



Building a Brighter Future

California's Progress Toward
a Million Solar Roofs



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Executive Summary

California's Million Solar Roofs Initiative is succeeding. Thanks in large part to this visionary program, launched in January 2007, solar panels are multiplying on rooftops across the state. **As of mid-October 2011, California's solar industry is on the cusp of celebrating a major milestone – the installation of more than 1,000 megawatts (MW) of rooftop solar photovoltaic capacity in total.***

The Million Solar Roofs Initiative has helped California install more solar electric generation capacity than all but five nations in the world. At the same time, the program is building a strong and healthy solar industry in the state, creating local jobs, and helping to drive down the price of solar energy.

California has only begun to scratch the surface of the massive potential of solar energy. State leaders should ensure that the Million Solar Roofs Initiative continues to succeed during its final five years, and lay the groundwork for further expansion of solar energy in the future.

Five years in, the Million Solar Roofs Initiative is one-quarter of the way toward its goal of installing 3,000 MW of distributed solar energy systems by the end of 2016 – putting the program on a pace to meet the overall goal on schedule.

- Since the first solar panels under the Million Solar Roofs Initiative were connected to the grid in 2007,

*All solar capacity figures in this report are presented in terms of alternating current Watts, measured under California Energy Commission PTC test conditions, unless otherwise noted.

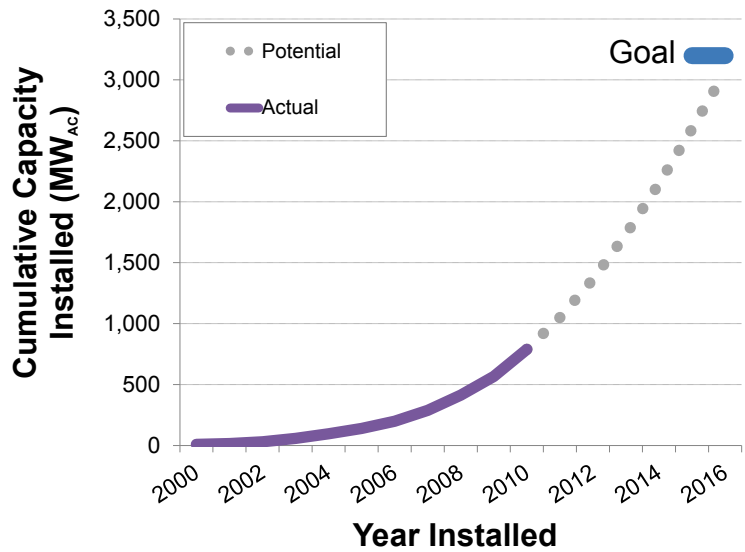
California has installed nearly 800 MW of solar photovoltaic power.

- Counting activity from earlier solar programs, as of mid-October 2011, California is on the cusp of the milestone of installing more than 1,000 MW of rooftop solar power – a level of solar energy penetration achieved by only five nations in the world.
- California’s solar market has been expanding exponentially by about 40 percent per year. (See Figure ES-1.) If the market continues growing at a rate of 25 percent per year, the state will achieve the 3,000 MW goal by the end of 2016.

The Million Solar Roofs Initiative is helping to reduce the cost of solar energy in California.

- Since the program began, the total installed cost of residential solar energy systems in California has fallen 25 percent – and the cost of commercial-scale systems more than 40 percent. In 2007, residential systems typically cost \$10 per Watt, while costs in 2011 average \$7.60 per Watt (through August, in 2011 dollars).
- Given available incentives, many customers are already seeing immediate cost savings by going solar – especially customers with larger electricity use in parts of the state with tiered pricing or time-of-use electricity rates.
- If progress continues at the same rate, residential solar energy should reach break-even costs statewide – even without upfront rebates – within the next five years.

Figure ES-1: Actual (through 2010) and Potential (through 2016) Solar Installations in California



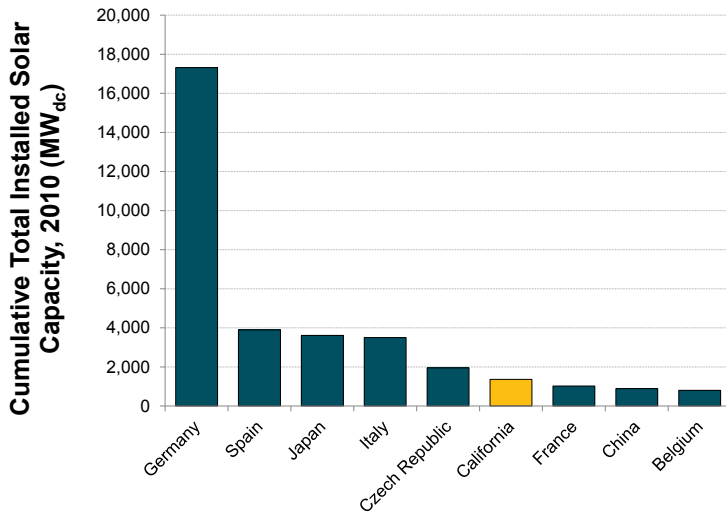
The Million Solar Roofs Initiative is making California’s solar industry stronger.

- California is home to about 20 percent of all solar power companies in the United States. More than 3,500 firms are active in California’s solar industry. These firms employ more than 25,000 people.
- The industry has roughly doubled in size since 2007, and is a bright spot in our overall economy.

Despite its rapid progress, California has only barely tapped into the massive potential for solar power.

- California has tremendous untapped solar energy potential. The National Renewable Energy Laboratory estimates that the state could host

Figure ES-2: Cumulative Installed Solar Photovoltaic Capacity by Country, through 2010



more than 80,000 MW of rooftop solar capacity – which could generate more than a third as much electricity as California uses in a year.

- Other countries are demonstrating that it is possible to rapidly expand the solar market and achieve ambitious goals. Germany, for example, has already reached 17,000 MW_{dc} of solar capacity – nearly 17 times California’s current total – through consistent and strong public policy support. (See Figure ES-2.)

California should continue its efforts to build the strength of its solar market and solar industry. Key steps include:

- Ensure that the Million Solar Roofs Initiative reaches its goal by the end of 2016.

- Encourage the state’s municipal utilities, especially the Los Angeles Department of Water and Power, to meet or exceed their portion of the Million Solar Roofs goal.
- Increase the use of solar energy systems in new construction by requiring all new homes to include solar power or other on-site renewable electricity generation by no later than 2020, and all new non-residential buildings by no later than 2030, through a net-zero energy building code requirement.
- Adopt a strong feed-in-tariff policy to encourage solar power installation on warehouses, parking lots and other sites with low on-site energy demands but high levels of sunshine.
- Maintain or enhance the incentive value of net metering and lift the cap on its use to allow all California ratepayers to benefit from going solar.
- Remove barriers to installing solar energy systems at the local and state levels by streamlining interconnection and permitting.
- Finally, California should continue to set ambitious clean energy goals – such as Governor Jerry Brown’s goal of installing 12,000 MW of distributed electricity generation in California by 2020 – and design innovative policies to achieve them.

Introduction

Solar energy makes sense for California.

Environmentally, solar energy reduces the air pollution caused by burning coal, gas or oil to generate electricity – including pollution that contributes to global warming. Economically, solar energy helps break our costly dependence on fossil fuels and plays into California’s economic strength as the nation’s capital of high-tech innovation. And solar energy takes advantage of a resource that is clean, safe and ubiquitous, and which California has in virtually limitless abundance: sunlight.

It is no surprise, then, that Californians have been leaders in finding ways to tap the potential of solar energy.

The main hurdle facing solar power has been the same hurdle facing any new energy technology – making it cost-

competitive with established forms of energy generation that have benefited from decades of government and consumer investment.

In the mid-1990s, California leaders began to craft and implement programs designed to spur progress in the state’s solar industry. By offering rebates to consumers who install solar energy systems and facilitating the integration of solar power into the grid, California has helped the solar industry establish a foothold in the energy market. In the 10 years leading up to 2006, these programs resulted in the installation of nearly 200 megawatts (MW) of solar generation capacity in California and established the state as one of the world’s leading solar markets.

In 2006, however, California’s leaders recognized that the time had come

to take the next step – to bring solar energy to scale.

The California Legislature mandated the investment of \$3.3 billion in small-scale solar electric power systems, with the goal of increasing the state’s solar generation capacity by 3,000 MW within a decade. Six months later, the Legislature passed, and Governor Schwarzenegger signed, the Million Solar Roofs Bill (Senate Bill 1) into law.¹ This law established a statewide inter-agency effort, now called the Go Solar California campaign, which includes a number of different programs that promote the installation of new solar power systems.

The Million Solar Roofs Initiative is one of California’s – and indeed the nation’s – most important and ambitious public policy endeavors. Historic in both scope and scale, this Initiative represents the first unified state effort to turn solar power into a commonplace and affordable energy resource for average citizens.

The Initiative aimed to cut the cost of solar power in half and create a mainstream market for solar power within 10 years. At the same time, the program was designed to increase the stability of California’s energy supply, reduce the state’s contribution to the serious problem of global warming, make the state’s air cleaner, and launch an industry that is likely to be an economic engine for the state in decades to come.

As 2011 winds down, we are approaching the halfway point in the implementation of the Million Solar Roofs Initiative. In this report, Environment California Research & Policy Center takes a closer look at the important progress the program has achieved to date.

California has taken the first steps toward capturing the limitless potential of solar energy. In the next five years, we can continue laying the groundwork for the next great energy transition – one that will transform our economy, generate jobs, protect our health and preserve our environment for generations to come.

Photo: Anna Miller, CCSE



California's Million Solar Roofs Initiative was designed to cut the cost of solar power in half and create a mainstream market for solar power within 10 years. This important and ambitious policy is working.

The Million Solar Roofs Initiative Is Succeeding

In 2006 California created the Million Solar Roofs Initiative (now part of the “Go Solar California Campaign”), a plan to use \$3.3 billion in incentives to drive the installation of 3,000 megawatts (MW) of solar power by the end of 2016, while also reducing the price of solar power and creating a vibrant, sustainable solar industry in California for the long term.

The program was designed to achieve economies of scale in the solar industry. By increasing demand for solar energy systems, the program helps the solar industry to manufacture and install systems more cheaply. As prices go down, demand increases exponentially, creating a “virtuous cycle” that will make solar power a major part of California’s electricity system. (See Figure 1 on page 10.)

The program is working as planned. The incentive system has been predict-

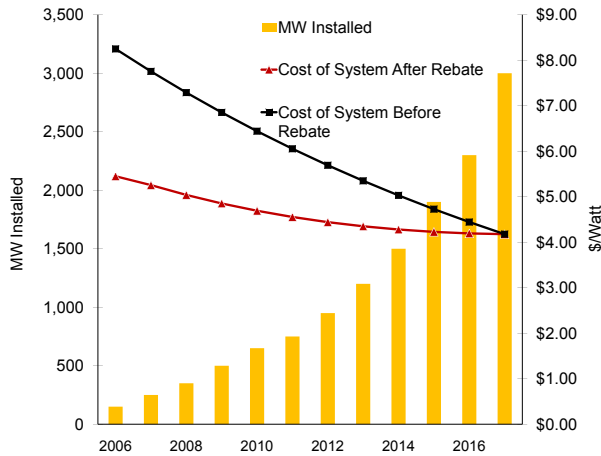
able, transparent, and effective – setting a strong example of how to advance the clean energy market for other states and the nation as a whole.

Five years in, California now has more solar electric generation capacity than all but five nations in the world. At the same time, the program is building a strong and healthy solar industry in the state, reducing air pollution and helping to drive down the price of solar energy.

The Million Solar Roofs Initiative Is On-Pace to Meet Its Goal

Nearly five years in, the Million Solar Roofs Initiative has reached just beyond one-quarter of its goal of installing 3,000 MW of solar photovoltaic systems on

Figure 1: Achieving Economies of Scale: How the Million Solar Roofs Initiative Is Designed to Work²



The Million Solar Roofs Initiative was designed to use incentives to drive economies of scale in the solar industry, helping the solar industry to manufacture and install systems more cheaply. As prices go down, demand goes up, creating a “virtuous cycle” that will make solar power a major part of California’s electricity system.

rooftops across the state – putting the program on a pace to meet the overall goal on schedule.

Since the first solar installations under the Initiative were plugged into the electricity grid in 2007, California has added nearly 800 MW of solar capacity on or near residential and commercial buildings.³ Including solar projects completed under earlier solar programs, California is on the cusp of the milestone of installing more than 1,000 MW of rooftop solar power as of mid-October 2011.⁴

The state’s solar market has grown exponentially, at a pace of about 40 percent per year. (See Figure 2 on page 11.) This dramatic rate of progress conforms exactly with how the project was designed to

work. The theory behind the design of the program was that initial incentives would begin to accelerate growth in the solar market, which would install increasing amounts of solar panels each subsequent year. As the market built momentum, the amount of the incentives could be scaled back, while preserving continued market growth. In other words, the fact that the program is one quarter of the way to its goal at the half-way mark shows that it is on track to meet its overall goals.

Driven substantially by progress in California, solar power is the fastest growing industry in America.⁵

California’s Investor-Owned Utility Ratepayers Are Leading the Way

The California Solar Initiative, which is the program funded by ratepayers of the state’s three investor-owned utilities, is a bright spot in California’s overall solar market. This program has yielded the most solar capacity, installed at the fastest pace.

The California Public Utilities Commission (CPUC) deserves credit for designing a predictable and transparent incentive system. Through the program, installers have a clear and accurate understanding of available incentives over time, helping to sustain rapid market growth without interruption. Moreover, the commission makes frequently updated market data available to the public, helping to ensure that ratepayer investments in the program are delivering value. This program sets a strong example of how to advance the clean energy market for other states and the nation as a whole.

As of September 2011, the California Solar Initiative has installed more than 600 MW of solar capacity – or about

The Structure of California’s Million Solar Roofs Initiative

The Million Solar Roofs Initiative is composed of three main parts:

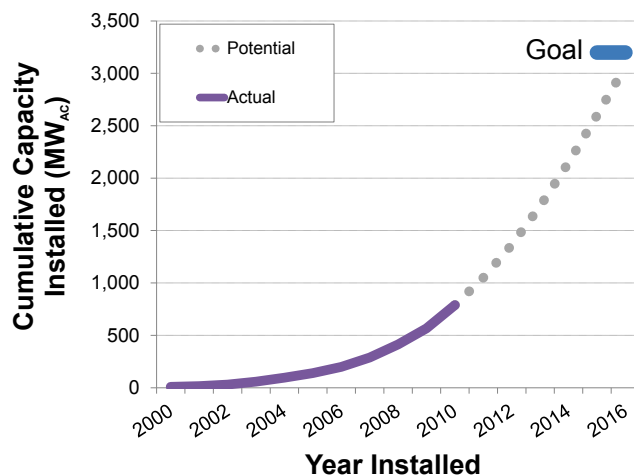
1. *The California Solar Initiative*, managed by the state Public Utilities Commission, seeks to expand the number of solar energy systems installed on existing homes in investor-owned utility territories, including Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric. This part of the program has a goal of installing 1,940 MW of solar capacity by 2016, on an original budget of \$2.167 billion.
2. *Publicly-owned utilities*, such as the Sacramento Municipal Utility District or the Los Angeles Department of Water and Power, manage their own programs. Collectively, these utilities have a goal of installing 700 MW of solar capacity by 2016, with an available budget of \$784 million.
3. *The New Solar Homes Partnership*, managed by the California Energy Commission, seeks to expand the amount of solar energy systems installed on new homes built in investor-owned utility territories. This program aims to install 360 MW of solar capacity by 2016 with a budget of \$400 million.

The California Public Utilities Commission and the California Energy Commission have branded the package of programs designed to increase the amount of solar photovoltaic and solar hot water systems installed in the state as the “Go Solar California Campaign.” The agencies have established a web portal with comprehensive information about the campaign at www.gosolarcalifornia.com.

75 percent of the total activity under the Million Solar Roofs Initiative.⁷ The program has reached nearly a third of its overall goal – and applications currently in the pipeline will bring it to nearly halfway.⁸

On the residential side of the California Solar Initiative, the CSI program administrator reports that investor-owned utilities will have enough funding to exceed their goals. Together, all three utilities expect to add about 610 MW of net-metered residential solar energy systems in their service territories – or about 6 percent more than their goals.⁹

Figure 2: Actual (through 2010) and Potential (through 2016) Solar Installations in California⁶



On the commercial side of the program, the California Legislature recently passed and Governor Jerry Brown signed a bill that corrected for a budget shortfall.¹⁰ The shortfall was created primarily because more governments and non-profits – which can't take advantage of tax breaks and thus are offered larger cash incentives – participated in the program than expected.¹¹ Additionally, many commercial systems receive incentives based on generation performance and these systems performed about 6 percent better than expected.¹²

Before the correction, the program administrators expected to run out of money after reaching 65 percent of the commercial solar installation goals.¹³ The new changes to the program should ensure that it will be able to meet its targets – and probably ahead of schedule given the strong level of interest in the program.

Some Publicly-Owned Utilities Need to Accelerate Progress

Under California's Million Solar Roofs Initiative, more than 40 publicly-owned utilities each have a role to play in achieving the state's overall goals for solar installation. Some of these utilities are succeeding in advancing their local solar markets. Others are behind where they should be and need to implement their solar rebate programs more aggressively.

As of the end of 2010 (the most recently reported data available), the state's publicly-owned utilities had installed 65 MW of solar power, or about 10 percent of the overall goal of 700 MW for the sector.¹⁴

Given the design and function of the rebate program, the largest number of solar installations will come in the later years of the program. Utilities that have

Table 1: Leading Publicly-Owned Utilities in Terms of Reaching Solar Installation Goals, through 2010¹⁶

Utility	Goal (kW)	Percent Attained Through 2010
Truckee Donner Public Utilities District	596	33%
Palo Alto, City of	6,500	33%
Banning Public Utilities	2,000	32%
Healdsburg, City of	530	30%
Lodi Electric Utility	3,000	25%
Trinity Public Utility District	240	22%
Alameda Municipal Power	2,127	18%
Modesto Irrigation District	30,000	17%
Sacramento Municipal Utility District	125,000	16%
Pasadena, Water & Power Department	14,000	16%
Redding Electric Utility	3,000	15%

Table 2: Leading Publicly-Owned Utilities in Terms of Installing the Most Solar Power, through 2010¹⁷

Utility	Goal (kW)	Installed Through 2010 (kW)	Percent
Sacramento Municipal Utility District	125,000	19,677	16%
Los Angeles Dept. of Water & Power	280,000	17,417	6%
Modesto Irrigation District	30,000	5,173	17%
Silicon Valley Power	30,000	3,505	12%
Turlock Irrigation District	23,000	3,217	14%
Imperial Irrigation District	44,000	2,551	6%
Pasadena, Water & Power Department	14,000	2,177	16%
Palo Alto, City of	6,500	2,126	33%
Burbank Water & Power	15,000	1,644	11%
Roseville Electric	14,750	1,595	11%
Riverside Public Utilities	26,000	1,459	6%
Anaheim Public Utilities	12,000	1,199	10%

achieved more than 15 to 30 percent of their goals by the end of 2010 are well on their way to overall success, such as the cities of Palo Alto, Lodi, Alameda, the Modesto Irrigation District and the Sacramento Municipal Utility District (SMUD). (See Table 1.)

However, twelve publicly-owned utilities reported zero progress to the Public Utility Commission by the end of 2010. Another 11 utilities reported achieving less than 10 percent of their overall solar energy goals. These utilities should implement their solar incentive programs more aggressively.

In particular, the Los Angeles Department of Water & Power (LADWP) is crucial to the success of the overall Million Solar Roofs Initiative. LADWP alone accounts for 40 percent of the overall solar installation goal for publicly-owned utilities, and more than 9 percent of the total statewide goal.

LADWP had reached only 6 percent

of its goal by the end of 2010. Through July 2011, LADWP has exceeded 8 percent of its goal.¹⁵ The city's progress has been slowed due in large part to a pattern of starts and stops within the city's solar energy rebate program and chronic underfunding of the overall incentive program for going solar in Los Angeles. Even though LADWP ranked second amongst municipal utilities in terms of the overall amount of solar capacity installed by the end of 2010 (see Table 2), it is by far the largest utility and needs to accelerate progress.

Unlike the California Solar Initiative, publicly-owned utilities do not provide detailed market data on a regular basis, submitting only annual summary reports to the Public Utilities Commission. Providing more detailed information on a more frequent basis could encourage greater transparency in publicly-owned utility incentive programs and encourage more installer participation.

The New Solar Homes Partnership: A Promising Market Hampered by the Housing Crisis

The New Solar Homes Partnership aims to drive the installation of solar energy systems on new homes built in investor-owned utility territories through financial incentives.

The new home market is one of the best avenues available to expand California's solar capacity. Solar energy technology is cheaper when installed at the time of construction, since homes can be oriented to maximize the sunlight captured by a rooftop system, and builders can achieve economies of scale in the purchase and installation process. In 2010, residential systems installed on new homes were \$0.7 per Watt cheaper, on average, than comparably-sized systems on existing homes.¹⁸

Moreover, new solar homes are in demand. Studies of home sales in new California developments have found that

homes with solar power as a standard feature sell two to three times faster than non-solar homes that are otherwise equivalent.¹⁹ Owners of new solar homes report great satisfaction with their purchase.²⁰

Despite the advantages of including solar power systems on new homes, the incentives offered through the New Solar Homes Partnership have not been enough to overcome the overall impact of the housing crisis. As of September 2011, the New Solar Homes Partnership is less than 4 percent of the way toward completing its goal. The program has reached about 13 MW of capacity installed, compared to the overall goal of the program of 360 MW by 2016.²¹ Another 23 MW of solar projects are on deck in pending applications, which will bring the program to 7 percent of its overall goal.²²

Because of the housing crisis, opportunities to include solar power systems on new homes have declined. New housing starts in California dropped 75 percent between 2006 and 2009. The multi-family housing market began to rebound in 2010, but not the single-family market. Overall, the housing sector remains significantly depressed.²³

Even with reduced construction of new homes, many opportunities to install new solar energy systems have gone unrealized. From 2007 through 2010, the industry built 150,000 single-family homes. However, the New Solar Homes Partnership only installed 3,500 solar energy systems – on a mere 2.5 percent of all new homes.

The Energy Commission loosened some of the eligibility requirements in 2010, which may accelerate participation over time.²⁴ However, policy measures beyond incentives may be necessary to capture the huge potential for progress that new home construction represents for California's solar market.

Photo: Courtesy of SunRun



The new home market is one of the best avenues available to expand California's solar capacity.

The Million Solar Roofs Initiative Has Helped to Reduce the Cost of Solar Energy

The overall success of the Million Solar Roofs Program is helping to reduce the cost of solar energy. At its current pace, the program is on track to cut the cost of solar installations in half by the time the program ends at the close of 2016.

In California, the average cost of a residential solar installation has fallen from \$10.20 per Watt in January 2007 to \$7.63 per Watt through August 2011 (in 2011 dollars), a decline of 25 percent.²⁵ (See Figure 3.)

In the commercial, government, and non-profit sectors, where the trend has been towards larger systems, the price decline has been even more pronounced. (All other factors being equal, larger systems tend to be cheaper due to economies of scale). Installations on these non-residential rooftops have dropped from \$10.69 per Watt in January 2007 to \$6.31 per Watt so far in 2011 (through August), a price drop of more than 40 percent.²⁶ (See Figure 4.)

Some of this cost decline stems from the fact that solar panel prices have dropped dramatically. Since 2001, manufacturers have cut the retail cost of a solar module in half.²⁹ Panels are part of a global market, and prices have universally declined as the global market has grown, as manufacturing capacity has increased and spread to new countries, and as improved technologies have been introduced.

However, modules are only about 40 percent of the cost of a solar installation. The remainder of the cost of a solar energy system includes installation labor, electronics needed to connect the panels to the electricity grid, overhead, and other non-module costs. These costs are

Figure 3: Residential Solar Energy Systems Are Becoming Cheaper²⁷

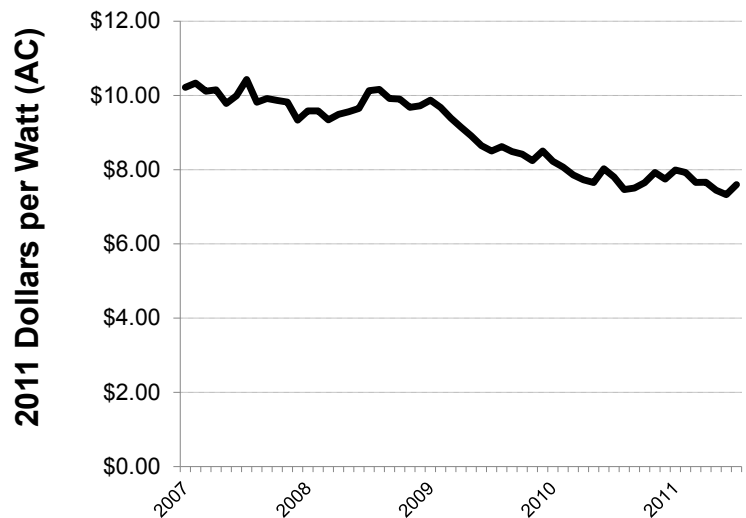
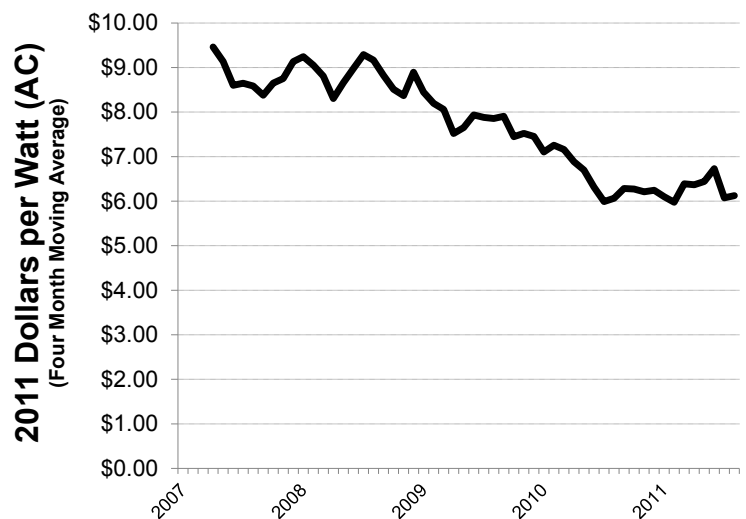


Figure 4: The Average Cost of Non-Residential Systems Is Rapidly Declining²⁸



much more closely tied to the strength of the local market and can be affected by policies that accelerate market development, like California's Million Solar Roofs Initiative.

In a 2011 report, the Lawrence Berkeley National Laboratory concluded that non-module costs have fallen nearly 40 percent since 1998, with a pronounced drop of 18 percent from 2009 to 2010. The analysis includes some installers outside of California, but draws most heavily on the California Solar Initiative – showing that California’s market development is helping to drive down costs locally.

The impact of having a well-developed market on reducing local costs is most clearly apparent in Germany, with the world’s most developed base of solar infrastructure. In Germany, small residential solar installations in 2010 averaged \$4.2 per Watt, before incentives.³⁰ Germany installed nearly 7,000 MW of solar power in that year alone, with much of that capacity coming from smaller installations.³¹

In California in 2010, small residential systems cost about \$7.80 per Watt.³² That year, California installed just over 193 MW of solar capacity.³³ As California’s market size grows closer to Germany’s, consumers can expect further reductions in the cost of going solar.

Photo: Online Creative Media



Solar energy is quickly becoming a mainstream part of California’s electricity system, and will continue to grow in importance in the coming years – thanks to the state’s efforts to accelerate the development of the solar marketplace.

California’s Solar Market Is Growing Even as Incentives Decline

The dramatic growth in California’s solar market – and the accompanying decline in prices – has occurred even as incentives have declined, with the program performing exactly as it was drawn up by its architects.

In the residential market under the California Solar Initiative, incentive amounts have dropped by 75 percent since 2007, averaging 60 cents per Watt for projects installed in 2011.³⁴ In the non-residential market, average incentives have dropped by more than two-thirds, averaging \$0.98 per Watt in 2011.³⁵ For new projects, incentives can now be as low as \$0.25 per Watt.³⁶

This dynamic will provide California’s electricity ratepayers with more distributed solar generation for their dollar – plus all the benefits that distributed solar energy provides, including a more stable electric grid and less air pollution – as California’s solar market continues to grow.

Solar Power is Becoming Cost-Competitive with Traditional Forms of Electricity Generation

Thanks to the cost reductions driven by the global market and California’s pioneering policies, solar power is becoming cost-competitive with traditional forms of electricity generation.

For many commercial and large residential electricity users, electricity from new solar energy systems is already cheaper than electricity from the grid, given available federal and state incentives.³⁷ Significant numbers of California’s families are already seeing cost savings from going solar, as evidenced by the success of third-party

solar financing companies like SolarCity, SunRun and Sungevity.

As solar energy costs continue to decline, the need for rebates and other financial incentives will also decline. As of 2011, residential customers who use a lot of electricity in areas with tiered electricity pricing can already achieve savings from solar power systems even without rebates.³⁸

In an earlier report, Environment California Research & Policy Center estimated that cost savings for the residential market as a whole would be available, without rebates, when the cost of a residential installation fell to \$5.25 per Watt (2011 dollars) – assuming that adequate supporting policies are available to facilitate the connection of large amounts of solar power to the electricity system, including net metering.³⁹ If progress continues at the same rate it has over the past four years, residential prices will reach this cost-competitive position without rebates in mid-2014.⁴⁰ Outside investment analysts place this milestone at around 2016.⁴¹

Regardless of the actual timing of this milestone, it is already clear that solar energy is quickly becoming a mainstream part of California's electricity system, and will continue to grow in importance in the coming years – thanks to the state's efforts to accelerate the development of the solar marketplace.

The Million Solar Roofs Initiative Has Helped to Create a Strong Solar Industry in California

California is building a strong and sustainable solar industry that will be around for the long haul.



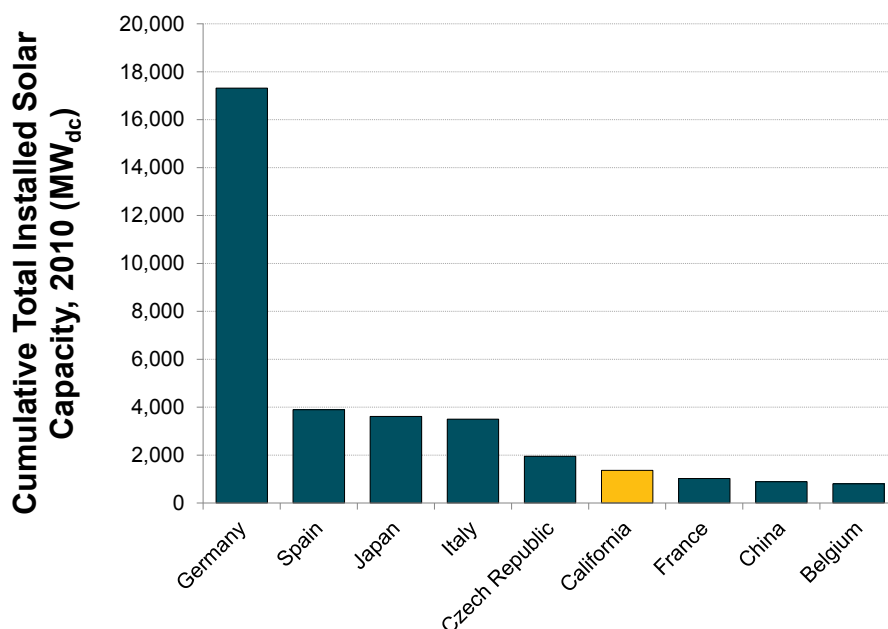
California is building a strong and sustainable solar industry that will be around for the long haul.

California is home to about 20 percent of all solar companies in the United States. More than 3,500 firms are active in California's solar industry, currently employing more than 25,000 people.⁴² The industry has doubled in size since 2007.

The state's consistent support for clean energy makes it a magnet for cleantech venture capital. In the first half of 2010, approximately 40 percent of global clean technology-oriented venture capital came to California.⁴³ Since 2006, California has received \$11.6 billion of this cleantech funding, supporting solar power as well as other clean energy technologies from energy efficiency to transportation. This financial support is part of the reason that researchers and entrepreneurs in California hold a large share of the nation's green technology patents. From 2007 to 2009, nearly 40 percent of the nation's solar energy patents were registered in California.⁴⁴

California's support for solar power helped the industry weather the recent

Figure 5: Cumulative Installed Solar Photovoltaic Capacity by Country, through 2010⁵⁴



recession. While other sectors of the state economy shed jobs, overall employment in “green” sectors increased 5 percent from 2007 to 2008.⁴⁵ Nationwide, the solar industry grew nearly 7 percent in 2010, growing nearly 10 times faster than the overall economy.⁴⁶

The solar industry projects continued explosive growth. Industry analysts predict the installation of more than 1 million residential solar projects in California by 2020, adding on the order of \$30 billion to the economy and creating more than 20,000 new jobs per year.⁴⁷

California Has Only Just Begun to Scratch the Surface of Its Solar Energy Potential

Despite this dramatic growth, California has barely tapped into its overall solar energy potential. The National Renewable Energy Laboratory estimates that the state could host more than 80,000

MW of rooftop solar energy systems.⁴⁸ That much solar energy capacity could generate the equivalent of more than a third of the electricity that California uses in a year, statewide.⁴⁹

Other nations have shown that it is possible to achieve – and dramatically exceed – the pace of growth in the solar market necessary for California to reach its goal. Germany, for example, has already reached 17,000 MW of solar capacity – 17 times California’s current total – through consistent and strong public policy support.⁵⁰ Germany is on track to increase its use of renewable sources of electricity from 20 percent of its electrical supply in 2011 to at least 35 percent by 2020.⁵¹ By that year, Germany could have as much as 50,000 MW of solar power installed.⁵² In addition to Germany, solar programs in Spain, Japan, Italy and the Czech Republic have catapulted these markets ahead of California.⁵³ (See Figure 5.)

Policy Recommendations

Five years in, California's Million Solar Roofs Initiative is on track to succeed in bringing solar energy into the mainstream. Over the next five years, state leaders must continue to ensure that the program maintains steady progress toward its goals while simultaneously launching new programs to take California's solar market to a whole new level. Every additional solar panel installed on a rooftop in the state will help lower the cost of solar power and make solar technology increasingly accessible to everyday Californians – while reducing air pollution, creating local jobs and helping to stabilize the electric grid.

California should continue its efforts to build the strength of its solar market and solar industry. Key steps include:

Ensure that the Million Solar Roofs Initiative reaches its goal by the end of 2016.

- The September 2011 action by the Legislature to correct budget calculations in the California Solar Initiative is a good indication that state leaders have their eye on ensuring the overall success of California's solar market expansion programs. State leaders should continue to work to make sure that the programs stay on track. This includes continuing funding for new solar homes, maintaining or enhancing the effectiveness of net metering, maintaining a healthy cushion between the number of net-metered systems and the net



This photo shows Solar Grove, a solar parking lot built by Kyocera in San Diego that generates enough electricity to power 69 typical homes. Every additional solar panel installed in California will help lower the cost of solar power and make solar technology increasingly accessible to everyday Californians – while reducing air pollution, creating local jobs and helping to stabilize the electricity grid.

metering cap, and continuing to reduce barriers to going solar at the state and local levels.

Encourage the state’s municipal utilities to meet or exceed their portion of the Million Solar Roofs goal.

- Local leaders should work with publicly-owned utilities to ensure the effective implementation of their solar incentive programs. In particular, the Los Angeles Department of Water & Power is crucial to the success of the overall Million Solar Roofs Initiative, as the largest publicly-owned utility.

Create a net-zero energy building code to increase the use of solar energy in new construction.

- Incorporating solar power into new buildings at the time of construction represents an enormous opportunity to grow California’s solar market. Ultimately, policy makers need to move beyond simple incentives to capture the full energy potential of new buildings. To achieve more, California should require all new homes to include solar power or other on-site renewable electricity generation by no later than 2020, and all non-residential buildings by

no later than 2030, through a net-zero energy building code requirement. Such a requirement would be consistent with the state's overall clean energy goals, as well as with steps that President Obama has ordered for federal buildings.⁵⁵

Adopt a strong feed-in-tariff policy to encourage solar power installation on warehouses, parking lots and other sites with low on-site energy demands but high levels of sunshine.

- Currently, California's distributed solar power policies are geared toward small-scale solar energy systems (less than 1 MW) intended exclusively for meeting on-site electricity demands. California has recently also embarked on a program to support large installations (10-20 MW) through what is called a Reverse Auction Mechanism (RAM).
- A feed-in-tariff policy could help drive the market for medium sized solar projects (10 MW and under), which are typically installed on warehouses, along freeways, or in parking lots, brownfields and other places where there is little on-site electricity demand, but ample space to install solar panels.
- A feed-in tariff would require the state's utilities to purchase all of the electricity "fed into the grid" from a solar energy system at a set rate. Germany has used a feed-in tariff to drive the rapid growth of its solar market.

Allow all California ratepayers to benefit from going solar.

- Net metering partially compensates solar energy system owners for the substantial benefits that they provide to other users of the electricity grid,

including cleaner air, less global warming pollution, less need to finance the installation of new power plants or new transmission lines, and a more stable electricity grid. State leaders should maintain or enhance the value of net metering as an incentive for installing solar power. Accordingly, the California Public Utilities Commission should reject San Diego Gas & Electric's recent proposal to separate how much it charges customers for electricity from how much it charges to transport that electricity, which would result in an average \$11 monthly surcharge on solar panel owners in its service territory.⁵⁶

- Net metering is currently limited to 5 percent of a utility's peak aggregate demand, raised from 2.5 percent in February 2011. This cap is set too low to ensure that all solar energy system owners who participate in the Million Solar Roofs Initiative earn fair compensation for the benefits that their systems will provide to all ratepayers. California should expand its net metering cap or eliminate it altogether.
- The state should implement innovative programs that allow renters and multifamily building residents to benefit from the proliferation of solar.

Expand financing opportunities for solar energy systems.

- Other important policies can help ensure that homeowners or business owners who install solar energy systems maximize the return on their investments. Allowing on-bill financing could enable potential solar customers to install systems with no money down and low inter-

est payments, as an ongoing part of the utility bill. These programs, such as the PAYS America program (Pay As You Save), harness future savings from renewable technologies or efficiency measures to pay the up-front cost of installation. They are especially promising for multi-family dwellings because they allow the payments to be attached to the utility meter, making the program attractive to renters, as well as property owners.

- The Property Assessed Clean Energy (PACE) program, which enables property owners to finance renewable energy and energy efficiency projects through local government loans that are paid back via property tax bills, should be reinstated. California leaders can continue to advocate for the program to be restored at the federal level.

Remove barriers to going solar at the local and state levels, including minimizing challenges with interconnection and permitting.

- Different jurisdictions across the state have varying permitting and interconnection procedures and

fees, which can add unnecessary friction to the process of installing solar energy systems. State and local leaders should work to standardize procedures, minimize fees, and streamline the process of installing a new solar energy system and integrating it into the electricity grid. Industry analysts predict that reforming permitting would lead to the installation of an additional 132,000 residential solar power systems through 2020, a 13 percent increase in the pace of solar development – which would contribute \$5.1 billion to the California economy and create 3,900 full-time jobs.⁵⁷

Finally, California should continue to set ambitious clean energy goals and design innovative policies to achieve them.

- For example, Governor Jerry Brown’s goal of installing 12,000 MW of distributed electricity generation in California by 2020 is a strong step above and beyond the Million Solar Roofs Initiative. California should continue to take a leadership role in transforming our state’s energy infrastructure and our economy.

Notes

1. State of California Legislature, *Senate Bill 1 (Murray)*, 2006.

2. Dave Algozo, Mary, Braun & Bernadette Del Chiaro, Environment California Research & Policy Center, *Bringing Solar to Scale: California's Opportunity to Create a Thriving, Self-Sustaining Residential Solar Market*, April 2005.

3. This figure includes all customer-side interconnection, the vast majority of which since 2007 has come through the Million Solar Roofs Initiative. Including installations from the California Solar Initiative, per California Energy Commission & California Public Utilities Commission, *California Solar Initiative Working Data Set*, 7 September 2011, available at www.californiasolarstatistics.ca.gov/current_data_files; data from the New Solar Homes Partnership, per California Energy Commission & California Public Utilities Commission, *Find a New Solar Homes Partnership Community*, 23 September 2011, available at <http://www.gosolarcalifornia.org/communities/nshp.php>; and data from publicly-owned utility programs, per: California Energy Commission, *Publicly Owned Utilities' SB1 Solar Program Status Reports: Publicly Owned Utilities Life of Program and Yearly Statistics, 2009-2010*, 23 June 2011, available at www.energy.ca.gov/sb1/pou_reports/. All solar capacity figures measured in alternating current megawatts, using the California Energy Commission PTC test conditions, unless otherwise noted.

4. California Energy Commission & California Public Utilities Commission, *California Solar Statistics: California Leads the Nation*, updated 13 October 2011.

5. Solar Energy Industries Association and Vote Solar, *U.S. Solar Industry Achieved Record Cost Reductions in 2010 According to DOE Report; Solar Advocates: National Lab Study is Latest Indicator that Solar is Ready to Repower America* (press release), 15 September 2011.

6. Presents actual data through 2010 from the sources described in note 3. Potential data through 2016 represents a hypothetical scenario where California's solar market grows 33 percent in 2011, with the rate of growth steadily declining

to 18 percent in 2016, illustrated to represent one possible trajectory for the solar market to reach the 3,000 MW goal by the end of 2016.

7. California Energy Commission & California Public Utilities Commission, *Program Totals by Administrator*, downloaded from www.californiasolarstatistics.ca.gov/reports/agency_stats/ on 28 September 2011.

8. Ibid.

9. California Energy Commission & California Public Utilities Commission, *CSI Budget Report*, downloaded from www.californiasolarstatistics.ca.gov/reports/budget_forecast/ on 28 September 2011.

10. California Legislature, *Senate Bill 585 (Kehoe)*, Signed by Governor Jerry Brown on 22 September 2011.

11. California Public Utilities Commission, *Decision 10-09-046*, Background Section, September 23, 2010; Jeff Stanfield, "Calif. PUC Looks to Cut Budget-Busting Solar Incentive Payments, Change Rules," *SNL Power Week*, 2 August 2010.

12. California Public Utilities Commission, *California Solar Initiative Annual Program Assessment*, June 2010, p75.

13. See note 9.

14. California Energy Commission, *Publicly Owned Utilities' SB1 Solar Program Status Reports: Publicly Owned Utilities Life of Program and Yearly Statistics, 2009-2010*, 23 June 2011, available at www.energy.ca.gov/sb1/pou_reports/.

15. Los Angeles Department of Water & Power, *Solar Photovoltaic (PV) Incentive Program Status Report through July 2011*, August 2011.

16. See note 14.

17. Ibid.

18. Galen Barbose et al, Lawrence Berkeley National Laboratory, *Tracking the Sun IV: An Historical Summary of the Installed Cost of Photovoltaics in the United States from 1998 to 2010*, September 2011.

19. Cassandra Sweet, "Renewed Energy: Solar Homes Negotiate California Housing Slump," *Dow Jones Newswires*, 24 June 2008; U.S. Department of Energy, Office of Energy Efficiency and Renewable

- Energy, *A Homebuilder's Guide to Going Solar*, DOE/GO-102008-2599, April 2008; Elizabeth Douglass, "Sun-Powered Homes Defy a Cool Housing Market," *Los Angeles Times*, 25 September 2007; Brian Clarke Howard, "Solar-Powered Homes Outselling Weak Market," *The Daily Green*, 9 November 2007; Dana Hull, "Solar Industry Remains a Bright Spot in the Economy," *San Jose Mercury News*, 15 April 2010.
20. Charlotte Glennie, Environment California Research & Policy Center, *Saving with Solar: A Survey of Homeowners in California*, May 2010.
21. California Energy Commission & California Public Utilities Commission, *Find a New Solar Homes Partnership Community*, 23 September 2011, available at www.gosolarcalifornia.org/communities/nshp.php.
22. Ibid.
23. California Building Industry Association, *Housing Starts*, downloaded from www.cbia.org/go/cbia/newsroom/housing-statistics/housing-starts/ on 10 April 2011.
24. California Energy Commission, *New Solar Homes Partnership - Docket # 06-NSHP1*, 12 August 2011; California Energy Commission, *Energy Commission's New Solar Homes Guidelines Benefit California Builders* (press release), 28 January 2010.
25. The 25 percent figure represents the change in the average cost of residential systems in January 2007, the first month of the program, to the average cost of residential systems in 2011, including data from January through August. The data is from the California Solar Initiative, which maintains the best publicly-available database of solar cost records. It covers only installations in investor-owned utility territories, on existing buildings. California Energy Commission & California Public Utilities Commission, *California Solar Initiative Working Data Set*, 7 September 2011, available at www.californiasolarstatistics.ca.gov/current_data_files.
26. The 40 percent figure represents the change in the average cost of non-residential systems in January 2007, the first month of the program, to the average cost of non-residential systems in 2011, including data from January through August. The data is from the California Solar Initiative, per note 25.
27. Ibid, *California Solar Initiative Working Data Set*, 7 September 2011.
28. Ibid, *California Solar Initiative Working Data Set*, 7 September 2011.
29. Solarbuzz, *Module Pricing*, downloaded from www.solarbuzz.com/facts-and-figures/retail-price-environment/module-prices on 26 September 2011.
30. See note 18.
31. Paul Ausick, "Germany Rethinks Cuts to Solar Subsidies," *24/7 Wall St.* (247wallst.com), 6 June 2011.
32. Residential customer class installations in 2010 per note 25, *California Solar Initiative Working Data Set*, 7 September 2011.
33. California Public Utilities Commission, *California Solar Initiative Annual Program Assessment*, June 2011.
34. 2011 data through August from the California Solar Initiative, per note 25.
35. Ibid.
36. California Public Utilities Commission and California Energy Commission, *California Solar Initiative: Statewide Trigger Tracker*, 14 October 2011, available at www.csi-trigger.com/.
37. Shayle Kann, "Does Grid Parity Matter?" *Greentech Solar*, 22 June 2011.
38. BJ Stanbery, HelioVolt, *Convergence of Markets: Growth of Distributed Energy* (presentation), Third Thin Film Conference, 16 February 2011, available at www.slideshare.net/HelioVolt/photon-3rd-thin-film-conference-heliovolt-presentation16feb11.
39. See note 2.
40. Judged by linear regression of the cost curve in Figure 3 on page 15.
41. Ahmar Zaman and Shawn Lockman, Piper Jaffray Investment Research, *Solar Industry Growth ... You Ain't Seen Nothin' Yet: The Grid Parity Decade*, January 2011.
42. The Solar Foundation, *National Solar Jobs Census 2011: A Review of the U.S. Solar Workforce*, October 2011.
43. Next Ten and Collaborative Economics, *2010 California Green Innovation Index*, 7 October 2010.
44. Ibid.
45. Mary D. Nichols, "Climate Policies Drive

California's Economic Future," *Sustainable Industries*, 31 May 2010.

46. See note 42.

47. Alexander Quinn, Christine Safriet, and Christopher Clement, AECOM, *Economic and Fiscal Impact Analysis of Residential Solar Permitting Reform*, July 2011.

48. J. Paidipati et al, Navigant Consulting, Inc. for the National Renewable Energy Laboratory, *Rooftop Photovoltaics Market Penetration Scenarios*, Subcontract Report NREL/SR-581-42306, February 2008. This figure doesn't even begin to account for utility-scale solar power systems. A giant solar farm on a hundred square mile patch of the desert could technically generate as much electricity as the entire nation uses in a year: Bernadette del Chiaro, Tony Dutzik and Sarah Payne, Environment America Research & Policy Center, *On the Rise: Solar Thermal Power and the Fight Against Global Warming*, Spring 2008.

49. Assuming an average 1kW system generates more than 1,100 kWh of electricity per year. California uses about 270 million MWh of electricity per year, per: U.S. Energy Information Administration, *State Electricity Profiles: California*, DOE/EIA-0348(01)/2, April 2011.

50. BP, *Statistical Review of World Energy*, June 2011.

51. Paul Gipe, "Germany Aims for 35-40% Renewables by 2020," *Solar Today*, 25 July 2011.

52. Ibid.

53. See note 50.

54. Ibid.

55. The White House, *Executive Order 13514*, 5 October 2009.

56. Eric Wolff, "Energy: Solar Customers Furious with Utility over Proposed Rate Change," *North County Times*, 8 October 2011.

57. See note 47.