CALIFORNIA ENERGY COMMISSION

NEW SOLAR HOMES PARTNERSHIP

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New Solar Homes Partnership

Purpose

The California Energy Commission (Energy Commission) is developing the New Solar Homes Partnership, a solar incentive program for new residential construction. The goal of the New Solar Homes Partnership is to help create a self-sustaining market for new solar homes where builders, as standard practice, incorporate high levels of energy efficiency and high performing solar systems as standard features and home buyers demand energy efficient, solar homes. The Energy Commission intends to provide financial incentives and non-financial assistance in the form of builder and market support as the means to help create this self-sustaining market.

The New Solar Homes Partnership will be based upon the policy directives contained in the Energy Commission's 2004 and 2005 *Integrated Energy Policy Report*[1] and the existing Emerging Renewables Program. Also, the New Solar Homes Partnership will build on the successful approaches and infrastructure of the Energy Commission's Building Energy Efficiency Standards to promote high performance photovoltaic systems through calculation tools and third-party field verification as key elements of the program design.

The intent of this paper is to outline a draft staff proposal for the New Solar Homes Partnership. Many of the details have yet to be determined and thus a secondary purpose of this paper is to stimulate discussion of possible program designs for the New Solar Homes Partnership, within the constraints of the Energy Commission's stated policy. The staff plans to use the thoughts and ideas that result from this discussion in further developing the New Solar Homes Partnership. In particular, understanding the needs and concerns of the housing development industry and potential new-home buyers will be an essential task in developing a successful program.

A recent report, *Supporting Photovoltaics in Market-Rate Residential New Construction*[2], stated the following:

> "As a market segment for solar photovoltaic adoption, new homes have a number of attractive attributes. Homebuyers can easily roll the cost of the photovoltaic system into their tax-deductible home mortgage and, with rebates and other financial incentives, potentially achieve an immediate net-positive cash flow from the investment.
>
> The performance of PV [photovoltaic] systems can be optimized on new homes by taking roof orientation and shading into account when designing the home. Perhaps most importantly, subdivisions with PV [photovoltaic] systems installed on a large number of homes offer potential cost savings from volume purchases of modules and inverters and from scale

> economies in system design and installation. Finally, the ability of builders to install PV [photovoltaic] as a standard feature on multiple homes in new subdivisions offers an opportunity to circumvent the high transaction costs and information-related market barriers typically confronted when each individual homeowner must make a decision about installing PV [photovoltaic]."
>
> "California has, by far, the most significant experience of any state with PV [photovoltaic] in market-rate residential new construction."
>
> "A fundamental challenge [however] for organizations seeking to support PV [photovoltaics] in market-rate residential new construction is simply that there is very little experience with this market segment to draw upon."

The report's final recommendation is:

> "… engaging builders early on in program development can help to forestall potential program design issues and create a sense of buy-in for the building community."

This staff paper is the first of many opportunities for dialogue between builders, interested stakeholders, and the Energy Commission staff. Subsequent documents will become more focused and detailed as dialogue continues.

Background

Current Solar Incentive Programs

California currently has two legislatively-mandated solar incentive programs funded through investor-owned utility rates: the Energy Commission's Emerging Renewables Program and the California Public Utilities Commission's (CPUC) Self-Generation Incentive Program. The Emerging Renewables Program provides incentives for the installation of renewable distributed generation technologies, including photovoltaic systems under 30 kilowatt (kW),[3] whereas the Self-Generation Incentive Program provides incentives for distributed generation systems 30 kW to 1 megawatt (MW).

The Emerging Renewables Program provides incentives to encourage and support emerging technologies. The majority of fund recipients are small solar projects. The Emerging Renewables Program is funded through Public Good Charges created by Assembly Bill 1890.[4] Energy Commission staff receive and process all program applications with some contractor assistance, and authorizes individual rebate amounts. Rebates are based on installed capacity; current rebates for most solar photovoltaic installations are $2.80 per watt (affordable housing installations receive a higher incentive and self-installed systems a lower

incentive). Since 1998, the Emerging Renewables Program has allocated $253 million, primarily for existing residential incentives. As of April 2006, the Emerging Renewables Program provided incentives for the installation of more than 68 MW of solar PV projects. In 2005, the Energy Commission initiated the Pilot Performance-Based Incentive Program which pays per kilowatt-hour (kWh) incentives based on the amount of electricity generated by the system over three years rather than initial installed capacity.

California Solar Initiative

In January 2006, the CPUC adopted, in a Decision and Joint Staff Proposal, the California Solar Initiative.[5] In the decision, the CPUC states that it will implement a solar incentive program that addresses the commercial and existing residential market. The CPUC decision recognized the Energy Commission's intent to implement a solar incentive program for the new residential market.

The Energy Commission staff outlined in the Joint Staff Proposal[6] a tentative structure for a new solar program focused on residential new construction. The Energy Commission views this as a starting point for potential elements of the New Solar Homes Partnership, but recognizes that more substantial analysis and dialogue is needed to arrive at a program that fully realizes Energy Commission policy as established by the *Integrated Energy Policy Report* and considerably more involvement of California's housing development industry to establish a highly effective program.

Goals of the New Solar Homes Partnership

The goals of the New Solar Homes Partnership are consistent with the goals contained in the *Integrated Energy Policy Report*. By providing long-term declining incentives for solar systems, the New Solar Homes Partnership intends to assist in the creation of a sustainable solar market within the California new residential market that can exist without government incentives. The Energy Commission has set a goal of 400 MW of installed capacity by 2016 for the New Solar Homes Partnership.[7]

The New Solar Homes Partnership seeks to increase the number of photovoltaic installations by providing the builders with incentives to install photovoltaics on at least some of their new homes tracts within the next year. The incentives will allow the builders to reduce the cost of solar homes, i.e., homes with photovoltaics, to the home buyers. Increased sales of solar homes and increased customer satisfaction with lower energy bills will induce greater demand for solar homes. Increased demand for solar homes will eventually lead to builders voluntarily incorporating solar systems as a standard feature in new home construction.

The *Integrated Energy Policy Report* calls for a program that promotes high performing systems that will result in cost-effective public funding in terms of long-term energy generation per dollar of incentive support.

Rationale for the Design of the New Solar Homes Partnership

The design of the New Solar Homes Partnership will be predicated on providing the solar market continuity while grounding the program in currently established Energy Commission policy. The New Solar Homes Partnership will provide continuity by building upon the Energy Commission's existing Emerging Renewables Program. The policy that will shape the New Solar Homes Partnership is contained in the *Integrated Energy Policy Report* and will extend the performance-based approaches and infrastructure established by the Building Energy Efficiency Standards.

To guide the state in developing a successful photovoltaic program, the Energy Commission delineated several principles in the 2004 and 2005 *Integrated Energy Policy Report*. These principles include:

- Achieving a photovoltaic program on the scale articulated by Governor Schwarzenegger (i.e., a million solar roofs).[8] This scale would be achieved by enabling solar installations on all roofs on both new and existing residential and commercial buildings.

- Leveraging energy efficiency improvements while deploying photovoltaics; exceeding energy efficiency required for new buildings by the current building standards.

- Linking photovoltaic installations to dynamic pricing tariffs and advanced metering to use solar systems to meet peak load.

- Targeting solar installations to climate zones with high peak demands for air conditioning and where solar systems can provide the most benefit to the electricity system.

- Incorporating into a solar program long-term declining incentives, transitioning away from capacity-based incentives to performance-based incentives.

- Establishing a performance-based incentive structure integrating energy efficiency and time-of-use energy considerations.

- Providing electric utilities with a viable business role in a solar program.

- Incorporating solar thermal based on a better understanding of how to avoid the problems of previous solar water heating programs in the 1980s.

- Incorporating solar technologies into the 2008 Building Energy Efficiency Standards.[9]

The *Integrated Energy Policy Report* principles resonate with the goals and structures of the Energy Commission's Building Energy Efficiency Standards program. The Energy Commission's New Solar Homes Partnership can directly build on the methods and infrastructure that underlie the Energy Commission's Building Standards and the building industry's current reliance and absorption of those methods and infrastructure to deliver quality and energy efficiency in their homes. The Standards are performance-based, providing performance calculation tools to enable the industry to address performance issues that the builder has control over at design and construction, and protocols and third-party infrastructure to enable verification in the field that key performance features are installed as designed. The Standards performance approach is used by virtually all production builders to determine energy performance, accounting for climatic differences using the Energy Commission-adopted "Time Dependent Valuation" approach that weighs hourly energy use according to time of use and relative regional electric system distribution costs.

The Energy Commission should extend the Standards methods and infrastructure to the New Solar Homes Partnership by 1) providing photovoltaic performance calculation software for determining estimated Time Dependent Valuation-weighted kWh for setting incentives levels (this photovoltaic performance software should also be incorporated into Standards compliance software); 2) establishing installation protocols for photovoltaic systems that focus on the factors that result in higher performing photovoltaic systems; and, 3) extending the third-party field verification process and existing infrastructure to include onsite verification of photovoltaic systems to insure that installed systems perform as expected, consistent with the incentives payment.

It is extremely important for the Energy Commission to establish an incentive system for the New Solar Homes Partnership that strongly encourages the builder/developer to provide a high quality photovoltaic system design and installation that results in a high performing system. It also is important for the Energy Commission to establish eligibility requirements for the incentives that require quality assurance actions, including module and inverter performance certification, quality installation practices and verification of proper installation.[10]

Affordable Housing

The Energy Commission will have an affordable housing element in the New Solar Homes Partnership. The Energy Commission will determine how to structure this element in consultation with affordable housing developers, the California Department of Housing and Community Development, California Housing Finance Agency, Tax Credit Allocation Committee, and CPUC. The Energy Commission and CPUC will hold public workshops dedicated solely to the affordable housing element where we will invite public input and suggestions.

Elements of the New Solar Homes Partnership

The elements of the New Solar Homes Partnership include eligible participants, eligible systems and specifications, geographic scope, funding and program duration, procedures and administration, and incentives.

This staff proposal will use the approach defined in the Emerging Renewables Program as the basis for the New Solar Homes Partnership for each of these elements, where applicable. In instances where the *Integrated Energy Policy Report*, Building Standards-based approaches, or the needs of the new residential market differ from that of the current Emerging Renewables Program, the approach for a given element will be modified to conform to Energy Commission policy or market needs. Following the proposed approach to each element, there will be a discussion with a range of options that may work for a solar program directed to new residential construction.

Eligible Participants

Proposed:

Eligible participants will be targeted at the home builder although the home purchaser could receive the incentives instead should the builder so choose, and the builder or home purchaser may designate the equipment seller or system installer as the payee.

Discussion:

In the Emerging Renewables Program, eligibility is limited to the owner of the solar system although they may designate the equipment seller, system installer, or a third party as the payee. However, using system ownership as a criterion for eligibility in a solar program is not a useful concept in new residential construction.

Under the New Solar Homes Partnership, the new home builder is the targeted eligible participant. At the discretion of the home builder, the incentives could go

to the initial home buyer instead. On occasion, the builder or home purchaser may agree for the incentives to go to a third-party (e.g., a third-party could make arrangements with the home builder to finance the solar components and installation with the provision that they receive the incentives for the system). This is an example arrangement that illustrates that there may be people other than the builder or home purchaser who are eligible for the incentives.[11]

The range of possible eligible participants who might receive incentives or other benefits from a solar program directed to the new residential construction market, might include new home builders, for profit and nonprofit multifamily housing developers, new home buyers, solar installers, solar manufacturers, municipalities, or other agents involved in the construction, purchase, or sale of new residential homes or solar technologies that may be used in new residential construction. For example, the New Solar Homes Partnership might provide incentives to municipalities that have requirements for solar systems on a certain percentage of new homes or rental developments. A city might follow the example of the City of Roseville, which has directed its electric utility, Roseville Electric, to develop a program by May 2006 that will require at least 10 percent of all new homes to have photovoltaics.[12] In such instances, the New Solar Homes Partnership might provide funding to the city to administer and provide incentives to solar home builders or developers.

A solar program could be directed to many of the players mentioned above; perhaps the more fundamental question to consider in determining eligibility is, “How will eligibility in a solar program most effectively achieve the goal of creating a self-sustaining solar market in the profit and nonprofit housing development sectors?”

Currently, the installation and sale of solar systems in new single-family residential construction is largely driven by the facilitators (the builders, developers, solar manufacturers, utilities, and contractors) and not by the home buyers.[13] In some instances, when the builder has offered new homes with solar systems as a standard feature, the homes have readily sold. However, in other instances where the builder has offered solar systems as an option and not a standard feature in a new home sale, home buyers did not choose to have solar systems installed in their homes. Also, it appears that when the new home market softens, solar systems as an option are the first item to be eliminated for consideration by the new home buyer.

This situation appears to be quite different in Japan where solar systems have been aggressively promoted by the Japanese government. Anecdotal evidence suggests that in Japan a buyer will expect a new home to come with a solar system and will hesitate to buy a home that does not have a solar system.

It would appear that the current U.S. solar market is driven primarily on the supply side while the Japanese solar market has achieved a significant level of

demand pull. In designing the New Solar Homes Partnership, it may be prudent to consider where the market is now and the direction the market will go with incentives directed to a specific group.

Eligible Systems and Specifications

Proposed:

Eligible systems will be limited to those solar systems[14] that meet current Emerging Renewables Program requirements and meet additional requirements consistent with Building Standards-based approaches and goals of the *Integrated Energy Policy Report*. That is, eligible systems will be limited to solar systems installed on new residential units that have achieved an Energy Commission-specified level of energy efficiency above that required by the current Building Standards and that can communicate with advanced meters. These residential units may be homes, condominiums, or qualified multifamily housing under four stories.[15] The photovoltaic performance calculation software that the Energy Commission is developing will also require specific module performance data to be certified to the Energy Commission's standard. Eligible systems will be field verified by a Commission-approved third-party to insure systems are installed to meet or exceed the performance determined by the photovoltaic performance calculation software.

Discussion:

The Emerging Renewables Program limits eligible solar systems to those that have met specified criteria and have been approved.[16] Currently, to gain approval, a photovoltaic module must be Underwriters Laboratories certified or equivalent. Inverters must be UL 1741 certified with additional testing required. An eligible photovoltaic system must come with a five-year warranty. The system size must be less than the average annual electricity consumption or less than 200 percent of on-site peak demand (in kWh) during any month (for over 10 kW).

At today's prices for photovoltaic systems, there are readily available energy efficiency measures substantially beyond those required for compliance with the Building Energy Efficiency Standards that are more cost effective than photovoltaics alone. Installation of high energy efficiency measures reduces the electricity load of the home, and therefore the photovoltaic system can be smaller and less expensive. It is important to note that builders of homes with photovoltaic systems have routinely been willing to implement more energy efficiency measures in combination with the solar systems.

Combining high energy efficiency with photovoltaics results in increasing the overall cost effectiveness of the entire project. From a societal vantage point, combining high energy efficiency with photovoltaics maximizes the use of the societal resources that are being invested in photovoltaics. Societal dollars will

go farther, resulting in greater reduction in demand on the electricity grid if each photovoltaic installation is combined with high energy efficiency.

Combining high energy efficiency in photovoltaic projects also is consistent with the "loading order" in California's *Energy Action Plan*, which recognizes energy efficiency and demand response as the state's preferred means of meeting growing energy needs.[17] Energy efficiency is first in the loading order, followed by renewable energy. Combining high energy efficiency and photovoltaics in residential new construction projects honors the state loading order policy and delivers both preferred technologies at once.

The Energy Commission and CPUC Joint Staff Proposal suggested eligible solar systems be limited to those installed on homes that achieve a level of efficiency above Title 24 standards, equivalent to Energy Star Homes or some comparable level. Beginning in January 2006, the California Energy Star Homes program requires participant homes to be 15 percent more energy efficient than the state's *2005 Building Energy Efficiency Standards* and meet other program specifications to be consistent with the U.S. Energy Star Homes program.

California builders have had substantial experience with the U.S. Department of Energy's Building America program. The Building America program aims to increase home energy efficiency substantially more than the Energy Star Homes program, in the range of 40-50 percent more energy efficient than required by the Energy Commission's Standards. Building America projects choose energy efficiency features that, in combination with photovoltaics, result in a positive cash flow for the total building, including incentive payments for the photovoltaics. Building America places emphasis on choosing measures that the project team determines to be "builder friendly" in terms of the measures being reliable, available and achievable. Building America's long-term goal is to achieve zero energy homes.

As a long term goal, the Energy Commission supports the achievement of Zero Energy New Homes for mainstream construction. The concept of Zero Energy New Homes is that the energy use of the home is drawn down by high energy efficiency measures to the point where the remainder can be met by the photovoltaic system. The Energy Commission's Public Interest Energy Research program is pursuing expansion of Zero Energy New Homes in California through several pilot projects to develop and evaluate market strategies to deliver Zero Energy New Homes at affordable costs.[18] The Energy Commission's policy to emphasize the combination of high energy efficiency plus photovoltaics should facilitate the transition to Zero Energy New Homes.

Staff recommends that energy efficiency levels substantially beyond the California Energy Star Homes level, similar to those achieved by Building America, be expected (at higher levels, additional incentives may be provided) for the New Solar Homes Partnership.

The *Integrated Energy Policy Report* also calls for advanced meters and variable price tariffs to form the foundation necessary for a solar program to fully capture the benefits associated with photovoltaics that are not currently captured. To effectively connect the solar systems with advanced meters, the solar system must have the ability to electronically communicate with the advanced meter. Hence, eligible systems must have that functionality. This topic is further discussed in Appendix B, Advanced Metering Infrastructure.

Eligible solar system technologies in a new program might include grid-connected photovoltaic systems, solar water heating systems, solar-thermal electric generating systems, and solar heating and cooling systems. The CPUC Decision directed San Diego Gas and Electric to offer to the San Diego Regional Energy Office a contract to conduct a pilot solar water heating system program for a duration of 18 months. Therefore, solar water heaters will be further evaluated in the Energy Commission's solar program development after results of the pilot program are evaluated. Also, the other solar technologies appear to be either not well suited for new home construction or not yet market-ready. Therefore, evaluation of these technologies will also be deferred to a later date. For the very near-term, the New Solar Homes Partnership will focus on photovoltaic systems but will consider incorporation of the other solar technologies identified above after pilot solar water heating program evaluations are available.

Geographical Scope

Proposed:

The geographical scope of the New Solar Homes Partnership will be limited to the electricity distribution areas of the investor-owned utilities whose ratepayers contribute to the RRTF: Pacific Gas and Electric, Southern California Edison, San Diego Gas and Electric, and Bear Valley Electric. Through the photovoltaic performance calculator the climate dependent performance of photovoltaic systems will be assessed, enabling the Energy Commission to place priority through correspondingly higher incentives, on photovoltaic installations in climate zones where hot summers result in air conditioning-driven, high peak demand that significantly stresses California's electricity system.

Discussion:

The solar program that will eventually be developed and implemented by the Energy Commission will be for the societal benefit of all California citizens. Solar systems such as photovoltaic and solar water heaters when implemented on a large scale can reduce both electricity and natural gas consumption in California and thereby reduce natural gas and electricity price and price volatility, diversify

California's energy resources, and potentially increase grid reliability for all Californians.

The funding for this program will come from the current funding for the Emerging Renewables Program. The source of the Emerging Renewables Program funds are public goods charges that are collected from the investor-owned utilities under statutory authority.[19] Given that funds collected for the Emerging Renewables Program are from the electricity distribution areas of the investor-owned utilities, the Emerging Renewables Program limits participation to systems that will be installed in electricity distribution areas of: Pacific Gas and Electric, Southern California Edison, San Diego Gas and Electric, and Bear Valley Electric.

Customer-owned utilities do, however, in some cases, have their own solar programs. In particular, Sacramento Municipal Utility District has made significant contributions toward encouraging solar systems in new residential construction. The Energy Commission encourages all customer-owned utilities to develop solar programs for new residential construction.

The photovoltaic performance calculation program that is under development by the Energy Commission will account for climatic variations in the performance of photovoltaic systems and through Time Dependent Valuation will address time-of-use energy and relative regional electric system distribution costs. The use of the photovoltaic performance calculation program will implement a prioritization for incentive funding to hot, inland climate zones, areas of congestion, and areas of higher system growth that drive growth in peak demand.

Funding and Program Duration

Proposed:

Funding for the New Solar Homes Partnership is expected to be $350 million available from 2007-2016.

Discussion:

The Emerging Renewables Program, the Consumer Education, and other contributing Renewable Energy Programs will collect approximately $350 million for the 2007-2011 timeframe assuming the Legislature passes legislation adopting the Energy Commission's Investment Report.[20]

The Emerging Renewables Program, as part of the Renewable Energy Program, is authorized to carry out program activities from 2001 until 2006.[21] Although the Renewable Energy Program has the authority to collect funds until the end of 2011, new legislation is needed to authorize the Energy Commission to expend

funds collected for the Emerging Renewables Program, between January 1, 2007, and December 31, 2011.[22] However, this does create a mismatch between the timeframe for which funds are collected (2007-2011) and the duration of the California Solar Initiative outlined by the CPUC (2007-2016).

Under current law, the Emerging Renewables Program funds do not have a specific date by which they must be expended. Assuming the Legislature reauthorizes expending Emerging Renewables Program funds and does not change current law on fund expenditures, the Emerging Renewables Program funds collected from 2007–2011, could be expended for a longer duration.

Production homebuilders may be reluctant to participate in a solar program if the program duration is too short.[23] A longer program duration would be more consistent with the new home construction building cycle for developments which might be as long as three years.

In addition, a ten-year program consistent with the California Solar Initiative would provide greater certainty to the solar industry by providing a longer planning horizon and thus do more to establish a sustainable solar market, one of the prime goals of the California Solar Initiative.

The CPUC Joint Staff Proposal suggests an allocation of $350 million for an Energy Commission solar program for new residential construction. The Energy Commission intends to use the existing authority established in the Emerging Renewables Program for implementing, funding, and modifying a solar program. Thus, new funding sources are not required for a solar program; the program will rely upon the collection of program funds that are authorized under existing law.

Procedures and Administration

Proposed:

Procedures for applicants to the New Solar Homes Partnership will be based upon the current Emerging Renewables Program procedures. However, the reservation period will be extended to 24 months and a field verification of expected performance parameters will be required. Administration of the New Solar Homes Partnership will be contracted to a third-party, possibly the investor-owned utilities. Procedures will need to be updated to incorporate basing incentives on the performance estimated through the photovoltaic performance calculator and field verification of the installed systems' consistency with those calculations.

Discussion:

Under the Emerging Renewables Program, applicants seeking a rebate submit a Reservation Application Form and additional information to reserve a specific

rebate amount based on solar system capacity size. The Energy Commission reviews and determines if the application meets eligibility requirements. The Energy Commission then sends confirmation of a reservation of a specific rebate amount in the form of a Payment Request Form, which the applicant fills out and returns to the Energy Commission for payment after the system is installed.

The information that is submitted with the Reservation Application Form includes information on the physical site, purchaser, equipment seller, installer, utility providing electric distribution service to the site, equipment, and system rated output and requested rebate. Additionally, documentation of a purchase agreement, utility service, and submittal of other state forms is required to reserve a rebate.

The Emerging Renewables Program allows a new home developer to submit one reservation request and one master purchase agreement for the entire development and one master permit in lieu of building permits for each home. Further details on Emerging Renewables Program procedures for new housing development applicants are provided in Appendix A.

Under the Emerging Renewables Program, an applicant has a maximum of 18 months to complete construction and request payment after the application is first approved (a six-month extension may be allowed under certain circumstances). Homebuilders have stated that this timeframe may be unsuitable for new home builders since new residential construction may have a three-year timeframe from planning to sales of completed homes.

The Joint Staff Proposal proposed providing up-front incentives for photovoltaic systems but recognized the importance of establishing a program structure that insures high-performance systems:

> "… performance of the systems installed would be insured by adjusting the incentives paid to the specific insolation, shading, orientation, and installation characteristics of the systems. This adjustment would be established through third-party verification of installed systems, providing verification of installation quality and verification of performance. This process would also foster targeting of incentive funding to higher insolation areas and better installation practices."

Procedures need to be updated to incorporate the calculation and verification of photovoltaic performance. The Energy Commission will develop an inspection/verification protocol and guidelines to enable a third party to verify that the installed system meets or exceeds the specifications that were used to calculate the system's performance and that installation was done consistent with the installation guidelines. This verification will be designed to mesh seamlessly with the third party verification that builders are used to for energy efficiency measures in the many "beyond-Standards" programs conducted in California,

(e.g., California Energy Star Homes, investor-owned utilities and Sacramento Municipal Utility District New Construction Programs, the Building Industry Institute's Community Energy Efficiency Program and Green Builder Program, Zero Energy New Homes, and Building America).

The Energy Commission is in the process of establishing a performance calculation that properly accounts for the key factors that impact photovoltaic performance. Key factors would include performance factors that are certified for the module and inverter, as well as component matching, wiring approaches and other system design factors that impact system performance. The calculation method will use standard weather data to account for solar insolation and ambient temperature, address the physical characteristics of the installation, including orientation and tilt, the certified efficiency of modules and inverters, and solar obstructions that are knowable at the time of installation, including shading by chimneys, vents and roof configuration, shading by existing trees and neighboring structures, and onsite and neighboring landscaping planned by the builder. The calculation method also would account for normal performance degradation factors, including dirt and dust, loss in performance with age, balance of system losses, and potentially for shading that is likely to occur due to subsequent owner and neighbor landscaping. Staff recognizes that to facilitate the installation of high performance systems, it is necessary for the calculator to be easy to use, taking advantage of drop down menus and on-board data (e.g., libraries of module and inverter certification data and currently available weather files) to keep user inputs to an absolute minimum.

Thus, the New Solar Home Partnership will build upon well-established approaches and infrastructure used by the state's building standards and utility new construction programs to effectively make available to California's building industry the calculation tools, installation protocols and guidelines, and inspection and third-party verification procedures.

The utilities deliver their energy efficiency programs relying on the tools and infrastructure used by the building industry to show compliance with the state's building standards, including the Energy Commission-approved calculation methods and installation and field verification protocols. The utilities require that all energy efficiency measures in participating homes be verified by a third-party field verifier, consistent with the Energy Commission's Home Energy Rating System process. The largest production builders and the infrastructure of consultants, installers and raters that provide services to them are experienced with these program expectations. It will be a natural extension of this process for photovoltaic performance calculations, installations and inspection/verification to be done in a parallel manner.

Currently, the Emerging Renewables Program is administered in-house at the Energy Commission. Information from hard-copy applications is entered into a database; the information from the database is up-loaded weekly to the Energy

Commission's website where information is available to the applicant. Thus, the applicant can track the status of his or her application.

The Energy Commission has considered contracting out some Emerging Renewables Program administrative tasks to a third-party firm. Depending on how the New Solar Homes Partnership is structured, some administrative tasks could also be contracted out. For example, much of the administrative duties, such as receiving applications, processing meter data, calculating payments, and supporting a call center, could be contracted out to utilities or some other third party. Support services offered to home builders also could be contracted out. A third-party administrator or technical support provider might be a for-profit or non-profit entity.

Among potential administrators, the investor-owned utilities may have some synergies with their energy efficiency programs that are not available to other potential administrators.[24]

The Energy Commission has contracted out periodically for Emerging Renewables Program evaluation.[25] Similarly, the Energy Commission could contract out evaluation of a solar program. The solar program could also include a periodic evaluation of various aspects pertaining to the program such as systematic assessment of the extent to which expected energy production from the solar systems is maintained over time, the cost/benefit to the consumer of the solar system installed under the program, the progress toward program goals. An evaluation could also look at exogenous risks, such as silicon shortages or a slump in the housing market, with contingency actions that could be considered in response to those risks.

Incentive Structure

Proposed:

The incentive structure for the New Solar Homes Partnership will be an "expected" performance-based incentive aimed at the home builder although the home purchaser could also be eligible to receive the incentive or they may designate the equipment seller or system installer as the payee. An additional incremental incentive will be provided for affordable housing in a manner similar to the Emerging Renewables Program (as shown in Appendix C). Incentives will decline over the life of the program, eventual dropping to zero by the end of the program. Applications and payments will be based upon a first-come first-served basis.

Discussion:

As mentioned under Eligible Participants, in the Emerging Renewables Program the incentive is directed to the owner of the solar system although they may

designate the equipment seller, system installer, or third party (i.e., manufacturer) as the payee.

Monetary incentives for solar systems may be, among other forms, capacity-based incentives or performance-based incentives. In a capacity-based incentive, a payment is made taking into account only the peak power in kW produced by the solar system measured under laboratory test conditions, whereas, in a performance-based incentive, payment is made based on either the "expected" or "actual" annual energy in kWh produced by the solar system. Capacity-based incentives have been based solely on a rating of the instantaneous module output in kW at ideal lab testing conditions,[26] or a rating of the instantaneous module and inverter combination at somewhat less ideal testing conditions.[27]

Capacity-based incentives approaches have been viewed as advantageous because payments are made upon system installation, whereas a performance-based incentive approach based on actual performance would spread payments over a period of time as the system output is measured and reported. In other words capacity-based incentives have typically been one-time, up-front payments. On the other hand, performance-based incentives based on "actual" performance have usually been multiple-payments paid at intervals after performance is determined.

The Emerging Renewables Program and Self-Generation Incentive Program provide a capacity-based incentive based on the rated output of a complete system including component losses, which is currently paying $2.80 per watt and $2.50 per watt respectively (photovoltaic only).

The Energy Commission's Emerging Renewables Program is also currently providing the option of an "actual" performance-based incentive through a pilot program. Beginning in January 2005, the Pilot Performance-Based Incentive program offered "actual" performance-based incentives at $0.50 per kWh for all participants to be paid quarterly for the three successive years of measured performance. As of April 2006 there were more than 40 applications for participation in the pilot program, ranging from 4 kW to 220 kW in size and reserving the entire $10 million available to the pilot program. Three participants have begun receiving payments under the pilot program.

The Energy Commission's 2004 and 2005 *Integrated Energy Policy Report* calls for targeting climate zones with high peak demands for air conditioning. As discussed in the Rationale for a New Solar Homes Partnership section, these goals will be addressed directly by applying the Energy Commission-approved Time Dependent Valuation approach within the photovoltaic performance calculator. A solar program could further target hot areas of the state, which coincide with the highest population growth and consequently high building rates, with additional outreach or even higher incentives. These higher incentives might

more quickly achieve widespread adoption of solar in new homes and thus provide more benefit to the state as a whole.

Staff proposes that the New Solar Homes Partnership use an “expected” performance-based incentive, which accounts for the specific performance characteristics of the system and the installation to determine the expected output of the complete solar system, including component power losses, and the performance that will occur in actual installations due to insolation, orientation, and shading and other installation characteristics.[28]

The Energy Commission is working on a calculation method to address these factors. The “expected” performance-based incentive will be an up-front payment approach that addresses those system design and installation factors that can be controlled at the time of the installation, anticipating losses that are expected to occur, so as to provide both an accurate performance expectation for the installed system and an incentive for the builder to insure high performing designs and installations.

An advantage of an “expected” performance-based incentive over capacity-based incentives that are currently in place is that it would reward builders/developers of photovoltaic systems that are properly designed, placed, and installed to achieve their maximum energy production potential.[29] Advantages of an “actual” performance-based incentives approach based on measurements of system output are that homeowners would be rewarded for maintaining their systems and avoiding the impacts that occur due to shading from landscaping or other obstructions that were not present at the time of construction; also, an “actual” performance-based incentive would discourage homeowners from removing or disabling systems after an up-front rebate is paid, although this may be less likely with new residential construction.

However, builders and developers are not the occupants of the homes, do not pay the energy bills, do not have control over the maintenance of the photovoltaic system, and are highly motivated to avoid long-term liability associated with the ongoing performance of the home. It is anticipated that these factors will create barriers to a performance-based incentives approach that bases incentives on the “actual” photovoltaic performance experienced by homeowners who purchase, occupy and operate the home and who are responsible for system maintenance.

Builders will want an up-front rebate and will not want incentives paid to them to be dependent on the performance of the system measured after the home is sold and occupied, particularly given that performance is somewhat dependent on how the homeowner maintains the system and the extent to which shading occurs that was not known at the time of construction. An “actual” performance-based incentive would not provide an immediate payment to the builder upon the sale of a home, and it is unclear how the builder would continue to provide

photovoltaic electricity production data or be responsible for system maintenance after sale of the home.

On the other hand, if an “actual” performance-based incentive were available for the initial buyer of a new solar home, then the concerns raised by the builders might be avoided. In combination with an “expected” performance-based incentive, as proposed in this position paper, an “actual” performance-based incentive could provide incentive to the homeowner to better maintain their system, avoid shading that was not present at the time of construction, and not to remove or disable the system after the up-front rebate has been paid. This “actual” performance-based incentive could be separate from the “estimated” performance-based incentive directed to the home builder and perhaps provide greater “market pull.”

A recent analysis of costs trends in California concluded that photovoltaic installations on large new residential developments have lower costs of approximately $1.20 per watt, on average compared to the general retrofit market (that is, $1.20 less than the typical $8.00-$9.00 per watt installed cost). Even lower costs have been realized on average in photovoltaic installations on affordable housing, at approximately $1.90 per watt less than the general retrofit market. This result may be due to discounted prices and donated materials and labor for these installations. On the other hand, photovoltaic installations on custom homes were slightly more expensive at $0.18 per watt more than retrofit. The paper speculates that builders may be able to purchase components for lower cost based on volume purchases not available to the custom home buyer.[30] Some have suggested that an incentive be greater for photovoltaic that comes as a standard feature in a new home and less for photovoltaic offered as an option.[31] The costs cited above, however, are for the installed photovoltaic system only and do not include costs associated with additional energy efficiency measures above those required to meet current building codes.

Finally, the rebate amount might differ for production and custom home builders and affordable housing builders, but should achieve an equivalent economic impact. A solar program would need to establish appropriate incremental incentives for affordable housing and determine if a specific portion of funding should be set aside for affordable housing. The CPUC Joint Staff Proposal is silent on the appropriate amount for an incremental incentive.

The California Solar Initiative of the CPUC proposes to reserve 10 percent of the budgeted funding for solar system installation in affordable housing developments to serve the state’s low-income customers. The Energy Commission plans to promote and coordinate funding with other state or local agencies engaged in developing affordable housing. It’s anticipated that these systems will primarily be installed in multi-family buildings serving the state’s very low and lower-income households.

The Energy Commission's existing Emerging Renewables Program provides a higher rebate level (25 percent above the standard) for solar systems installed in affordable housing developments that meet specified criteria. To date, however, only about 1 percent of the applications submitted for the Emerging Renewables Program have been for affordable housing projects. Some of the reasons why the existing program is believed to have had limited success in this area, include:

- Limited program promotion and outreach to affordable housing developers;
- Potentially higher cost associated with affordable housing projects;
- Requirements to achieve energy efficiency standard above Title 24;
- Requirements for individual metering of multifamily units;
- Limited incentive structure for project owner/operator;
- Limited programmatic or technical assistance to affordable housing developers.

To structure an incentive that more effectively meets the needs of the affordable housing development, Energy Commission staff will be consulting with developers and State and local agencies that provide affordable housing financing (such as the State's Department of Housing and Community Development, California Housing Finance Agency, and Tax Credit Allocation Committee). Energy Commission and CPUC staff will also develop a program to more effectively promote availability of funding for solar system installations in affordable housing developments under the California Solar Initiative.

The Joint Staff Proposal anticipates a monetary incentive in the form of declining rebates over time. The Joint Staff Proposal also states that the rebate level would be coordinated with the rebate provided by the CPUC reflecting the differential cost between new construction and retrofit applications.

An incentive level and trigger mechanism was laid out for the CPUC program, and the Energy Commission would attempt to be consistent with this schedule. However, the new residential market segment might require an incentive level that achieves an equivalent "economic impact" but is not necessarily the same dollar amount. The Joint Staff Proposal identifies as well that "Local ordinances and applicable statewide standards may affect the timing, scope, and structure of incentives."

Monetary incentives, in whatever form they might take, could be allocated based on a first-come first-served basis, auction basis, by providing block funding through local governments, or other means. First-come first-served is likely the

most straight-forward approach but is not the only means available. The Joint Staff Proposal is silent on the incentive allocation method. The Emerging Renewables Program and Self-Generation Program both allocate funds on a first-come first-served basis.

Builder and Market Support Activities

In the years leading up to 2005, approximately 1,200 solar homes with energy efficiency measures beyond the building code were built in California, and approximately 1,200 solar and energy efficient homes are planned for construction in 2006. This likely represents a few dozen builders and less than 1 percent of new homes in new housing developments for 2006. In order to meet the goals of the solar program, the number of solar and energy efficient homes built per year would need to increase at least 30-fold over a ten-year period.

Given the need to dramatically increase the number of participating builders over the life of the program, additional efforts should be made in the early years. The program must appeal to a wide range of builders to gain wide acceptance. In particular, a successful voluntary solar program must entice builders who are not currently interested in building energy efficient solar homes.

The New Solar Homes Partnership would include support services that could emphasize a flexible, one-on-one approach targeted specifically at participating subdivisions, the building officials for those subdivisions, and the public in the vicinity. Services could include:

- Technical support including assistance in evaluating energy efficiency measures, evaluating projected electricity bills, interfacing with the building department (permits), help with contacting solar suppliers, facilitating product delivery, and interfacing with the utility (interconnection);

- Building official training in the local jurisdiction of the subdivision. Training might include photovoltaic code compliance classes offered at a location and time convenient to the building officials;

- Salesperson training for the home builder, possibly in-person training at a time and location convenient to the salespeople (for example, in a model home);

- Public awareness campaign targeted to a 50 mile radius around an eligible subdivision informing individuals of an Energy Commission “label” attached to solar-energy efficient homes;

- Inclusion on an Energy Commission list of subdivisions that meet the criteria for labeling as solar-energy efficient homes;

- Builder recognition.

These services could be available to builders of subdivisions of a certain size. They could also be offered on a regional or statewide basis without regard to where participating subdivisions are located or as a menu of services.

These services probably would need to be funded from the same budget from which the monetary incentives are allocated.

Program Transition and Coordination Issues

As the New Solar Homes Partnership is developed during 2006, a number of program transition and coordination issues must be addressed including:

- Notifying builders and developers of the New Solar Homes Partnership;
- Issuing contracts for program administration, support services, other outreach;
- Modifying the Emerging Renewables Program structure to accommodate the CPUC's new responsibility for incentives for solar systems under 30 kW on existing residential structures and new and existing commercial structures;
- Monitoring the San Diego Regional Energy Office's pilot solar hot water heating program;
- Monitoring the Energy Commission's Public Interest Energy Research Zero Energy New Homes projects;
- Monitoring legislation that might impact the New Solar Homes Partnership (such as Senate Bill 1);
- Coordinating with the utility energy efficiency programs;
- Coordinating with the public utility solar programs;
- Coordinating with advanced metering infrastructure efforts;
- Work with the CPUC to develop a net-metering and rate structure that will fully capture the benefits of solar power;
- Continuing research in potential business models that provide a role for the utilities in the solar market.

APPENDIX A

Current New Residential Program Application Requirements

As contained in the California Energy Commission, 2006, *Emerging Renewables Program Guidebook*, Sixth Edition. The Emerging Renewables Program specifies that for new construction sites that currently do not have electrical service, a copy of the building permit for the new home must be included with the reservation application. For new housing subdivisions, the master permit for the subdivision meets the building permit criteria. New home developers may purchase and install renewable energy systems as part of a new development before selling the home.

The renewable energy system is often a feature that is included in the new home price. In most cases it is unclear who will purchase the home, when it will be sold, and how much the end-user pays for the system. Unlike individuals, developers will often purchase the system equipment in bulk and have an agreement with a subcontractor to install systems on various homes in the development.

New construction reservation requests for multiple systems (such as in a subdivision) that are in the aggregate greater than 30 kW are not required to include an installation labor contract when installation is being performed by the builder's employees, but must still submit a purchase agreement for the equipment and separately list installation labor costs.

To obtain a rebate reservation for a new housing development where the sum of individual installed systems will total 30 kW or more, the developer may submit the following items instead of submitting separate documentation for each address:

• **One Reservation Request Form (CEC-1038 R1) for the entire new housing development.** The Reservation Request Form must be signed by the homebuilder (purchaser) and the seller (retailer, wholesaler or other supplier) of the electricity generation system. The reservation request must be accompanied by a detailed summary sheet containing the same information requested on the Reservation Request Form for each site (i.e., the physical addresses, generating system information, and system cost for each of the systems to be installed). This information may be listed directly on the form or incorporated by reference to the summary sheet or to the master purchase agreement.

• **One master purchase agreement for the entire new housing development.** The master purchase agreement(s) for the equipment and installation labor must contain the following information: signature of homebuilder (purchaser) representative, seller of the generating equipment, and installer (unless a letter or installation agreement for each subcontractor stating the price charged for specified homes in the housing development is provided); a list of the physical addresses of the system installations; the quantity, make and model of the electricity generating equipment and inverters to be installed at each address; the total cost of the equipment and/or labor; total eligible system cost and rebate requested for each address.

• **Payee Data Record (STD-204)** for the recipient of the rebate payment.

• **Utility Interconnection.** As with other new construction, identify the electric utility on the reservation application form.

• **Building Permit.** Include a copy of the building permit (or master permit for the subdivision)**.**

• **Final inspection signoff.** (At time of payment) - submit documentation showing final inspection signoff for the housing development or an interconnection agreement listing all of the addresses at which the utility confirms that an eligible electricity generation system was correctly installed. See "Reservation and Payment Process" for additional paperwork required at the time payment is claimed.

• **Reservations for Systems Sold as Options.** Developers who are interested in offering systems as an option to future home purchasers may obtain reservations for 10 percent of the lots in the proposed subdivision without identifying the specific lot in advance if all of the following conditions are met:

- The developer commits to the purchase of at least one system to be installed on one of the model homes and obtains a reservation at that site;
- The developer offers systems for sale as an option to new home purchasers;
- The reservation remains limited to homes in the same subdivision.

The amount reserved for 10 percent of the unspecified lots will be based on the same information as on the reservation application for the largest system on the model homes (equipment and amount reserved). With the reservation application for the model home, provide a statement identifying that the developer meets the above criteria and will sell systems as an option to buyers. Also, clearly identify the subdivision name, city and zip code, and the total number of homes to be built in the subdivision.

APPENDIX B

Advanced Metering Infrastructure

The Energy Commission's 2004 and 2005 *Integrated Energy Policy Report*[32], recommend that the state pursue the establishment of Advanced Metering Infrastructure. The CPUC has ordered the IOUs to prepare and propose Advanced Metering business plans, and is in the process of considering these plans for approval. Advanced Metering Infrastructure would require the utilities to install smart meters that allow two-way communication and control between the utility and the electric or gas customer. This infrastructure would enable the CPUC to put in place critical peak pricing and other dynamic pricing tariffs (time differentiated pricing with the option to dispatch higher prices during a system emergency).

The smart meters and variable price tariffs of Advanced Metering Infrastructure will enable the New Solar Homes Partnership to fully capture benefits associated with photovoltaics that are not currently captured. Advanced Metering Infrastructure would give customers the ability to choose to participate in utility critical peak or dynamic pricing programs and enable the utilities to be more responsive to supply and demand shocks, thereby reducing overall costs to the consumer and utility.

With Advanced Metering Infrastructure in place, residential and small commercial customers may offer more price response and reliability than large customers and hence accrue more benefit. Advanced Metering Infrastructure is expected to hasten the rise of solar as an important source of electricity generation and grid support in California.

Functionality Requirements of Advanced Metering Infrastructure

- Capable of supporting time of use, critical peak and two part hourly pricing tariffs - both dynamic (day ahead) and static rates;
- Capable of providing customers with easy access to their historical hourly usage data;
- Capable of handling changes in customer preference for rates or access to data without need for on site visit or new hardware;
- Capable of supporting applications that provide customer education and energy management information, customized billing, and complaint resolution based on billing data;
- Compatible with utility system applications that promote and enhance system operating efficiency and improve service reliability;

- Capable of interfacing with load control communication technology (could be sending price or emergency control signals).

Figure B-1 summarizes information on Advanced Metering Infrastructure including benefits, costs, net present value, the number of gas and electric meters, funding, and deployment schedule.

Figure B-1
Summary of Advanced Metering Infrastructure Analyses

	PG&E	SDG&E	SCE	Total
Total Benefits (millions)	$2,626	$660	$805	
Total Costs (millions)	$2,227	$612	$1,298	
NPV (millions)	$399	$48	($494)	
Electric Meters	5,100,000	1,300,000	4,800,000	11,000,000
Gas Meters	4,200,000	800,000	0	5,000,000
Total Meters	9,300,000	2,100,000	4,800,000	16,000,000
Pre-Deployment Funding requested (millions)	$49.0	$9	$40.0	
Deployment period	Mid 2006 to mid 2010	2007 to 2011	No Schedule at this time	

Mike Messenger, PowerPoint presentation

APPENDIX C

Current Affordable Housing Application Requirements

As contained in the California Energy Commission, 2005, *Emerging Renewables Program Guidebook*, Sixth Edition. Pursuant to Assembly Bill 58 (Keeley, Statutes Of 2002, Chapter 836), the Energy Commission has established a higher rebate level for qualifying systems installed on affordable housing projects. Qualifying systems include systems connected to and serving the energy needs of: 1) residential units subject to affordability requirements, 2) the office and residential unit of the project manager, provided all other residential units in the project are subject to affordability requirements, and 3) the common areas of the project, such as laundry rooms and parking structures, provided all residential units in the project (except the manager's unit) are subject to affordability requirements.

Qualifying systems installed on affordable housing projects will receive a rebate 25 percent higher than the standard rebate level, not to exceed 75 percent of the system cost, if the following additional criteria are met:

- The affordable housing project was undertaken pursuant to section 50052.5, 50053 or 50199.4 of the Health and Safety Code. Applicants must demonstrate this by providing documentation that identifies the statutory basis under which the project was undertaken. In addition, the applicant must provide a copy of the regulatory agreement or approval for the project's development that identifies 1) the project, 2) the number of residential units in the project subject to affordability requirements, and 3) the applicable affordability requirements for these residential units. The regulatory agreement or approval must expressly limit residency in the affordable residential units to persons with extremely low, very low, lower or moderate income persons as defined by the Health and Safety Code section 50052.5, 50053, 50199.4, or regulations adopted by the California Department of Housing and Community Development.

- Each residential unit (apartments, multifamily homes, etc.) for which a system is being installed has an individual electric utility meter. Applicants must provide documentation from the electric utility confirming service and meter number.

- Each residential unit for which a system is being installed is at least 10 percent more energy efficient than the current standards specified in Title 24 of the California Code of Regulations or has already taken or will take measures to reduce the unit's energy use by at least 10 percent as calculated pursuant to Title 24 compliance models (usually C2R model runs). When systems are installed to serve the energy needs of a project's

common areas, the entire affordable housing project must be at least 10 percent more energy efficient than the current standards specified in Title 24 of the California Code of Regulations or must have already taken or will take measures to reduce the entire project's energy use by at least 10 percent as calculated pursuant to Title 24 compliance models. Applicants must provide the energy efficiency calculations performed by an individual certified by the California Association of Building Energy Consultants. For a list of Certified Energy Plans Examiners, visit the Energy Commission's Web site at: [http://www.energy.ca.gov/efficiency/cabec_roster.html]

Endnotes

[1] California Energy Commission, 2004, *Integrated Energy Policy Report, 2004 Update.* http://www.energy.ca.gov/reports/CEC-100-2004-006/CEC-100-2004-006CMF.PDF California Energy Commission, 2005, *2005 Integrated Energy Policy Report.* http://www.energy.ca.gov/2005publications/CEC-100-2005-007/CEC-100-2005-007-CMF.PDF The pertinent policies from these two reports are described later in this paper.

[2] Barbose, Galen, Wiser, R., Bolinger, M., 2006, *Supporting Photovoltaics in Market-Rate Residential New Construction: A summary of Programmatic Experience to Date and Lessons Learned.* Lawrence Berkeley National Laboratory and Clean Energy States Alliance.

[3] The Emerging Renewables Program's Pilot Performance Based Incentive does not limit system size but instead limits the maximum rebate to $400,000 for any system or group of systems at one site and $1 million per corporation or government parent installing systems.

[4] Continued by SB 1194 and AB 995

[5] As outlined in Decision 06-01-024, *Interim Order Adopting Policies and Funding For the California Solar Initiative,* and the in the accompanying Appendix A, *Revised Joint [CPUC/Energy Commission] Staff Proposal To Implement A California Solar Initiative of Rulemaking R04-03-017*

[6] Joint Staff Report, Appendix A, Section 5

[7] On page 10, the 2006 Renewable Energy Investment Plan actually defines a 400 MW goal for emerging renewables, which could include wind and other renewable technologies. Based on previous installation rates of the various technologies, the 400 MW is expected primarily from the New Solar Homes Partnership.

[8] Press Release, August 20, 2004, Governor Schwarzenegger calls for one million solar energy systems in California Homes

[9] Note that the Energy Action Plan II called specifically for inclusion of photovoltaic systems into the 2008 Standards. California Energy Commission and California Public Utilities Commission. 2005. *Energy Action Plan II: Implementation Roadmap for Energy Policies.* http://energy.ca.gov/energy_action_plan/2005-09-21_EAP2_FINAL.PDF

[10] Wiser, Ryan. *Quality Assurance for Photovoltaic Systems.* Lawrence Berkeley National Laboratory and Clean Energy States Alliance. http://www.cleanenergystates.org/Innovative%20Practices%20Report/Quality_Assurance.pdf

[11] The Emerging Renewables Program places additional requirements upon leased systems as shown in Appendix 5, Section E of the *Emerging Renewables Guidebook*.

[12] Roseville may have certain demographics (and its own utility) not shared by many other cities that make such a program possible.

[13] KEMA-Xenergy Presentation, June 24, 2004.

[14] For the very near-term, a solar system will be synonymous with a photovoltaic system but will eventually include other solar technologies mentioned later is this paper.

[15] Buildings four stories or more are considered commercial and solar installations on commercial structures will be funded under the California Public Utilities Commission program.

[16] *Emerging Renewables Program Guidebook*, Sixth Addition, Appendix 3.

[17] California Energy Commission and California Public Utilities Commission, 2005, *Energy Action Plan II: Implementation Roadmap for Energy Policies.* http://energy.ca.gov/energy_action_plan/2005-09-21_EAP2_FINAL.PDF

[18] California Energy Commission, 2004, *Research, Development and Demonstration Projects Focused on Zero-Energy New Homes (ZENH)*. Request for Proposals, RFP # 500-04-501.

[19] The Emerging Renewables Program, as part of the Renewable Energy Program, is authorized under Senate Bill 1038 to disburse funds collected.

[20] California Energy Commission. 2006. *2006 Renewable Energy Investment Plan* http://www.energy.ca.gov/renewables/investmentplan/documents/index.html

[21] The Emerging Renewables Program, as part of the Renewable Energy Program, is authorized under Senate Bill 1038 to carry out program activities from 2001 until 2006. Senate Bill 1038 authorizes the Energy Commission to disburse funds collected from 2002 until the end of 2006 in the implementation of the Emerging Renewables Program.

[22] The Energy Commission provided to the legislature recommendations for allocating REP funds in the Energy Commission's 2006 Renewable Energy Investment Plan.
[23] Galen Barbose, Ryan Wiser, Mark Bolinger *Supporting Photovoltaics in Market-Rate Residential new Construction: A Summary of Programmatic Experience to Date and Lessons Learned*, Lawrence Berkeley National Laboratory
[24] The Energy Commission is interested in exploring other roles the utilities might play in the solar homes market. The Energy Commission is currently funding a research contract under the Zero Energy New Homes project that will explore the benefits Zero Energy New Homes produce for the electric utility and to develop market models in which the electric utility can serve as a major driver for reducing the cost to the homeowner.
[25] Regional Economic Research, 2000, *Renewable Energy Program Evaluation, Emerging Renewable Resources Account, Volume IV.*
http://www.energy.ca.gov/renewables/documents/RER_RENEWABLE_REPORT.PDF
Scheuermann, K., D. Boleyn, P. Lilly and S. Miller, 2004, *Measured Performance of California Buydown Program Residential PV Systems.*
[26] Standard Test Conditions rating in watts dc
[27] PVUSA Test Conditions rating in watts ac
[28] The California Public Utilities Commission Joint Staff Proposal recommends that the incentives should be adjusted based on shading, orientation, and other performance characteristics and additional incentive be provided to applicants that achieve efficiency levels beyond the Energy Star Homes level. The intent is to facilitate maximum feasible efficiency in homes with solar installations, leading to zero-energy homes.
[29] California Energy Commission, 2005, *Decisions on Pilot Performance-Based Incentive Program.*
http://energy.ca.gov/2005publications/CEC-300-2005-002/CEC-300-2005-002-CTF.PDF
[30] Letting the Sun Shine on Solar Costs: An Empirical Investigation of Photovoltaic Cost Trends in California, Ryan Wiser.
[31] Barbose, Galen, Wiser, R, Bolinger, M, 2006, *Supporting Photovoltaics in Market-Rate Residential New Construction: A summary of Programmatic Experience to Date and Lessons Learned.* Lawrence Berkeley National Laboratory and Clean Energy States Alliance.
[32] California Energy Commission, 2004, *Integrated Energy Policy Report, 2004 Update.*
http://www.energy.ca.gov/reports/CEC-100-2004-006/CEC-100-2004-006CMF.PDF
California Energy Commission, 2005, *2005 Integrated Energy Policy Report.*
http://www.energy.ca.gov/2005publications/CEC-100-2005-007/CEC-100-2005-007-CMF.PDF
The pertinent policies from these two reports are described later in this paper.