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September 2002

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CASE STUDIES OF STATE SUPPORT FOR RENEWABLE ENERGY

Using Bulk Purchase Commitments to Foster Sustained Orderly Development and Commercialization of PV

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CASE SUMMARY

Case Description

The largest barrier to the widespread adoption of photovoltaics (PV) is its high cost. PV is particularly well suited for mass production and installation that could greatly reduce its costs. However, mass production and installation may only occur if prices decline sufficiently to stimulate increased and sustained demand. Several utilities, cooperatives, and clean energy funds have attempted to overcome this classic chicken-and-egg problem by making bulk purchase and installation commitments. This case study explores the efforts of the Sacramento Municipal Utility District (SMUD), the California Power Authority, the Western Solar Utility Network (WesternSUN) Cooperative, and the City of Chicago.

Innovative Features

- Early experience with buy-down programs for PV has shown that deep PV price reductions, at least for residential systems, are not assured in the near term (see

separate case study on buy-down programs). Lack of sustained markets and manufacturing economies of scale, and a weak installation and servicing infrastructure, are often-blamed culprits. To overcome these challenges, each of the programs described in this study uses innovative bulk purchase and/or installation efforts.

- SMUD offers the longest-running experience, and although recent allegations suggest that its program has not been as successful as some have claimed, SMUD's efforts nonetheless exemplify the strategy known as "sustained orderly development and commercialization," which calls for steady growth in the market rather than haphazard large volume purchases that can actually cause supply shortages and lead to price increases.
- Two of the cases we examine, SMUD and the City of Chicago, have used bulk purchase

commitments in an attempt to secure not only price reductions, but also local economic development benefits by attracting manufacturing facilities to the area.

Results

- Of the programs examined, SMUD has the most experience to date, installing more than 10 MW of PV since 1993 and reportedly achieving cost reductions of nearly 11% per year on average, to the point where the installed cost of SMUD PV systems comes in at about half that of systems sold elsewhere in California. These claims have recently been challenged.
- The California Power Authority has received guaranteed bids through 2005 that reflect more modest price reductions,

but this is perhaps due to the substantial uncertainty over the eventual outcome of the Power Authority's efforts.

- WesternSUN reports being able to secure price discounts with relatively modest purchase commitments, particularly among thin-film PV dealers.
- Spire Solar Chicago has had a difficult time meeting its price targets, due primarily to delays in the construction of its new manufacturing facility.
- While the possible role of clean energy funds in this process requires further thought, this case study illustrates the advantages of bulk purchase and installation programs.

CASE STUDY DETAILS

The largest barrier to the widespread adoption of photovoltaics (PV) is no doubt its high capital (and leveled \$/kWh) cost. Moreover, early experience with standard buy-down programs for PV has shown that, under these programs, sizable and near-term PV price reductions are not assured, at least for residential systems (see separate case study on buy-down programs). Lack of sustained markets and manufacturing economies of scale, and a weak installation and servicing infrastructure for residential systems, are often-blamed culprits. And yet, as a modular technology, PV is particularly well suited for mass production techniques that could greatly reduce its costs. PV could also benefit from mass installation programs to drive down installation costs. However, mass production will likely only occur if prices decline sufficiently from current levels to stimulate increased and sustained demand, while mass installation also requires healthy demand.

Several utilities, cooperatives, and clean energy funds have attempted to overcome this classic chicken-and-egg problem by making bulk purchase commitments that provide PV

manufacturers with the assurance of a future market that they need to expand their manufacturing capabilities and achieve cost reductions. Some of these programs also involve mass installation efforts to drive down installation and servicing costs. This case study explores the use of bulk purchase commitments to reduce PV system costs for the Sacramento Municipal Utility District (SMUD), the California Power Authority, the Western Solar Utility Network (WesternSUN) Cooperative, and the City of Chicago. While the possible role of clean energy funds in this process requires further thought, the programs reported in this case study illustrate the advantages of bulk purchase and installation programs.

The Sacramento Municipal Utility District

With more than 10 MW of PV installed in its service territory since 1993, SMUD is perhaps the most often cited example of using bulk purchase commitments and installation to achieve cost reductions (although recent revelations have tarnished SMUD's image – see final paragraph). SMUD has pursued a strategy known as “sustained orderly

development and commercialization” (SODC), which posits that a predictable, reliable, and substantial multi-year purchase commitment will eliminate disruptive boom/bust cycles and allow the PV industry to grow in an orderly fashion. In other words, haphazard large volume purchases by themselves are not the answer, and can in fact cause price *increases* as production constraints are reached. Instead, steady, reliable purchase commitments will allow the PV industry to expand manufacturing capacity and achieve cost reductions. SMUD also centralizes PV installation and servicing to drive down those costs as well.

SMUD’s SODC program has evolved over the years.¹ In its first phase, from 1993 to mid-1998, SMUD released yearly solicitations for 500 to 1,000 kW of PV systems. While in retrospect SMUD’s PV procurement has been remarkably steady over this period (see table below), reportedly allowing substantial price reductions to occur, annual solicitations may not provide sufficient long-term security for manufacturers to ramp up production. As a result, the second phase of the program involves a 5-year (through mid-2003) 10 MW purchase commitment spanning all system components: modules, inverters, and installation. SMUD expected this second phase to bring the fully installed cost of PV to

below \$3/W in 2003, a level that is often cited as the threshold at which customer-sited PV becomes cost-competitive with retail electricity prices. In addition, SMUD used the long-term contract as a means to secure local economic development benefits. Energy Photovoltaics, Inc., the winner of the PV contract, has opened a thin-film manufacturing facility in Sacramento (the financially troubled CalSolar), while Trace Engineering agreed to locate an inverter assembly facility in Sacramento.

The following table (sourced from a SMUD presentation) shows the reported cost reductions achieved through SMUD’s SODC strategy from 1993 to 2000. Figures for 2002 are reportedly based on firm contracts. According to the table, the total turnkey cost of PV systems, including SMUD overhead, has declined by an average annualized 10.8% since 1993, and the installed cost of SMUD’s PV systems (~\$4-5/W) comes in at about half that of systems sold elsewhere in California under the statewide buy-down program (\$8-11/W). If accurate (see final paragraph below), this figure alone strongly illustrates the potential value of bulk purchase and installation programs.

Year	Turn-Key Cost (\$/W)	SMUD Added Cost (\$/W)	Total Cost (\$/W)	Installed Capacity (kW)
1993	7.70	1.08	8.78	495
1994	6.23	0.90	7.13	675
1995	5.98	0.89	6.87	554
1996	5.52	0.85	6.37	461
1997	4.80	0.84	5.64	495
1998	4.60	0.83	5.43	490
1999	4.18	0.74	4.92	1,402
2000	3.85	0.48	4.33	1,541
[2002]	[2.76]	[0.39]	[3.15]	[2,600]

Source: Schwent, 2001

¹ A portion of SMUD’s program was undertaken with funding assistance from the Utility Photovoltaic Group (UPVG), which itself was funded by the U.S. Department of Energy.

The specific programs that SMUD has employed to create PV demand are perhaps less relevant to this case study than the bulk purchase aspect, but nevertheless deserve mention. The PV Pioneer I program, which began in 1993, targeted residential hosts for PV systems. SMUD owns and operates the systems, which are connected to the utility-side of the meter, and charges each host a \$4/month green premium. In 1994, SMUD added the Neighborhood PV Pioneer program to install systems on community buildings such as churches and schools. In 1999, SMUD launched the PV Pioneer II program that enabled customers to purchase PV systems – with the help of SMUD buy-downs – and net meter them. SMUD has also installed large “solarports” (PV-shaded parking lots), central-station projects sited at sub-stations and a mothballed nuclear plant, and building-integrated photovoltaic (BIPV) applications.

While these SMUD programs have clearly resulted in the installation of large amounts of PV over the years (i.e., 10 MW), recent events call into question the aggressive system cost reductions for which SMUD’s programs have become famous. An article in the September 6 edition of the *The Sacramento Bee* charges that SMUD has fallen well short of its capacity goals and “rocketed past its budget limits” (Dahlberg 2002). Specifically, SMUD’s board has been asked to spend \$7.6 million on solar programs in 2002 – more than twice the originally requested \$3.2 million – to install 1.2 MW of PV – only about 60% of the original 2 MW goal for 2002. These cost overruns and capacity shortfalls reportedly stem from a number of factors, including:

- double-counting the benefits of the PV program in the budget;
- higher-than-projected solar panel costs, driven in part by the financial problems of CalSolar, which would have been SMUD’s cheapest supplier;
- reliance on various grants and subsidies that SMUD did not ultimately receive;
- unauthorized changes in supplier contracts; and
- incorrectly subsidized out-of-service territory systems.

This story, which also involves the early retirement of SMUD’s long-time PV program director, is only beginning to unfold. It is clear, however, that given this turn of events, the data that SMUD provides on system costs (see table above) should, at the very least, be viewed with a critical eye.

California Consumer Power and Conservation Financing Authority (“Power Authority”)

The California Power Authority was created at the height of California’s electricity crisis to finance the construction of new power plants – both renewable and conventional – sufficient to ensure a 15% capacity reserve margin for the state. One of the Power Authority’s earliest acts was to issue a Request For Bids (RFB) for PV, fuel cell, and microturbine capacity between 2002 and 2005. Winning bidders to this RFB will be eligible to bid in future Requests for Proposals (RFPs) for specific projects at prices at or below those indicated in their response to the RFB.

While no subsequent RFPs have yet been issued, the prices contained in the responses to the RFB are somewhat indicative of potential cost reductions that can be achieved through bulk purchase commitments. For example, Kyocera and Siemens PV modules offered to the Power Authority in 2002 were priced 30% to 40% below prices quoted at Real Goods, a popular retailer of renewable energy equipment. Furthermore, among those who were responsive to the RFB instructions and provided figures for both price and volume through 2005, eight companies committed a total of 215 MW of crystalline PV modules from 2002-2005 at weighted average price decreases of 2% per year. Likewise, three companies committed a total of 51.5 MW of thin-film PV modules from 2002-2005 at weighted average price decreases of nearly 7% per year. Including the cost of O&M, warranties, etc., the Power Authority calculates that the lowest cost of PV generation bid – before factoring in the impact

of state buy-down incentives, tax credits, and any depreciation benefits – was 17¢/kWh in 2002 and 16¢/kWh in 2003. Since the Power Authority does not *guarantee* any individual bidder future business, the guaranteed prices and price reductions contained in these responses are likely to be conservative.² Furthermore, the figures quoted are based on equipment costs only; further savings could potentially be realized from bulk installation practices.

Western Solar Utility Network (WesternSUN) Cooperative

WesternSUN buys PV in bulk for about 26 municipal and cooperative utilities in the Northwest. The cooperative purchases complete PV systems directly from manufacturers and resells the systems to members for resale to end-use customers. In 2002, they have committed to buying 100 kW of thin-film PV and roughly another 100 kW of crystalline silicon systems. Applications run the gamut from utility green pricing programs to residential rooftop PV to school systems. While the total annual volume (200 kW) is relatively small compared to that supported by SMUD or (potentially) the Power Authority, WesternSUN's purchase commitment has been growing by 100% every year since it began 3 years ago. WesternSUN reports that price reductions from bulk purchases have been more pronounced for thin-film than for crystalline silicon, perhaps due to strong demand for crystalline silicon and the fact that thin-film PV is still in its infancy and suppliers are looking for markets. An examination of product offerings on WesternSUN's web site suggests that price reductions of 17% below suggested retail for crystalline and 30%-40% for thin-film systems are available to members.

The Chicago Solar Partnership

In 1999, the City of Chicago and ComEd used a \$2 million and \$6 million purchase commitment, respectively, to lure Spire

Corporation – a Massachusetts-based manufacturer of PV assembly line equipment – to build a PV manufacturing facility on a redeveloped brownfield site on the west side of Chicago. Additional incentives are provided by the state's Renewable Energy Resources Program (RERP), which funds 60% of installed PV system costs, as well as an additional \$6 million from ComEd not specifically earmarked for Spire systems, but nonetheless available for PV in general. This "brightfield" initiative – the first of its kind – resulted in a new company called Spire Solar Chicago, and a new collaborative called the Chicago Solar Partnership.

Spire Solar Chicago has installed roughly 550 kW since January 2000, mostly on public buildings such as museums and schools within Chicago city limits. While price reductions were built into the \$8 million purchase commitments, Spire Solar Chicago has thus far had difficulty meeting them due to a number of factors, including construction delays, incomplete production lines and low production volume, a requirement to use expensive union labor, and strict building codes that have caused some installation delays. These factors have reportedly made it difficult to beat \$10 per installed watt. The new manufacturing facility was only recently completed in February 2002, well behind schedule. In the interim, Spire Solar Chicago was operating out of temporary facilities with incomplete production lines and sub-optimal working conditions. Furthermore, the price reductions were based at least partially on a 500 kW PV installation at another brownfield site, which has not yet happened.

While Spire Solar Chicago has faced its share of difficulties, the company remains optimistic that prices will begin to decline now that it has settled into its new production facility and ramped up to full production capacity. In fact, one representative of the company believes that Spire Solar Chicago is probably on a parallel track to where SMUD was after its first three years of supporting PV.

² Manufacturers may also have built in some margin to allow them to "sharpen their pencils" in response to actual RFPs issued in the future.

Advantages and Disadvantages of Bulk Purchases

The advantages of system standardization, bulk purchase commitments, and a centralized installation and servicing infrastructure are obvious – reduced prices for installed PV. And yet, several disadvantages of this approach also deserve mention. First, system standardization comes at a cost – PV customers may not have the range of system choices that they would otherwise desire. Second, a bulk purchase commitment requires “picking winners,” and the development of a centralized PV installation and servicing infrastructure may be frowned upon by current PV installers. Finally, identifying an appropriate role for a state clean energy fund in this process requires further thought – the cases summarized here are not directly applicable to a state fund.

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Personal communication with: Mike Nelson (Western Sun) and Mark Burger (Spire Solar Chicago)

Comments provided by: Jeanne Clinton (California Power Authority)

Websites:

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<http://www.westernsun.org/aaproducts.html>

www.smud.org/pv/index.html

ABOUT THIS CASE STUDY SERIES

A number of U.S. states have recently established clean energy funds to support renewable and clean forms of electricity production. This represents a new trend towards aggressive state support for clean energy, but few efforts have been made to report and share the early experiences of these funds.

This paper is part of a series of clean energy fund case studies prepared by Lawrence Berkeley National Laboratory and the Clean Energy Group, under the auspices of the Clean Energy Funds Network. The primary purpose of this case study series is to report on the innovative programs and administrative practices of state (and some international) clean energy funds, to highlight additional sources of information, and to identify contacts. Our hope is that these brief case studies will be useful for clean energy funds and other stakeholders that are interested in learning about the pioneering renewable energy efforts of newly established clean energy funds.

Twenty-one total case studies have now been completed. Additional case studies will be distributed in the future. For copies of all of the case studies, see:

<http://eetd.lbl.gov/ea/ems/cases/> or <http://www.cleanenergyfunds.org/>

ABOUT THE CLEAN ENERGY FUNDS NETWORK

The Clean Energy Funds Network (CEFN) is a foundation-funded, non-profit initiative to support the state clean energy funds. CEFN collects and disseminates information and analysis, conducts original research, and helps to coordinate activities of the state funds. The main purpose of CEFN is to help states increase the quality and quantity of clean energy investments and to expand the clean energy market. The Clean Energy Group manages CEFN, while Berkeley Lab provides CEFN analytic support.

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FUNDING ACKNOWLEDGEMENTS

Berkeley Lab's contributions to this case study series are funded by the Assistant Secretary of Energy Efficiency and Renewable Energy of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098. The Clean Energy Group's contributions are funded by the Energy Foundation, the Surdna Foundation, the Rockefeller Brothers Fund, and the Turner Foundation. An earlier version of this case study was prepared for the Energy Trust of Oregon, and we appreciate the vision of the Energy Trust – and Peter West in particular – for initiating this work. We also thank Larry Mansueti and Jack Cadogan of the U.S. Department of Energy for their ongoing support.

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