



U.S. CLEAN Programs

Where Are We Now? What Have We Learned?

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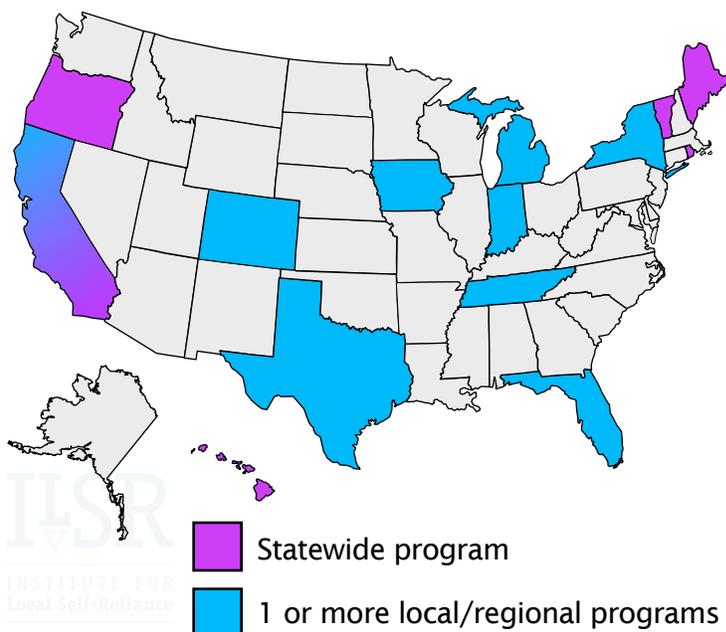
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Executive Summary

CLEAN programs (*Clean Local Energy Accessible Now*) provide long term contracts with utility companies whose price is set to guarantee a modest return for investors. They have long been used in Europe (as “feed-in tariffs”) to spur renewable energy development, often with remarkable success. In Germany for example, CLEAN contracts have been credited with developing over 50,000 megawatts of wind and solar power. Indeed, so successful have these contracts been that Germany recently all but eliminated the premium paid for solar energy and re-directed the premium to encourage innovation in on-site use and storage systems.

While late to the game, **Americans are finally in the game.** In 2012, all or part of fourteen American states have adopted CLEAN contracts for renewable energy. Many more are in development.

U.S. States With CLEAN or Similar Program



The recent surge in popularity coincides with the recognition that on-again, off-again federal tax incentives undermine renewable energy investments and that the falling price of solar energy creates a need for a more flexible and regionally tailored transitional incentive.

But U.S. CLEAN programs still suffer from four common shortcomings.

Program Caps: A key shortcoming of U.S. programs is very small program size, especially given that these are multi-year, cumulative caps. Evidence from other countries is that larger scale programs achieve greater cost reductions.

Scant Support for Small Scale: Another shortcoming, as discussed in greater detail in the full report, is the lack of support for on-site residential solar. Sacramento, for example,

allocated almost all of its 100 megawatt (MW) allocation to projects 1 MW and larger. Palo Alto's program is restricted to projects 100 kilowatts (kW) and larger. Although there may be some cost savings involved in focusing on larger projects, these are modest. On the other hand, the benefits of having tens of thousands of households with on-site solar and therefore an economic self-interest in supporting expanded renewable energy far outweigh the possible increased costs. Europe has found this to be the case. Nearly 90% of Danish wind turbines are locally owned, as is most of German solar and half its wind power.

Financial Complexity: Another shortcoming of U.S. CLEAN programs derives from federal renewable energy policy. Unlike Germany, the U.S. uses tax incentives. The search by CLEAN program participants for tax equity partners increases the complexity and the cost of renewable energy programs. It also dramatically restricts the potential for non-profit organizations and the public sector, which are tax exempt, to host renewable energy generators.

The ideal CLEAN program has an all-in price that allows investors to earn a return without having to resort to creating complex tax equity arrangements. This allows CLEAN regulators greater flexibility in tailoring the program to specific objectives and in modifying the program quickly as the external context changes (e.g. cost reductions in renewable energy). CLEAN contracts also allow for the promotion of small scale and locally owned generators.

All U.S. states and utilities price their CLEAN contracts assuming the use of tax incentives. This saves local ratepayers money but costs the programs flexibility and subjects them to the vagaries of political changes in Washington.

Minimal Planning: Few U.S. CLEAN programs have transparent and predictable price adjustments (like the German "growth corridor") or incentives for on-site consumption and storage to encourage more effective use of distributed renewable energy.

Where We Are

The following table summarizes the state of CLEAN programs in the U.S. Program prices assume the use of tax incentives by participants. Without that assumption, the prices would have to be much higher. Prices have been normalized for solar insolation, contract length, and currency.¹ Prices in bold are for programs supporting residential solar, and otherwise reflect the price for the smallest solar supported under the program.

In comparison, the German feed-in tariff (FIT) is an all-in price that doesn't require the use of extraordinary tax incentives for investors to earn a return. Yet the German FIT is lower than all comparable U.S. CLEAN programs. That is a testament to the length, dynamism and success of the German program. As the renewable energy industry has increased, its price has decreased. As the chart shows, the German FIT was set at 45 cents

German Small Solar FIT Contract Price



per kilowatt-hour (kWh) in 2010 (down from 75 cents in 2004) and in its recent iteration has a price set at 25 cents per kWh (not adjusted to U.S. insolation as in the table).

Summary of CLEAN Programs in the United States

Locality	Date Launched	Program Size	Installed Capacity	Solar Contract Price*
California	2008	500 MW	23 MW	12.0¢
Farmers Elec. Coop. (IA)	2008	n/a	n/a	10.2¢
Consumers Energy (MI)	2009	5 MW	2.0 MW	16.9¢
Gainesville (FL)	2009	32 MW	10 MW	24.0¢
Maine	2009	50 MW	4.5 MW	10.0¢
Oregon	2009	25 MW	n/a	42.0¢
Sacramento (CA)	2009	100 MW	66 MW	12.0¢
Vermont	2009	50 MW	5.3 MW	23.0¢
Hawaii	2010	80 MW	11 MW	28.6¢
Indianapolis Power & Light (IN)	2010	125 MW	2.2 MW	17.0¢
San Antonio (TX)	2010	10 MW	n/a	27.6¢
Tennessee Valley Authority	2010	100 MW	4.6 MW	5.5¢
NIPSCO (IN)	2011	30 MW	3.0 MW	21.0¢
Rhode Island	2011	40 MW	n/a	22.0¢
Long Island Power Authority (NY)	2012	50 MW	n/a	19.9¢
Los Angeles (CA)	2012	10 MW	n/a	n/a
Palo Alto (CA)	2012	4 MW	0 MW	14.0¢
U.S. TOTAL		1,211 MW	132 MW	
Germany	1990	n/a	53,000 MW	15.7¢

**U.S. prices reflect the external use of federal tax incentives (and would otherwise be much higher). Germany's price is comprehensive.*

Acknowledgments

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Introduction

CLEAN (Clean Local Energy Accessible Now) policies for renewable energy have enabled more than half the world's installed wind power and more than three-quarters of its solar power. Born (and abandoned) in California in the 1980s, the CLEAN policy was revised and improved in Germany in the early 1990s and had widespread adoption throughout Europe (as a "feed-in tariff") by the early 2000s.

Beginning in 2009, U.S. states and several investor-owned and municipally-owned utilities began tip-toeing into CLEAN. As of April 2012, fourteen American states have regional or statewide CLEAN programs. Many more are considering them.

Until very recently, U.S. states have been reluctant to adopt CLEAN contracts, instead relying on an increasingly fragile and complex system of state and federal tax incentives, coupled with state renewable energy mandates.

The federal government's continued reliance on tax incentives complicates the ability of states to establish CLEAN programs that can give investors reliable, long term, all-in-one prices for renewable energy.

It also makes these programs vulnerable to changes in the political climate. Currently the U.S. Congress is debating whether to allow tax incentives for wind energy to expire this year. (The solar incentives are not scheduled to expire until 2016).

CLEAN programs are also rising in visibility in the U.S. because of the increasing awareness that, if historical cost reductions continue, on-site solar could be competitive with the retail price of utility electricity for tens of millions of Americans in the next five years. (See [Rooftop Revolution: Changing Everything with Cost-Effective Local Solar](#) for a more detailed discussion of the policy implications of low cost solar).

What is a CLEAN program?

There are three key features to a CLEAN contract policy:

1. A guaranteed, transparent process for connection to the electric grid.
2. A long-term, standard power purchase contract for all electricity produced.
3. A fixed power purchase price sufficient to guarantee a modest return on investment over the contract term.²

This will occur in different times in different parts of the country. The CLEAN program makes an ideal transitional incentive, one that can be tailored to the needs and capacities of different states and can be phased out gradually as renewable energy costs decline.

Interestingly, CLEAN applies to independent energy generators the same process and principles that underpin traditional utility regulation. When a regulated utility builds a power plant, the state Public Utility Commission allows it to set a price that earns it a specified rate of return over a long period of time. That is what a feed-in-tariff in Europe does as well.

However, the separate layer of federal tax incentives adds a layer of complexity that is not present in Canadian or European programs.

Given the increased interest in the U.S., Germany's recent modifications to its feed-in tariff, and the debate over the efficacy and durability of existing U.S. renewable

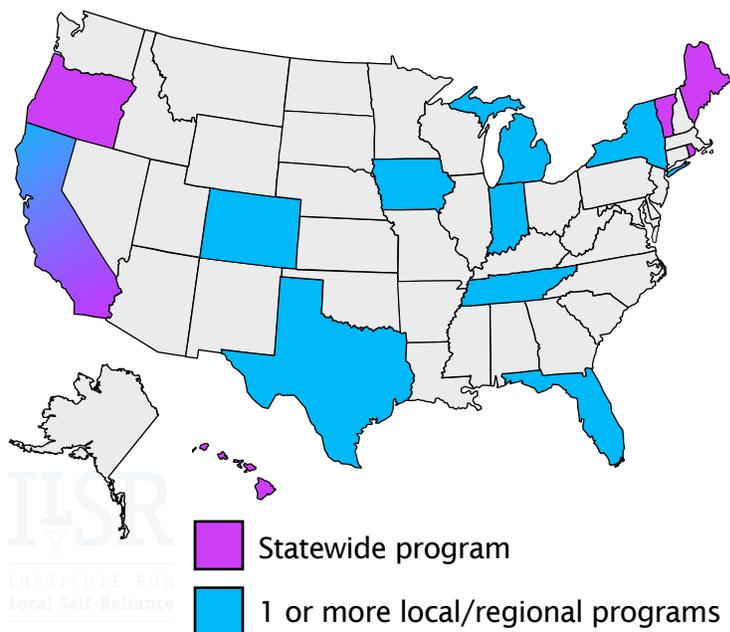
energy incentive programs, it is an opportune time to report on recent CLEAN program developments and to offer some observations about how utilities and states might improve them.

This report provides details on all known U.S. CLEAN programs. It then discusses the dynamics of the German feed-in tariff. And finally, it extracts lessons from both the German and the American experiences that might be useful to cities and states considering this rising policy tool.

Existing CLEAN Policies

As of April 2012, CLEAN or similar policies have been adopted in part or all of fourteen states and have been responsible for the development of about 132 megawatts (MW) of renewable energy.

U.S. States With CLEAN or Similar Program



CALIFORNIA

In 2008, the state of California opened a 500 MW program for renewable energy systems 1.5 MW and smaller that is similar to a CLEAN program. While it offers long-term, standardized contracts and prices based on the kilowatt-hours produced by projects, prices were 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.³

Through early 2012, only 23 MW of capacity are operational under this program, most likely because producers are not eligible for net metering or other incentive programs.

Sacramento Municipal

In 2009, the Sacramento Municipal Utility District (SMUD) launched a CLEAN program for up to 100 MW of solar power.

Almost all the capacity was allocated to projects 1 MW and larger, including one 30 MW solar array. Contracts were signed for 10-20 years at fixed prices based on the value of the power and its time of delivery to the SMUD grid.

The following table shows the 20-year contract prices for 2012 in dollars per kilowatt-hour (kWh), broken down into three seasons and two time-of-day deliveries (off peak periods were left out since almost no solar is generated during that time period).⁴

SMUD CLEAN Program

Time of Generation	Contract price (per kWh)
Fall/Winter on peak	\$0.093
Fall/Winter super peak	\$0.099
Spring on peak	\$0.085
Spring super peak	\$0.087
Summer on peak	\$0.096
Summer super peak	\$0.285

SMUD's higher price for super peak power (delivered between 2 and 8 PM, Monday through Saturday) means that solar PV projects receive a modestly higher price than most types of generation. Over a year, a PV project would likely average about \$0.118 per kWh generated, a price that worked well for the larger-scale project in SMUD's queue.

Nearly two-thirds of SMUD's contracted projects were completed by April 2012.

Palo Alto Municipal

In early 2012 the municipal utility in Palo Alto, CA, launched a commercial solar CLEAN program. It proposed paying 14 cents per kWh on 20-year contracts for solar projects (and lesser amounts on shorter-term contracts).⁵

Projects must be 100 kilowatts (kW) or larger and they may not cumulatively provide more than 15% of the power on any particular part of the electric distribution grid (for more on the 15% rule, read [Rooftop Revolution – March 2012](#)).⁶

Palo Alto Municipal CLEAN Program

System size or location	Contract price (per kWh)
> 100 kW	\$0.140

The program's first solicitation window closed on April 30, 2012, with no

contracts. The reason may be that less costly ground mounted PV projects can't be done on expensive land in Palo Alto and the tariff price is too low for rooftop arrays.⁷

FLORIDA**Gainesville Municipal**

The Gainesville, FL, CLEAN program, launched in 2009, offers one of the most robust solar programs in the United States, offering 20-year contracts for solar PV. The program is capped at 4 MW per year for 8 years.

System sizes are capped at 1 MW or 300 kW for ground- and roof-mounted, respectively. The following table shows the prices paid for projects connected in 2011.⁸

Gainesville Regional Utilities Solar CLEAN Program

System size or location	Contract price (per kWh)
Building or Pavement	
< 10 kW	\$0.320
10-300 kW	\$0.290
Ground	
10-25 kW	\$0.290
25-1000 kW	\$0.240

Gainesville is an excellent example of how CLEAN contract prices adjust to follow the trend in installed costs. The 2012 contract price for the smallest solar projects is \$0.24 per kWh, 25% lower than in 2011.

Gainesville's CLEAN program has interconnected over 10 MW of solar through early 2012.

HAWAII

In November 2010, Hawaii launched its solar CLEAN program. The program has three size classes (two on the smaller islands). The program is capped at 80 MW overall, divided between Oahu (60 MW), the Big Island, Maui, Lanai, and Molokai. The following table illustrates the size categories and rates for Oahu (the other islands have smaller project size caps).

Hawaii Solar CLEAN Program

System size or location	Contract price (per kWh)
< 20 kW (Tier 1)	\$0.274
20-500 kW (Tier 2)	\$0.238
> 500 kW (Tier 3)	n/a

The Hawaii CLEAN program has been slow to develop. Since the rates were set in November 2010, only 11 MW of the program's 60 MW capacity has been built (although 95% of the capacity has been reserved).⁹

One reason for the slow development is the opposition by Hawaii's near-monopoly utility. The investor-owned Hawaiian Electric Company (serving all islands except Kauai) claims it can curtail – or refuse to purchase power – from any solar project in the program, at their discretion.¹⁰ This makes attracting investors difficult.

In addition, the state's utilities hew to the "15% rule," a very conservative safety margin for local grid operations limiting solar PV to 15% or less of minimum daytime demand on distribution circuits. On Oahu, prospective solar producers can view a list of all properties by street address to determine if there is capacity left under the 15% cap in their area.¹¹ (For more on this issue, read the *Technical Barriers* section of our [Rooftop Revolution](#) report).¹²

The following tables provide an update on the status of the Hawaii CLEAN Program (numbers may not sum due to rounding).¹³

Hawaii CLEAN Status (all islands, MW)

	Allocation	Reserved	Complete
Tier 1	4.0	0.8	0.03
Tier 2	59	58	11
Tier 3	18	2	0
Total	80	61	11

INDIANA

Indianapolis Power & Light

In March 2010 Indianapolis Power & Light (IPL), received approval for a 3-year pilot CLEAN program (called Rate REP) for solar, wind and biomass.

The program is capped at 1% of IPL's electric sales (approximately 125 MW) and is available for projects up to 10 MW (with minimum sizes of 20 kW for solar and 50 kW for wind and biomass). Contracts were originally for 10 years, but were extended to 15 years in 2012. Solar and wind projects cannot produce more electricity than is used at their location.

The following table shows the rates paid by IPL.

Indianapolis Power & Light CLEAN Program

Technology	Contract price (per kWh)
Solar PV	
< 20 kW	n/a
20-100 kW	\$0.24
100 kW to 10 MW	\$0.20
Wind	
50-100 kW	\$0.140

Technology	Contract price (per kWh)
100-1000 kW	\$0.105
1-10 MW	\$0.075
	\$0.085 and
Biomass	\$6.18/kW per month

Like most U.S. CLEAN programs, IPL received applications for more capacity than it had available but as of April 2012 only 2.2 MW of projects had come online.

The three year pilot program ends March 30, 2013. IPL needs to file a petition by June 2012 to extend the program.

Northern Indiana Public Service Corporation

A utility-based CLEAN program in Indiana is run by Northern Indiana Public Service Corporation (NIPSCO), providing 15 year contracts for wind, solar, biomass, and hydropower.

Projects must be between 5 kW and 5 MW in size and 500 kW of capacity is reserved for small wind (smaller than 100 kW) and small solar (smaller than 10 kW), apiece, of the 30 MW program total.¹⁴

NIPSCO CLEAN Program

System size or location	Contract price (per kWh)
Wind < 100 kW	\$0.170
Wind 100 kW to 2 MW	\$0.100
Solar < 10 kW	\$0.300
Solar 10 kW to 2 MW	\$0.260
Biomass < 5 MW	\$0.106
Hydropower < 1 MW	\$0.120

Through April 2012, NIPSCO had connected approximately 3 MW of projects, mostly biomass.¹⁵

IOWA

Farmers Electric Cooperative

Launched in 2008 by this 500-member cooperative, the Renewable Energy Purchase program provides 10-year contracts for solar PV and wind projects up to 10 kW in size. Customers can get the purchase price for up to 25% of their on-site consumption (the remainder can be net metered).

FEC CLEAN Program

System size or location	Contract price (per kWh)
Wind < 10 kW	\$0.200
Solar < 10 kW	\$0.200

The program is uncapped in total, but is effectively limited to 25% of total electricity sales. In 2011, the total program produced less than 0.1% of sales.

MAINE

Launched in 2009, Maine's CLEAN program is the only program limited to locally owned renewable energy projects (1 MW and smaller). Projects receive the lesser of a 1.5 multiplier to their renewable energy credit (REC) 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.¹⁶ 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).¹⁷

MICHIGAN

Consumers Energy

In 2009 Consumers Energy, which serves 6 million residents in the center and north of Michigan's lower peninsula, launched one of the country's first solar CLEAN programs. Its small-scale solar program provided 12-year contracts for solar projects up to 150 kW, with a total program cap of just 2 MW (filled almost immediately).¹⁸ Nearly all the contracted projects were completed by April 2011.¹⁹

The utility decided to expand the program with an additional 3 MW (evenly split between residential and non-residential solar) in late 2011, using 15-year instead of 12-year contracts.²⁰

Consumers Energy Solar CLEAN Program

System installed date	Contract price (per kWh)
2009 residential	\$0.65
2009 commercial	\$0.45
2010 residential	\$0.53
2010 commercial	\$0.38
2011 Q4 commercial*	\$0.23
2012 Q1 residential	\$0.26
2012 Q2 commercial	\$0.23
2012 Q2 residential	\$0.26
2012 Q3 residential	TBD

*switch to 15-year contracts

OREGON

Oregon's "CLEAN program" was enacted in 2009 and offers a 15-year production payment for solar. The program is capped at 25 MW over four years. Rates are differentiated by project size (< 10 kW, 10-100 kW, and over 100 kW). The largest projects competitively bid for contracts.

At the inception of the pilot program, the incentive payment was based on the cost of generation, specific to the region of the state. More recently, in response to perceived demand, the incentive payment has been reduced to the lowest level the PUC thinks is necessary to attract sufficient interest so that each allotment of program capacity is fully reserved and installed. The producer actually receives the incentive rate minus the retail electricity rate. Payments are only made for electricity generated that does not exceed onsite consumption.²¹

Oregon CLEAN Program

System size or location	Contract price* (per kWh)
Solar < 10 kW	\$0.32 to \$0.41
Solar 10-100 kW	\$0.25 to \$0.29

*Retail rate is subtracted from contract price

TENNESSEE

Tennessee Valley Authority

Started in 2010, the Tennessee Valley Authority Renewable Standard Offer Program provides a performance-based incentive for electricity produced from solar, landfill gas, wind, biomass, and anaerobic digestion. Contracts range from 10-20 years with prices based on season and time-of-day electricity value, from 3.5 to 16 cents per kWh. The program does not provide guaranteed interconnection or a purchase contract.

The program is open to up to 100 MW of projects and had 4.6 MW of connected projects by early 2012.

TEXAS

San Antonio Municipal

In 2010, CPS Energy, the municipal utility serving San Antonio, TX, launched a very limited CLEAN program for solar. The program size was 10 MW of solar PV over two years and offered a single price, 20-year contract for solar PV projects 25-500 kW.

In mid-2011, no projects had received a contract and just half of the original applicants were still in the queue. Unexpected interconnection costs and property tax assessments (the state's property tax exemption only applies to behind the meter projects, not the CLEAN projects) eliminated much or all of the financial upside for prospective producers.

CPS Energy Solar CLEAN Program

System size or location	Contract price (per kWh)
20-500 kW	\$0.270

VERMONT

The most robust statewide CLEAN 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 state limits the size of individual projects to 2.2 MW. The program is fully subscribed. The following table illustrates the contract prices.²²

Vermont CLEAN Program

Technology	1st year price (per kWh)	Annual inflation
Solar PV	\$0.240	0
Hydro	\$0.119	0.5%
Landfill gas	\$0.087	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%

Vermont's program garnered much early interest, but in the two years since the program opened in October 2009, only 5.3 MW of the program's 50 MW limit have been built.²³

Dust in the Corners

Some areas in the U.S. have CLEAN programs in name, but have design flaws or oversights that may hinder their adoption. The follow table outlines some of the drawbacks of particular CLEAN programs with low participation.

Problems for Particular U.S. CLEAN Programs

Locality	Limitation
California	Price based on a combination of time-of-day production and market price referent. Projects not eligible for other incentives.
IP&L, Indiana	Price only paid for electricity used on-site.
FEC, Iowa	Price only paid for electricity used on-site (up to 25% of use).
Maine	Only pays \$0.10 per kWh, regardless of technology.
Oregon	Price only paid for electricity used on-site, and is reduced by net metering.
Palo Alto, CA	Initial price based on avoided cost was insufficient to overcome high costs for land acquisition for ground-mounted solar arrays.
San Antonio, Texas	High interconnection costs and property tax changes made even the generous CLEAN price insufficient for profitable projects.
Tennessee Valley Authority	Price based on avoided cost to utility, contract does not guarantee interconnection.



Forthcoming CLEAN Programs

Several jurisdictions have announced CLEAN programs that have yet to become operational.

CALIFORNIA

Los Angeles Municipal

Approved in April 2012, Los Angeles Department of Water and Power (LADWP) will open a CLEAN program in 2012.²⁴

The program is a two-stage process. By June, applications for a competitively-bid 10 MW will be accepted, used as a price discovery process for a fixed-price CLEAN contract for an additional 65 MW (possibly up to 140 MW) over the next several years. The pilot program's contract price is capped at \$0.30 per kWh, but is likely to be much lower.

The LADWP solar program supports commercial solar in two size classes, 30-150 kW and 150-1000 kW, with 20% of capacity (2 MW) reserved for smaller installations.²⁵

LADWP Municipal CLEAN Program

System size or location	Contract price (per kWh)
30-150 kW	< \$0.30
150-1000 kW	< \$0.30

COLORADO

Fort Collins Municipal

The local utility in Ft. Collins approved a \$1 million per year solar CLEAN program to take effect in 2013. The program is awaiting city council ratification and prices will be set based on the market price of solar PV in 2013.

NEW YORK

Long Island Power Authority

In April 2012, the Long Island Power Authority (LIPA) announced a 50 MW CLEAN program for solar PV. The program will run through June, 2014 and LIPA will purchase power on 20-year, fixed price contracts.²⁶

The program will accept solar projects sized between 50 and 500 kW and pay 22 cents per kWh.²⁷

LIPA CLEAN Program

System size or location	Contract price (per kWh)
50-500 kW	\$0.220

RHODE ISLAND

In 2011, Rhode Island became the sixth U.S. state to implement a CLEAN program, with contracts for wind and solar power (biogas was mentioned in the statute, but no contract prices have been set). Contract terms are for 15 years for the relatively small program (5 MW in 2011, growing to a total of 40 MW by the end of 2014).²⁸

The following table shows the contract prices, as set in September, 2011. According to the law, these are "ceiling prices," capping the auction price for projects larger than 500 kW and representing the actual contract price for projects 500 kW and smaller.²⁹

Rhode Island CLEAN Program

System size or location	Contract price (per kWh)
Wind < 1.5 MW	\$0.134
Solar PV	
10-150 kW	\$0.334
150-500 kW	\$0.316
500-5000 kW	\$0.290
Biogas	n/a

U.S. CLEAN Program Summary

The following table summarizes CLEAN programs in the U.S. by total size, kilowatts per capita, and installed capacity (where available).³⁰ To date, two-thirds of renewable energy capacity developed under U.S. CLEAN contracts is the result of the Sacramento program for large-scale distributed solar (half of that from a single 30 MW project). Hawaii, Gainesville, and Vermont contribute most of the rest of the installed capacity. Many of the U.S. CLEAN programs do not offer contracts for residential-scale solar.

Another common theme is under-utilized capacity. Only a quarter of the

approximately 400 MW of active program capacity has been built so far. Hawaii, Vermont and the Indiana programs (in particular) have had some difficulty transforming projects from promises to production. There are a variety of reasons (explored later) for the unrealized potential of U.S. CLEAN programs.

Very few U.S. CLEAN programs share the same breadth as the German program, covering a wide range of technologies. Vermont, NIPSCO, and Rhode Island are the only programs with offers for technology other than wind and solar.

The following table summarizes CLEAN programs in the U.S. by program size, installed capacity, and contract price for solar. Program prices assume the use of tax incentives by participants. Without that assumption, the prices would have to be much higher (30% or more). Prices have been normalized for solar insolation, contract length, and currency.³¹ Prices in bold are for programs supporting residential solar, and otherwise reflect the price for the smallest solar supported under the program.

Summary of CLEAN Programs in the United States

Locality	Date Launched	Program Size	Installed Capacity	Solar Contract Price*
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Tennessee Valley Authority	2010	100 MW	4.6 MW	5.5¢
NIPSCO (IN)	2011	30 MW	3.0 MW	21.0¢
Rhode Island	2011	40 MW	n/a	22.0¢
Long Island Power Authority (NY)	2012	50 MW	n/a	19.9¢
Los Angeles (CA)	2012	10 MW	n/a	n/a
Palo Alto (CA)	2012	<u>4 MW</u>	<u>0 MW</u>	14.0¢
U.S. TOTAL		1,211 MW	132 MW	
Germany	1990	n/a	53,000 MW	15.7¢

**U.S. prices reflect the external use of federal tax incentives (and would otherwise be much higher). Germany's price is comprehensive.*

The German Model

By virtue of its success (enabling the deployment of over 53,000 MW of wind and solar power), the German “feed-in tariff” (FIT) is the international gold standard. It’s also an illustration of policy making done right, with 80 percent of Germans happy with the program’s cost.³² In fact, 61 percent of Germans expressed their willingness to pay even more for green power.³³

The German program offers long-term contracts, at a price for power sufficient to provide investors a 5-7% annual return.³⁴

Germany’s FIT provides different tariffs for different types of renewable energy, based on the cost to produce electricity. Prices are set higher for those uses policy makers want to encourage (e.g. on-site production, innovative siting). The changing context for renewable energy policy making (e.g. the cost of renewable energy and the size of its output relative to the existing grid system) makes flexibility very useful and important. A very brief history of the German feed-in tariff illustrates this flexibility.

Germany’s first feed-in tariff law, adopted in 1991, offered producers 80% of the retail electricity rate. But when that price fluctuated, so did producer profits, making investments risky.³⁵

ELECTRICITY COST
(residential)

 30 cents per kWh

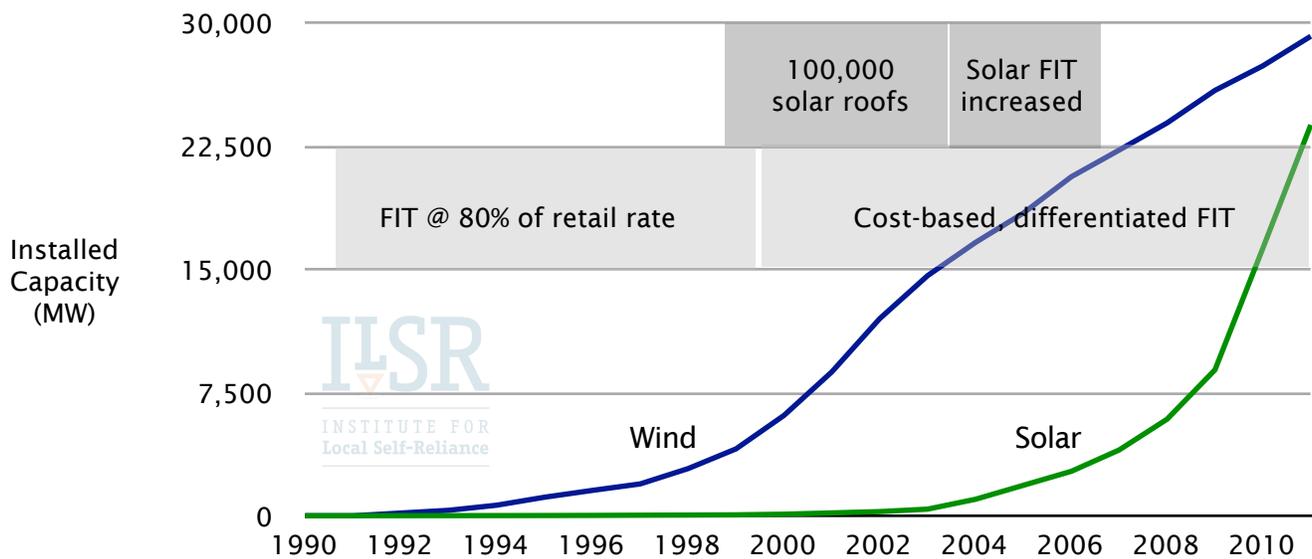
 11.6 cents per kWh

SUNSHINE RESOURCE
(average daily insolation)

 Munich: 3.28

 Vermont: 4.33
Indiana: 4.62
Florida: 5.30
Hawaii: 5.54

Growth of Wind and Solar in Germany



Wind producers lobbied for change, and in 2000 the tariff rate was pegged to the cost of production (and the strength of local wind resources).

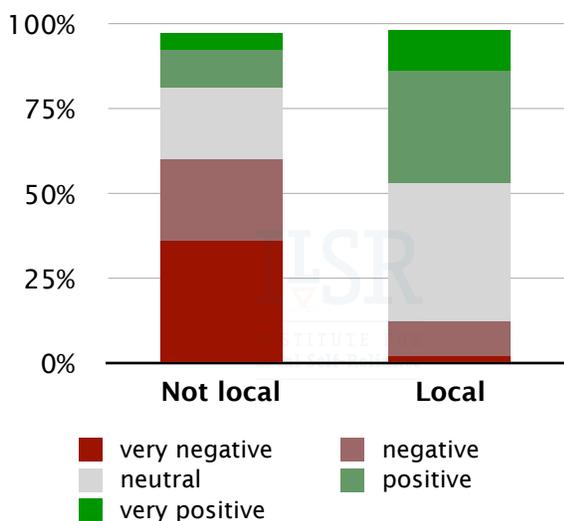
Further refinements to the wind tariff included a re-powering incentive (to encourage older wind projects to upgrade to newer, more powerful turbines) and a grid compatibility bonus for connecting projects where there was existing capacity on the electricity system.

Similar refinements happened with the German solar program. In 1999, Germany launched a 100,000 solar roofs program. Five years later, it significantly increased the price and combined it with the regular FIT program, increasing prices for smaller and rooftop installations.

The solar program has also paid higher prices for building-integrated PV installations and more recently offered bonuses for on-site consumption and storage.

Perhaps the most important aspect of Germany's FIT has been the accelerated pace of downward price adjustments.

Public Support for Renewable Energy (based on ownership of existing project)



Reductions were occurring every other year starting in 2007, but prices fell twice in 2010 and today solar feed-in tariff prices have begun to drop monthly.

Keys to Success

The German renewable energy program owes its success to three components: support for local ownership, frequent price adjustments, and aggressive planning.

Ownership

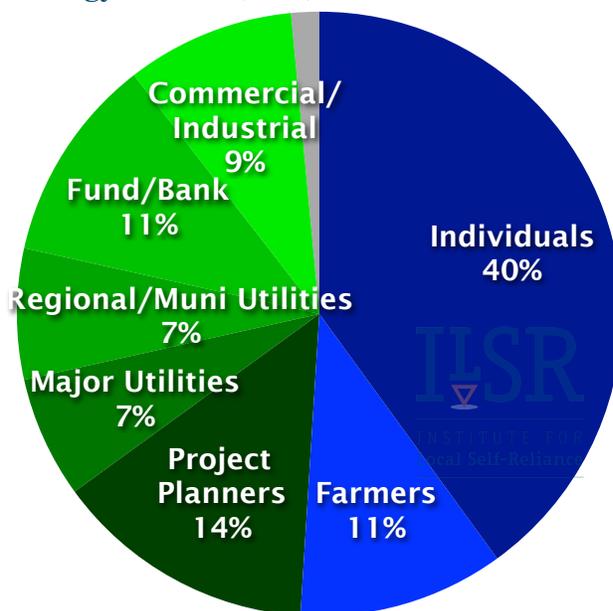
Public support for the German FIT program is high (see chart, below left) because over half of the installed wind and solar power is owned by German citizens and cooperatives (see chart, below right).³⁶

Pricing

Three features of German FIT pricing have aided the program's success.

1. Price differentiation - offering different prices for different technologies and for different sizes of project - has helped

Ownership Share of German Renewable Energy Market (2011)



grow a variety of renewable energy technologies simultaneously. It has also allowed for more democratic participation, since higher prices for smaller projects allowed individual homeowners to add rooftop solar.

2. All-in pricing – The all-in nature of the German FIT price makes investment very simple. Because the price is sufficient to attract private investment, the German government was able to completely eliminate all other subsidies.

3. Frequent price adjustments have also been important to keep the program cost-effective. The Germans have adapted quickly to a remarkable drop in the cost of solar power, cutting solar tariffs six times since January, 2010.

Planning for the Future

Germany has also tried to anticipate future needs with new policy strategies. With wind power, for example, they adopted a re-powering bonus to encourage owners of the oldest wind projects to erect larger turbines to increase production.

Changes have been more significant in the solar program. In particular, the last two years have seen a significant shift in program design to maximize its effectiveness as a distributed renewable energy resource.

The catalyst for change was in 2011, when an abundance of FIT-supported distributed solar provided enough peak electricity such that afternoon electricity prices no longer rose significantly. That led policy makers to search for ways to shift solar producers from an export-to-the-grid orientation to on-site consumption.

In 2011, for the first time, the German FIT program included a bonus payment for customers that regularly consumed more

than 30% of the electricity produced on-site. The payment encouraged individuals to shift their consumption to periods when their solar arrays were producing and also to consider investing in on-site storage.

In 2012, the German parliament reinforced the focus on on-site consumption. Their proposed revisions would apply the feed-in tariff contract price to just 80% of the power generated from small-scale (10 kW and smaller) solar projects and 90% of the electricity generated from projects 10 kW to 1,000 kW.³⁷

As the FIT contract price has dropped below the retail electricity price it has become more rewarding for a homeowner to use their solar electricity to satisfy their own needs rather than export it to the grid. In other words, it's more worthwhile to offset electricity purchases than it is to export all electricity to the grid and be paid the FIT rate.

These policy changes are still being refined as regulators gain more feedback from their impact. At this time, the typical homeowner can use approximately 30% of their solar production on-site without any storage or significant time-shifting of consumption. However, the incremental value of on-site use compared to the feed-in tariff price is not yet enough to pay for on-site storage. As the FIT rate continues to decline, however, the margin between the “export” price and the “on-site” value will eventually make storage worthwhile.

No doubt, the Germans will continue to tweak their feed-in tariff policy as solar prices drop and production increases in order to minimize the public subsidy and maximize the use of locally-owned, distributed renewable energy resources.

Lessons for U.S. CLEAN Programs

U.S. experience with CLEAN is still modest. State and utility policies are still in their infancy. There's much to learn. Our previous and current analyses of U.S., Canadian, and European CLEAN programs points to some key lessons.

Program Caps

First and foremost, the scale of American CLEAN programs pale in comparison to international ones because every U.S. program has a numerical cap, ranging from 3 MW for Consumers Energy to 125 MW for the complete Indiana Power & Light program. These programs represent 1% or less of the jurisdiction's total electricity sales. In Germany and Denmark, where there is no cap to CLEAN contracts, 20% or more of electricity comes from electricity sources developed under the CLEAN program. Neighboring Ontario already has several thousand megawatts under contract from its 3-year old program (see [Maximizing Jobs From Clean Energy: Ontario's 'Buy Local' Policy](#)).

Experience shows, not surprisingly, that the larger the scale of CLEAN programs the greater the cost savings. Germany has nearly a 50% price advantage in project installation costs, due almost entirely to its large, streamlined market for solar (solar panels are sold on a world market, so national price differences for hardware are small).³⁸

Scale

Another lesson from Germany is that encouraging small scale, locally owned, renewable energy projects builds significant support for continued renewable energy expansion. Several U.S. programs do not seem to have on-site or local ownership as a policy objective. In Sacramento, the municipal program offers a single, low solar CLEAN price that has resulted in projects mostly 1 MW and larger. Some

jurisdictions purposefully focus on larger projects – e.g. Palo Alto has a 100 kW minimum project size – to be able to set lower prices and claim a lower ratepayer impact. It is true that larger projects will have lower per kW costs, although the difference may be minimal. But many small projects mean many households (and businesses) that begin to have an economic self-interest in supporting further renewable energy developments.

Price

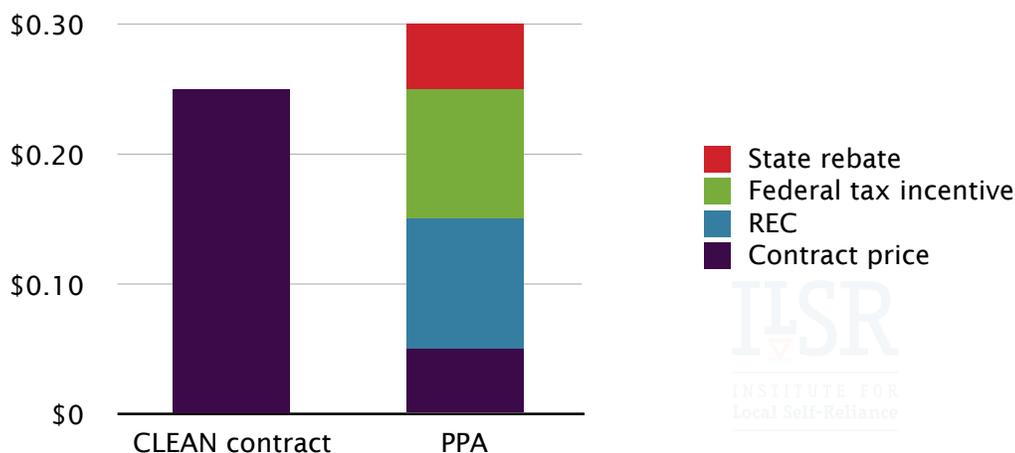
Price also matters. In communities where the CLEAN price is too low, development will lag as developers struggle to make projects pencil out. If prices are too high, then developers can make excessive returns. The major difference between CLEAN programs and other policies is the longevity of those prices. Market prices may fluctuate significantly while CLEAN contract prices are fixed for 15-25 years by contract. In Germany, as noted, contract prices for new projects are adjusted frequently.

Tax Incentives

American CLEAN contracts are not an all-in price for generating electricity, but must be combined with federal tax incentives (and sometimes state incentives, as well) in order to make the renewable energy installation profitable for investors.

The reliance on tax incentives constrains the U.S. CLEAN programs. Federal tax

CLEAN Offers Simpler Pricing



incentives are subject to the vagaries of Congressional politics.

Federal tax incentives also increase complexity as developers often partner with companies seeking tax write-offs, which in turn encourages larger projects and increases the overall cost of the project.

When CLEAN prices require developers to use tax incentives, it either precludes cities, schools, and other public entities (that don't pay taxes) from participation or requires them to arrange complex legal partnerships with for-profit entities to finance renewable energy projects. Individuals may also struggle to finance a solar project if they can't find the money upfront while they await their anticipated tax credit.³⁹

As shown in the chart, a developer constructing a project in country where the CLEAN contract is the only price/incentive for power production has a very straightforward revenue stream. In places like the U.S., developers have to cobble together four or more revenue streams and the overhead costs of aggregating can make these projects more expensive.

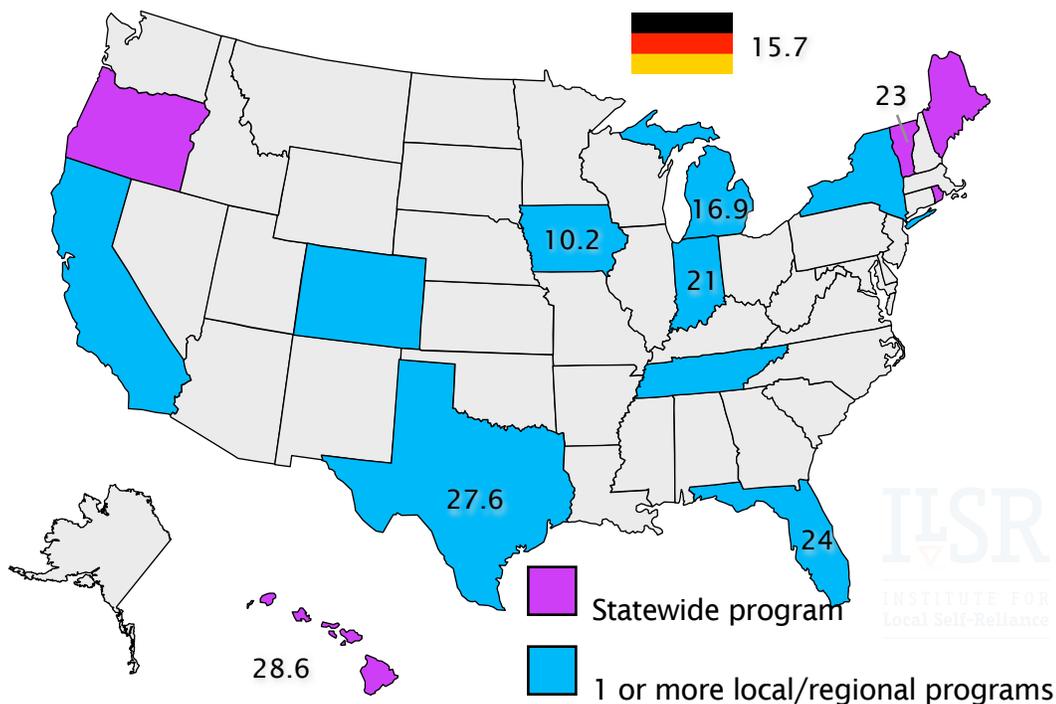
The tax incentive problem also complicates community wind and solar projects that attempt to merge local ownership with capturing the economies of scale inherent in larger projects.⁴⁰ Complex federal securities rules to prevent fraudulent investments make organizing a community-based project legally tricky and financially expensive.

CLEAN programs where the price is transparent and sufficiently high to attract investors do not require additional incentives and encourage local ownership. Nearly 90% of Danish wind turbines are locally owned, as is 90% of German solar and half its wind power.

Unfortunately, there's a tradeoff. If a state or utility CLEAN program is designed as an all-in price, it means local ratepayers will pay more due to the loss of the federal taxpayer subsidy. However, it also means that the program is more flexible, can be tailored to local needs and conditions, and is easier to use.

The problem of federal incentives suggests two solutions. On the one hand, local CLEAN programs could set all-in prices and be much more explicit about supporting only locally owned projects for their greater economic returns.

Residential Solar Feed-In Tariff Prices (Normalized)

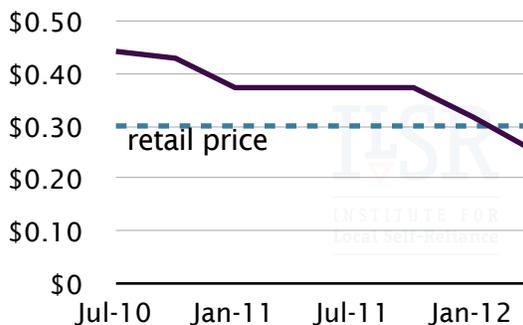


On the other hand, the federal government could shift to cash-based renewable energy incentives or adopt a federal CLEAN program. This would integrate more smoothly with state- or utility-based CLEAN programs.

German-U.S. Price Comparison

One result of the German attention to detail with their feed-in tariff has been a dramatic decline in the cost of solar. The map (above) illustrates the price paid for residential-scale solar in U.S. CLEAN contracts, compared to the rate in Germany of 15.7 cents per kWh (adjusted).

German Small Solar FIT Contract Price



All map prices have been adjusted to account for differences in currency value, solar insolation, and contract length (For more on this calculation, see [Who Has the Most Cost-Effective Solar Feed-in Tariff?](#)).⁴¹

The U.S. prices do not include the effect of the federal tax credit, which is typically taken in addition to the price shown. With out the tax credit, U.S. prices would be 30% (3-5 cents) higher. Thus, the

Germans are paying far less for residential solar than are any of the U.S. CLEAN programs (with the exception of the very small Iowa utility program).

A number of U.S. CLEAN solar programs are not shown in the map because they do not support residential solar. Prices for their smallest-sized eligible solar projects are shown in the following table. Once again, prices are adjusted for differences in currency value, solar insolation, and contract length (but assume developers are taking the federal tax credit). Once again, the Germans pay less for equivalently sized solar projects, even without accounting for the 30% price hike for U.S. projects if developers could not use the federal tax credit.

Adjusted U.S. Solar CLEAN Prices

Locality	Price for Smallest Solar (\$ per kWh)
Germany (30-100 kW)	\$0.13
Indianapolis Power & Light (20-100 kW)	\$0.17
Rhode Island (10-150 kW)	\$0.22
Sacramento (1 MW)	\$0.12
Palo Alto (> 100 kW)	\$0.14
Long Island Power Authority (50-500 kW)	\$0.20

Diversity

Another important feature of successful CLEAN programs is diversity. Programs that offer multiple contract prices based on project size (or even resource quality) encourage development over a wider area and in a variety of sizes. This encourages democratization of ownership, but also helps maximize use of existing grid infrastructure by supporting larger-scale projects (that may only work in certain

parts of the grid) as well as small-scale projects that can connect anywhere.

A diversity of technologies is also good policy, because it will help overcome the variability of renewable electricity production. Wind blows more strongly at night and solar produces best during daytime, making the two technologies natural allies for round-the-clock power supply. Hydro, biogas, and other technologies can help provide additional, and most importantly, on-demand renewable energy sources.

Legal Issues

In the U.S., CLEAN programs are hobbled by federal law. State-based policies can run afoul of either the Federal Power Act or the Public Utility Regulatory Policies Act (PURPA).

In general, all contracts for interstate electricity sales are overseen by the Federal Power Act (FPA). Three states are exempted from the FPA because of minimal interstate electricity interconnections (Hawaii, Alaska, and Texas). This is the legal basis for Hawaii’s CLEAN program. For the remaining states, the FPA requires cost-based CLEAN contracts to be reviewed individually by the Federal Energy Regulatory Commission (FERC), making CLEAN programs under the FPA administratively impossible.⁴²

States can avoid the FPA regulation by narrowing their program to PURPA’s “qualifying facilities” (roughly, projects 80 MW and under that are certified by the FERC) as long as the price they set is not above the utility’s “avoided cost.” This is the marginal cost for the utility to obtain an additional kWh of electricity from the market, and is typically very low.

A FERC order in January 2011 also suggested that states could go further and set the price for power in a more traditional fashion, by taking a hand in determining the avoided cost.⁴³

However, some utilities are not subject to PURPA and therefore states could not compel them to offer contracts under a PURPA-styled CLEAN program.⁴⁴

In the case of Maine's pseudo CLEAN program, the price is set via a renewable energy certificate. In Oregon, the program restricts participants to producing less than is consumed on site to avoid FPA and PURPA. For Vermont and Rhode Island, it's unclear how they have avoided the federal legal conflicts. One expert notes that, "My belief is that the Vermont program is okay because no one has challenged it."⁴⁵

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.

Ultimately, federal energy laws require state-based CLEAN programs to thread the needles of legality and simplicity, a feat that has proven beyond the capability of most states.

Prepare for the Future

A hallmark of Germany's CLEAN program is its dynamism. American CLEAN programs must similarly adapt to a changing energy market.

First, CLEAN programs should have regular price adjustments to accommodate changing market dynamics. Germany's recently adopted "growth corridor" for solar is a particularly innovative strategy that sets a growth target (e.g. 3,000 MW of

solar per year) and sets a transparent schedule for price reductions based on the market's over- or under-supply. Few American CLEAN programs have any year-to-year price transparency, and for renewable energy projects that take longer than a year to develop, such mystery is costly.

CLEAN programs should also prepare for a time when renewable energy (especially solar) approaches "grid parity." Some have suggested that when electricity from solar costs less than electricity from the utility, no special policy is needed any longer. But that's not the case.

Even with net metering (allowing on-site generators to turn the meter backwards), grid parity is no guarantee of profitable solar installations. As solar becomes a significant part of the marketplace, it can distort electricity prices. For example, the enormous surge in solar power deployment in Germany has eliminated the afternoon spike in power prices.⁴⁶ Solar arrays that have been financed with the assumption of offsetting expensive "peak power" may find that their revenue stream has dried up due to "too much" solar on the grid.

Additionally, utilities may successfully argue that net metering policies (allowing Americans to roll back their meter and receive energy savings at the retail electricity price) do not sufficiently cover their fixed costs. They may alter their billing structure to shrink the portion based on energy consumption, reducing the value of on-site solar power.

Another consideration is that traditional subsidies will be much less politically palatable when solar is competitive with grid electricity prices.

Thus, a CLEAN program may be an important tool for continuing the growth

of solar past a point of parity with retail electricity prices. If retail prices remain high, CLEAN provides a method for selling power that can't be consumed on-site, providing a contract for power sales and a price that may still be higher than the wholesale electricity price. If retail prices have plummeted, a CLEAN program can still offer a contract price based on the cost of production.

Such adjustments would be incredibly difficult with existing U.S. incentives, in large part because it would rely on action by Congress. Right now, the only action Congress is primed to take on energy incentives is to eliminate them. There are no proposals to gradually reduce

incentives nor are there proposals to adjust the tax incentives based on regional energy resources, project sizes, or level of on-site energy consumption.

A CLEAN program is designed to be flexible, so it can also adjust more appropriately to changes in the relative price of solar power and grid power. Germany is one of the few places in the world where their energy financing policy has already had to accommodate this transition, and they did it through the regular decrease in CLEAN contract prices. There's no such phase out being considered for existing U.S. tax incentives, nor are those policies well suited to such adjustment.

Conclusion

CLEAN programs are on the rise in the United States, but their contribution thus far is pitifully small. Only 132 MW of renewable energy has been installed under CLEAN programs, the tiniest fraction of the 50,000 MW installed in the country.

The good news is that the CLEAN programs outlined so far are focused on distributed generation, projects no larger than 20 MW. This scale of wind and solar project can capture most economies of scale, can be integrated into the grid more easily, and constructed more rapidly. These smaller scale projects and the simplicity of CLEAN programs also lends itself to local ownership, a crucial strategy for marrying the economic benefits of renewable energy to clean energy production and for building ongoing political support.

American CLEAN programs are being considered or implemented by a growing number of states even as the German, and more recently, the Ontario, Canada CLEAN programs can inform U.S. policymakers. The rapid growth in U.S. CLEAN programs also means a growing body of knowledge about implementing and expanding CLEAN domestically.

The return of CLEAN contracts to the United States has taken several decades, but the trajectory suggests good things to come.

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