
System output (annual)	1,205 kWh AC 0.5% annual degradation
Federal Incentives	
Nominal value of federal tax credit	$1,200
Nominal value of depreciation (30% tax rate)	$1,018
Project Finances	
Portion debt	80%
Debt term	10 years
Interest rate	5% CLEAN Contract 7% SREC
Rate of return expected	6.6% CLEAN Contract 10% SREC
Real discount rate (rate less inflation)	2%

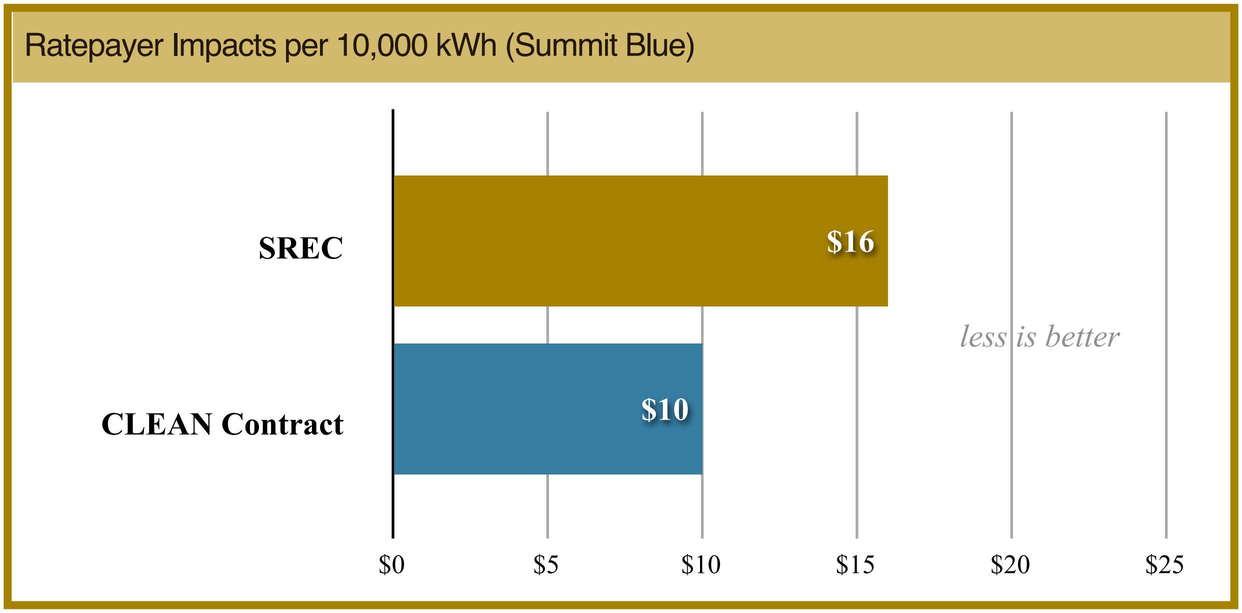
Due to the lower risk, lower transaction costs and greater transparency of the program, the CLEAN-financed solar project delivers electricity for 15.8 cents per kWh over 25 years while the SREC-financed project is at 19 cents.



The results of this simulation are in harmony with an analysis of policy alternatives for supporting solar in New Jersey conducted in 2007 by Summit Blue. They looked at the ratepayer impact of various solar policies ranging from feed-in tariffs (a.k.a. CLEAN Contracts) to SRECs. Their conclusion was that the CLEAN Contract Program offered the lowest ratepayer impact, with SRECs being among the most expensive mechanism for financing solar development. The following table and chart illustrate the weighted average ratepayer impact in total dollars and in dollars per 10,000 kWh of consumption (a typical annual amount for a household).[38]

Weighted Average Ratepayer Impacts (Millions, Summit Blue)

Policy	Average Cost
15-year full CLEAN Contract	$3,738
Auction	$4,001
Hybrid tariff	$4,885
Underwriter, 15-year	$4,971
Rebate/SREC	$5,217
SREC only	$5,857
Commodity market	$5,923



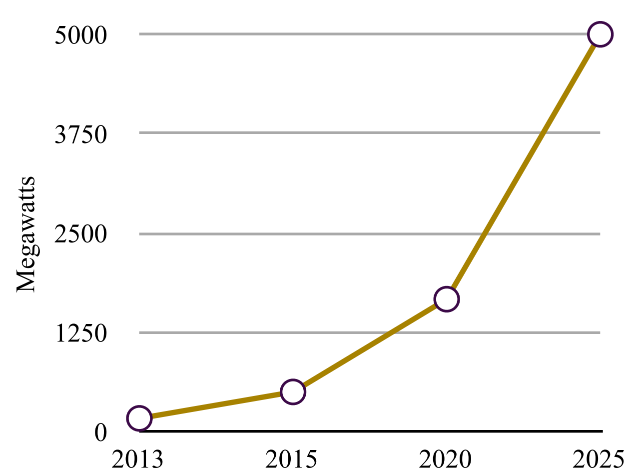
In theory and practice, the risk premium inherent in the SREC market outweighs any potential efficiencies from market pricing of the actual SRECs. CLEAN Contracts are more cost-effective tool for financing solar projects.

Case Study: New York

The New York legislature is currently considering a solar energy mandate for electric utilities. Like New Jersey and other states with solar carve-outs, the legislation would establish an SREC market to help solar developers finance state-mandated projects. The Solar Industry Development & Jobs Act of 2011 would require utilities to purchase approximately 5,000 MW of solar by 2026, equivalent to about 3% of load. Several incremental targets call for limited growth of the solar market in the short term followed by strong growth after 2020.[39]

Year	Target (% of total energy sales)	Target (MW)
2013	0.1%	167
2015	0.3%	500
2020	1.0%	1,667
2025	3.0%	5,000

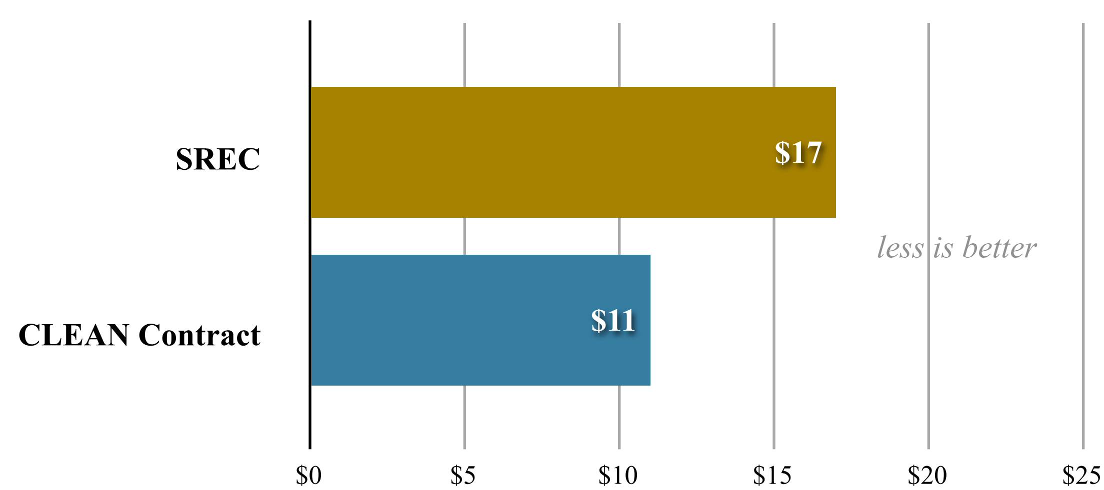
Solar Market Goal for NY Solar Jobs Act



The bill also calls for a price cap, limiting the total cost of the program to 1.5% of annual retail electricity revenues of retail electric suppliers (including the Long Island Power Authority). This would effectively cap program costs at around $189 million (for the year 2009).[40]

A shorthand method of calculating the relative cost-effectiveness of policy strategies for meeting the 2026 goal is to use the Summit Blue analysis of New Jersey's state solar policy. New Jersey's solar mandate (5,300 GWh or approximately 4,700 MW by 2026) is remarkably similar to the New York proposal. The following chart shows that for a typical household consumption of 10,000 kWh per year, an SREC program to meet New York's solar mandate would cost ratepayers about 50 percent more than a CLEAN Contract Program.

Ratepayer Impact of NY Solar Mandate per 10,000 kWh (Adapted from Summit Blue)



While this initial estimate is a good ballpark, the following analysis tests the cost effectiveness of the two solar policies for meeting New York's 2026 goal of 3% of electricity from solar. There are four models examined, an Optimal and Expected model each for SRECs and CLEAN Contracts.

New York Solar Model 1 of 4 (SRECs, Optimal)

For the first cut, the model assumes that SRECs work perfectly, resulting in exactly the amount of generation targeted by the state's solar mandate each year, and perfectly pricing the credits to the expected cost of solar (achieving the razor-thin equilibrium mentioned earlier). The following table lists the assumptions.

Project Parameter	Assumption
Installed cost per Watt (2013)	$4.00
System output (annual)	1,205 kWh AC per kW DC 0.5% annual degradation
Federal Incentives	
30% tax credit	
Accelerated depreciation (@ 30% tax rate)	
Project Finances	
Portion debt	80%
Debt term	10 years
Interest rate	7%
Discount rate	5%
Revenue Stream	
Initial SREC value ($ per MWh)	$327
SREC contract length	1 year
Change in SREC value at contract renewal	91% of initial
Avoided cost of electricity (2013$ per kWh)	$0.145

The installed cost of solar in the United States is already under $4.00 per Watt for utility-scale solar PV installations, with costs for smaller, commercial-scale solar averaging $5.20 per Watt and residential solar installed at $6.42 per Watt.[41] Given that the majority of solar electricity produced under a state solar mandate will come from large-scale installations and the 5-year trend of installation costs declining at an average annual rate of 9%, $4.00 per Watt seems an appropriate starting point for installed costs.

The project finances portion is based on an expectation of low interest rates in the future, but also the higher risk associated with an SREC policy model. The debt share and term are typical for solar projects.

The revenue stream (SRECs) are assumed to be sold on 1-year contracts, with prices declining at the average annual rate of 9%.

The avoided cost of electricity is taken from a very recent Synapse report of avoided costs during summer peak for the Western Massachusetts region, neighboring on New York.[42]

With these parameters, the 20-year net present value of the New York SREC Optimal program is $4.2 billion, with a ratepayer savings of 6.4 cents per kWh over the program life. However, as highlighted by this year's SREC market crash in five different states, the assumption of optimal pricing is highly optimistic. The following model provides more realistic market expectations.

New York Solar Model 2 of 4 (SRECs, Expected)

In this model, the major change is the assumption that every third year the supply of SRECs will exceed the state solar mandate, resulting in a market crash much like has happened in late 2011 in most states with SREC markets. The additional assumptions underlying this analysis are shown below.

Project Parameter	Assumption
Revenue Stream	
Initial SREC value ($ per MWh)	$327
SREC contract length	1 year
Change in annual Alternative Compliance Price	-9%
Market Conditions	
Frequency of market oversupply	3 years
Change in SREC price during oversupply event	25% of SACP
Installed solar capacity in oversupply year	20% of expected
Growth in years following market crash	
Year 1	120% of expected
Year 2	150% of expected

The expected capacity growth of solar during and after the oversupply year is based on the historical expansion of U.S. wind power capacity during the expiration and renewal cycles of the federal Production Tax Credit. The expected SREC price is an estimate based on the change in SREC values during the recent market crash.

With these parameters, the expected 20-year net present value of the state's solar program falls from $4.2 billion to $2.5 billion, with a ratepayer savings of 3.5 cents per kWh over the program life, reflecting the sub-optimal pricing of solar based on the state's artificial demand signal rather than actual market costs.

New York Solar Model 3 of 4 (CLEAN Contracts, Optimal)

This section models a CLEAN Contract Program under optimal conditions, with solar installations exactly matching the solar mandate in each year.

Project Parameter	Assumption
Installed cost per Watt (2012)	$4.00
System output (annual)	1,205 kWh AC per kW DC 0.5% annual degradation
Federal Incentives	
30% tax credit	
Accelerated depreciation (@ 30% tax rate)	
Project Finances	
Portion debt	80%
Debt term	10 years
Interest rate	5%
Discount rate	5%
Revenue Stream	
CLEAN Contract	*initial rates below*
Change in contract price by year	-9%

Initial CLEAN Contract rate for New York

Rooftop project size	Price	Share of solar production
< 30 kW	$0.23	10%
30-100 kW	$0.21	20%
100-1000 kW	$0.21	25%
1 MW and over	$0.20	45%

By lowering risk to developers, the CLEAN Contract Program is expected to require a lower cost of capital (5% instead of 7%) and a lower internal rate of return (~6.5% versus 10%) for project developers. It's also assumed for this model run that the program develops exactly as much solar as expected under the solar mandate, essentially providing a program cap (and assuming that contract prices are attractive enough to generate demand to meet the cap).

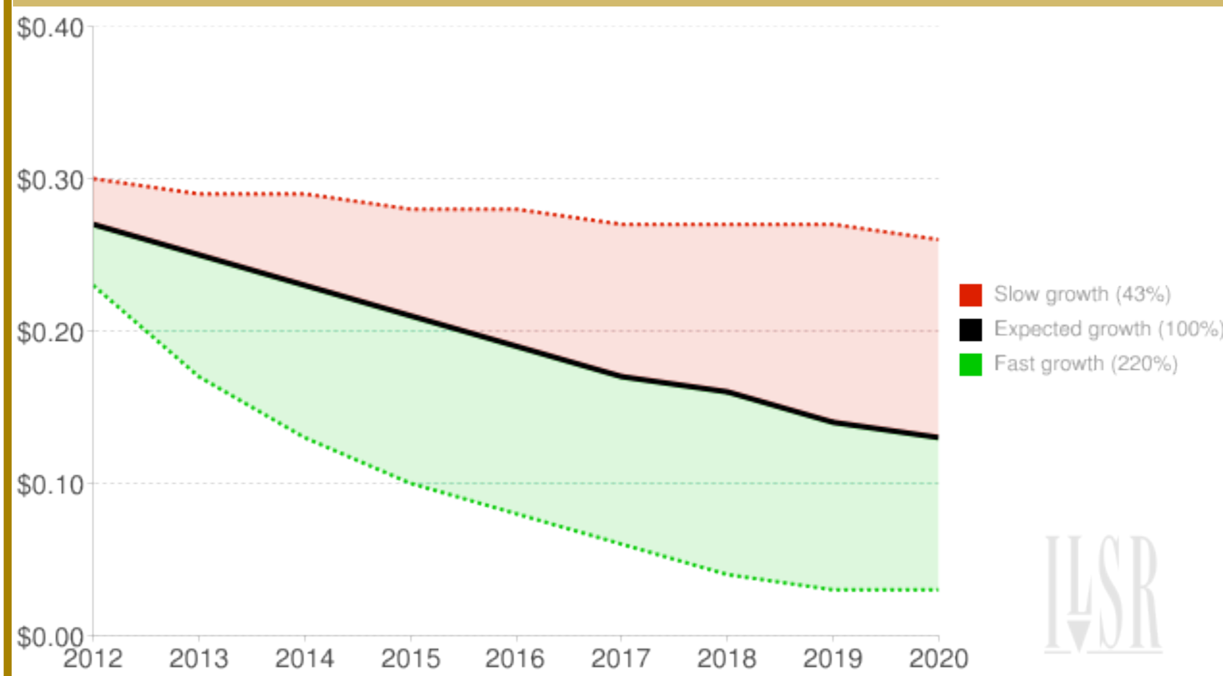
With these parameters, the 20-year net present value of the New York Solar program with CLEAN Contracts is $3.3 billion, with a ratepayer savings of 4.7 cents per kWh over the program life, significantly better than the Expected SREC model but not as good as the Optimal (and highly unlikely) SREC model.

New York Solar Model 4 of 4 (CLEAN Contracts, Expected)

It's also possible for CLEAN Contract programs to perform unexpectedly, and the most likely outcome is a surplus or shortfall of solar development relative to the state target. A hard capacity cap could serve as an upper bound and ratepayer protector, but the more advanced CLEAN Contract Programs also include a "growth corridor," adjusting contract prices based on how the year's installations matched desired levels.

The following chart illustrates how a growth corridor works.

Germany's PV Growth Corridor (Solar Contract Price per kWh)



The black line represents expected growth in capacity and the expected price decline of 9% annually. However, the upper dotted line represents very slow growth (only 43% of expected capacity) and reduces the change in contract price from -9% to -1.5% annually. The lower dotted line represents an overheated solar market where annual contract prices fall by as much as 24% to bring development back in line with expectations.

A model growth corridor is illustrated in the table below.

Percent deviation from target solar capacity	Additional contract price change	Total year-to-year contract price change
+100%	-9%	-18%
+67%	-6%	-15%
+33%	-3%	-12%
0%	0%	-9%
-33%	+3%	-6%
-67%	+6%	-3%

Given the relatively stable pricing of a CLEAN Contract Program and the small size of the New York solar program compared to the world market, it's unlikely that there will be many years with large deviations from expected growth.

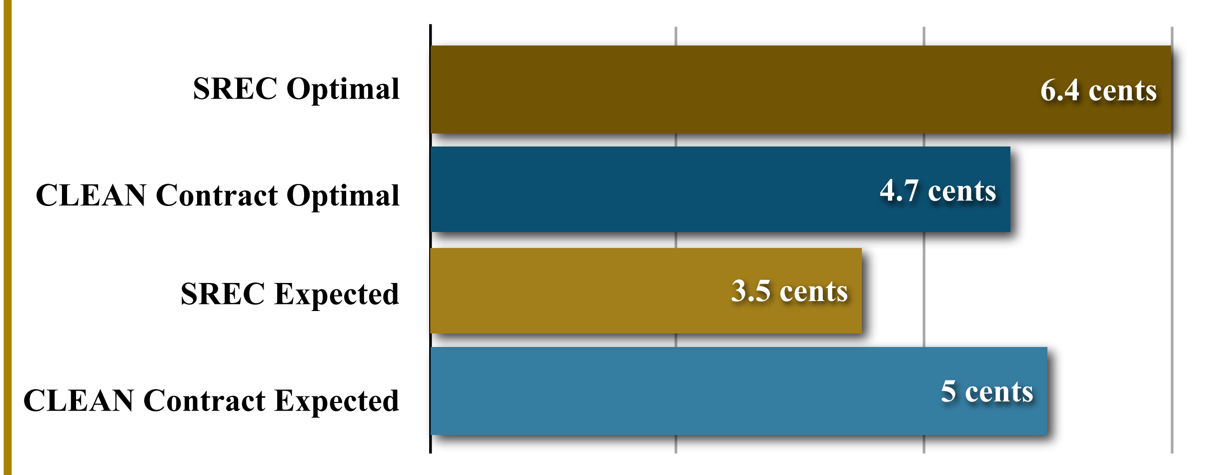
However, for the sake of comparison, every third year (like the SREC model) will have a deviation sufficient to change the annual contract price assumption. Because existing CLEAN Contract Programs in the U.S. are completely subscribed, it seems reasonable to assume a bias toward too much rather than too little solar. Therefore, of the four deviation years, one will be 35% less than expected, two will be 35% greater than expected, and one will be 70% greater than expected.

The result of this model run are remarkable. The price adjustments based on actual installed capacity improve the economics of the CLEAN Contract Program significantly. With the parameters as discussed, the Expected CLEAN Contract model has a 20-year net present value of $3.7 billion, with a ratepayer savings of 5.0 cents per kWh over the program life.

Solar Policy Model Comparison

With four models for the proposed New York solar program, it's possible to evaluate which provides the best value to the state. The following chart illustrates the ratepayer savings of each solar program, in cents per kWh (relative to a future with no solar program).

Ratepayers Savings of New York Solar Models (per kWh)



What's interesting about the data is the small variation in the value of the CLEAN Contract Program value when modeled in ideal circumstances compared to an expected outcome, and the fact that the Expected model for CLEAN Contracts has a higher ratepayer value!

The SREC program could provide the greatest ratepayer value only in the highly unlikely event that the market is perpetually in perfect balance.

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When comparing the expected outcomes, the CLEAN Contract Program provides 40% greater ratepayer savings than an SREC program while providing 13 percent more solar power. This value advantage includes an additional 600 megawatts of solar, as our model run ended with the CLEAN Contract Program at 5,200 megawatts and the SREC Expected model delivering just over 4,600 megawatts.

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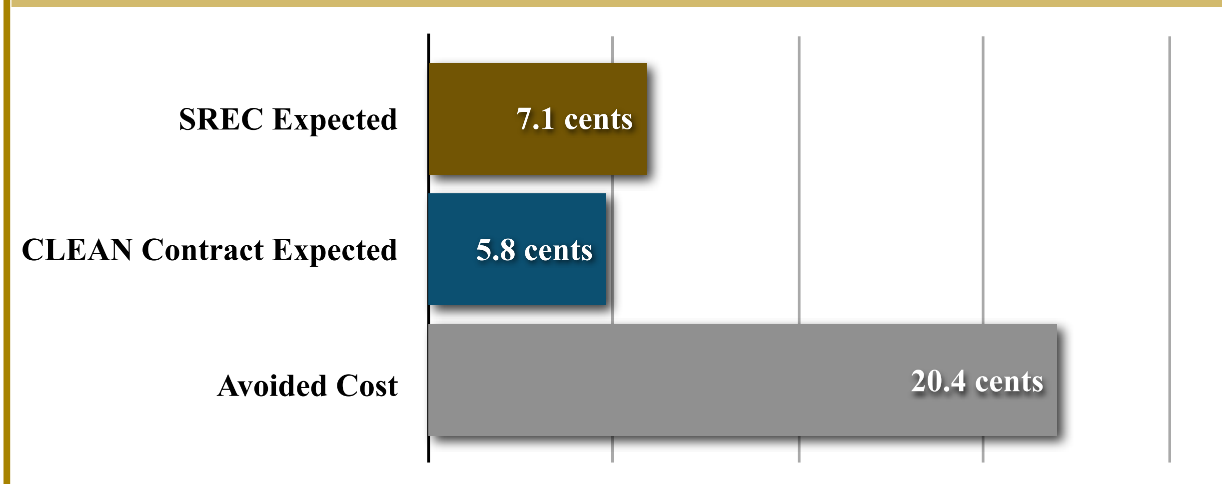
It should be noted that in no case did any of the programs come near to the legislative cost cap for the solar program.

While a comparative analysis of net present value is the most precise, it may also be useful to compare the gross cost of the solar policy models against a business-as-usual scenario (acquiring the same amount of power at the avoided cost). The following chart compares the cost per kWh of acquiring the same 5,000 MW of power via solar (using SRECs or CLEAN Contracts) or via traditional power sources based on the utility's avoided cost.

Ratepayer Cost of New York Solar Models (per kWh)



Sensitivity Analysis

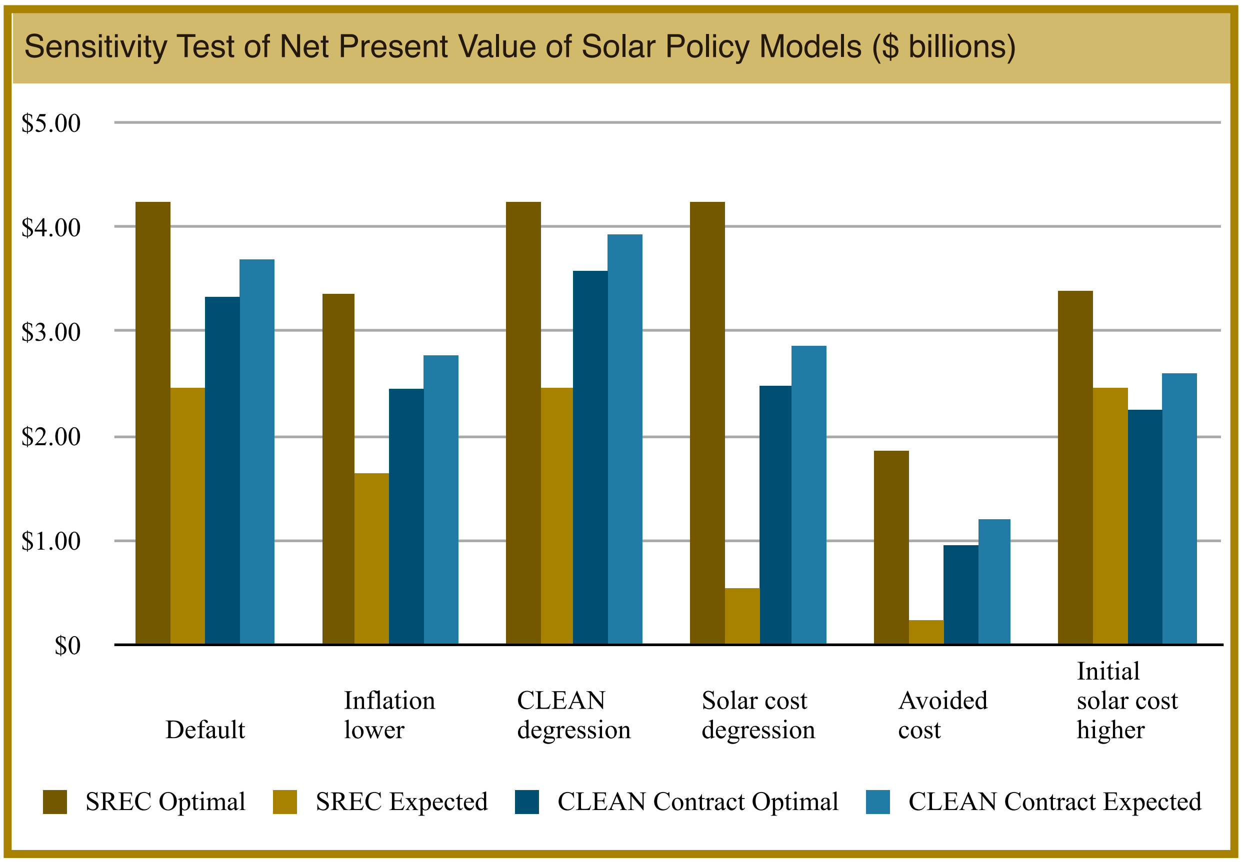
The models provide a good high-level understanding of the performance of the two solar policies for New York, but they rest on assumptions. The following table tests out a number of our assumptions to see how it changes the overall ratepayer value. In particular, it considers the results with a lower inflation rate (reducing the avoided cost of utility power), lower solar cost reductions (6% annually instead of 9%), a lower utility avoided cost (10 cents instead of 14.5 cents), and a higher initial installed cost of solar ($5.00 instead of $4.00 per Watt). The final assumption tested was how a 1% greater annual price decline under the CLEAN Contract Program (because of its developer certainty and low risk) might change the relative analysis.

Furthermore, the models were examined again for their ability to stay under the program cost cap laid out in the 2011 solar legislation.

Sensitivity Test of Net Present Value of Solar Policy Models ($ billions)

Model	Default Value	Inflation lower (2%)	Cost reductions lower (6% annual)	Avoided cost lower (10 cents)	Solar cost higher ($5.00/W)	CLEAN program solar cost reduction (+1%)
SREC Optimal	$4.24	$3.36	$4.24	$4.24	$1.86	$3.39
SREC Expected	$2.46	$1.64	$2.46	$0.54	$0.24	$2.46
CLEAN Contract Optimal	$3.33	$2.45	$3.58	$2.48	$0.95	$2.25
CLEAN Contract Expected	$3.69	$2.77	$3.93	$2.86	$1.20	$2.60

The following chart provides a graphic analysis of the same data.



Most of the assumptions only impact the outcome at the margins, with two exceptions. When the cost of solar does not decline as rapidly as expected, the much higher cost of solar in early years dramatically reduces the value of the SREC Expected model. While still offering positive ratepayer value, it's only $500 million compared to nearly $3 billion from the Expected CLEAN Contract model.

The change in the utility avoided cost for power (a 33% reduction) also significantly shrinks the value of the solar program models, as would be expected. What's impressive is that given the magnitude of the change, all solar policies are still positive value to ratepayers, with the Expected CLEAN Contract Program performing significantly better than the Expected SREC policy.

The only remaining issue is the legislative cost cap. While none of the default model runs hit the cost cap, the SREC Expected model does run afoul of the 1.5% cost cap in two cases. When solar costs fall slower than expected (Solar cost degression) or with a lower avoided cost, this model run exceeds the cost cap. However, the cost overrun is small, only 1% in a single year in the first instance, and 5% in a single year in the second. Neither of the CLEAN Contract Program models had any cost overruns.

Conclusion

As states consider policy options for encouraging the development of distributed energy – particularly solar PV – they would do well to consider the policy mechanism. CLEAN Contract Programs feature significantly reduced developer risk, increased price transparency, and simplified grid interconnection. As a result, CLEAN Contract Programs deliver more solar with a higher ratepayer value than SREC "market-based" programs.

The result is no surprise. SREC programs try to artificially layer a market mechanism over a state solar mandate. Because the price of the incentive hinges solely on the relationship between the solar market and the state mandate, the price is entirely uncertain and remarkably volatile. This atmosphere of high risk is anathema to the development of a new industry, requiring risk premiums in borrowing money to finance solar and in the expected rate of return for solar developers. Combined, the risk makes solar more expensive to the ratepayer.

CLEAN Contract Programs ignore the pretense and volatility of a market-based price by focusing on the key issue: delivering solar at the most competitive price, based on the actual cost of production. The high level of transparency, predictability, and certainty gives developers a strong market signal: build solar power at a modest rate of return, and make your profit on volume instead of the individual project price.

New York's consideration of a state solar energy law comes at an opportune time. The collapse of SREC prices across multiple states provides a stark illustration of the risk for solar developers and the challenge of using SRECs to provide a consistent market for solar. The rush to legislative fixes in Pennsylvania, New Jersey, and other states shows that the policies rely more on the mandate than the market.

New York does not have to repeat the failures of its neighbors. A CLEAN Contract Program for New York could accomplish the same goals as envisioned for a state SREC market, but provide over a billion dollars in additional ratepayer value. It would provide solar developers significantly more transparency and certainty, and signal that New York is "Open for Solar."

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