
Business Plan
Berkeley Solar Initiative

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Introduction

As fuel prices escalate and environmental problems become more apparent, energy efficiency and solar renewable energy present practical options for property owners to reduce energy bills and invest in long term sustainability. Buildings comprise 48% of all energy consumption in the U.S, significantly more than the transportation or industry sectors¹. Reducing the fossil fuel needed to create comfortable, healthy indoor environments will greatly reduce our dependence on polluting energy sources, save on fuel expenditures, and reduce global warming. Energy efficiency upgrades and solar energy generation through photovoltaics and solar hot water are well-known, vetted ways to reduce fuel usage in buildings while improving comfort and indoor air quality.

The Berkeley Solar Initiative (BSI) is an innovative program spearheaded by the City of Berkeley, California that will make energy efficiency upgrades and solar energy more accessible for residential and small commercial consumers by removing market barriers that are inhibiting the widespread adoption of these technologies. BSI encompasses the renewable energy portion and some of the energy efficiency portion of East Bay Energy Watch (EBEW), a local government partnership with PG&E and multi-stakeholder effort that is helping to achieve California’s pioneering AB32 legislation, which will reduce greenhouse gases to 1990 emission levels by 2020. EBEW also contributes to Berkeley’s Climate Action Plan, or Measure G, which sets an ambitious goal of reducing greenhouse gases by 80% by the year 2050. The distinct goal of the Climate Action Plan is to save 112,000 tons of carbon dioxide emissions from electricity and natural gas sources, of which 4,000 tons will be saved by the Berkeley Solar Initiative efforts.

The BSI will offer a personalized consultation with each potential customer to provide them with guidance and resources to help navigate through the multitude of technology options and incentives available to property owners in the City of Berkeley. The purpose of the program would be to assure well-informed decisions by consumers about their solar and energy efficiency options, and thereby promote the development of a competitive, consumer-centered solar industry. The consultations will be conducted by qualified service provider organizations who have experience and in-depth knowledge of the solar and energy efficiency markets and who are able to connect clients with a broader portfolio of energy solutions, including efficiency. The

¹ U.S. Energy Information Administration Statistics Center

customer will take away from each consultation a better understanding of potential solutions available to reduce their energy fuel consumption and tools to achieve these upgrades. Through these consultations, the BSI will provide the customer with a host of services which could include the following:

- Assessment of customer's needs and current energy baseline
- Overarching presentation of the energy efficiency and solar technology program offerings
- Financial assessment for different technology options
- Contractor bid evaluations

In order to perform helpful consultations, the program providers must understand the economic forces and barriers that currently frame the energy efficiency and solar energy markets in the Bay Area. An essential aspect of the consultations will be an assessment of the barriers that are currently inhibiting customers from adopting these technologies and a discussion of how to overcome them. As the BSI gains more experience and traction within the community, BSI service providers will hone their understanding of the market and conduct consultations with increasing precision and relevance over time.

The program will also provide quality control for the customer after the installation where needed. Experience with the program will inform ongoing solar consulting programs designed to promote a competitive, customer-centered solar industry in the region.

Energy Efficiency and Solar Market Context

Renewable energy generation and energy efficiency upgrades are sensible actions for any building property, as these technologies improve comfort, reduce energy bills and encourage long-term environmental sustainability. Solar energy generation through photovoltaic cells and solar domestic hot water technologies have been in the U.S. market for over thirty years and have proven reliable and satisfactory for millions of home and business owners. Diagnostic testing methods can now prove the cost and comfort benefits of installing energy efficiency upgrades to buildings. When considered solitarily, these positive attributes alone should be enough to support widespread adoption of solar energy generation and energy efficiency upgrades to any building. However, a multitude of market barriers currently inhibit adoption of these technologies, even when they make sense from a technical and economic standpoint.

At the forefront of these market barriers is the perceived barrier of **'high first cost'**, or that property owners must afford a hefty down-payment in order to procure solar technology. On average, the cost of equipment and installation on a residential level for solar hot water is about \$6,000² and for solar electricity the cost ranges from \$20,000 to \$30,000³. Energy efficiency

² From *The Solar Energy Resource Guide*, 7th Edition 2006-2007. Nor-Cal Solar Energy Association

³ *CSI Installation Data for Berkeley since 2007*

of strictly residential projects: 158

of commercial, nonprofit, government: 15

Total # of CSI projects in database: 173

Ranges and averages for strictly residential projects:

	Average	Range
Installation Size (kW)	2.69	.93 - 7.18
Installation Cost	\$28,077	\$9638 - \$69,108
CSI Rebate	\$6,108	\$1,799 - \$14,408

upgrades vary greatly in cost according to scope, but currently in California, a basic duct blaster test, blower door test and visual inspection with basic upgrades such as duct sealing and air sealing is about \$700. The price increases with further diagnostic tests and upgrades. If the property owner does not seek long-term financing such as a loan to help cover the cost, the property owner must pay for the total cost of the parts and the installation from their savings up front. In a survey conducted of homeowners within the City of Berkeley by UC Berkeley's Renewable and Appropriate Energy Laboratory (RAEL), the respondents were asked to rank the most important purchase factor when considering solar. The largest portion of the respondents, 49.5%, listed insufficient funds to cover the high initial cost as the most inhibiting purchase factor.⁴ This percentage represents a higher portion than other listed market barriers by at least a factor of three. The Berkeley Financing Initiative for Solar and Renewable Technology (FIRST) will hurdle the high first cost barrier by allowing participants to pay for their upgrades gradually through property tax liens, and will remain a potential option for program participants under the Berkeley Solar Initiative. Of course, the higher the initial cost the more it is a barrier, so this market barrier is most significant with photovoltaics, less significant for solar hot water, and hardly a factor at all for energy efficiency upgrades.

When property owners must make a high initial investment on a technology that will save money over time, there is an inevitable payback period before which the property owner sees a return on the investment. In California, solar hot water systems have a payback period range of 5-10 years and photovoltaic systems have a payback range of 10-20 years, varying with the applicable rebate rates under the CSI.⁵ Payback periods for energy efficiency upgrades will vary with the extent of the work done and the monthly energy bills prior to upgrades, but energy efficiency upgrades tend to have shorter payback periods. The market barrier associated with payback periods is the **financial uncertainty risk** as to whether the property owner will stay with that property long enough to experience the return on their investment. Should the homeowner or business move before the system or upgrades have paid for themselves through energy savings, then the owner may suffer a net loss, if the home resale value does not cover the initial cost. Also, participants may assume that payback periods will be poor if they do not have the means or the knowledge to calculate the payback. The longer the payback period, the more risky the investment becomes. Frequently occurring comments in the RAEL survey cited "poor payback" as a reason not to invest in solar energy. A tool that helps homeowners understand and easily calculate their exact return on investment would ease some of these doubts. The Berkeley Solar Initiative must make participants aware of attractive financing packages, since financial barriers remain the largest inhibitors to adoption of solar or efficiency measures in Berkeley.

Additionally, property owners embarking on renewable energy generation technology for the first time will encounter an assortment of new information at the initial research stage, and when selecting a reputable system and installer. Conducting thorough research is time-consuming, and many busy home and business owners cannot commit the time it takes to make an informed choice for their purchase. The **information search cost** is enough of a barrier to deter a minimal portion of potential customers from pursuing solar energy generation or energy efficiency upgrades. According to the RAEL market survey, 9.5% of respondents listed lack of time to talk to vendors as the main barrier to adopting solar technologies. In addition,

Source: CESC

⁴ From Prasad, D. 'Market Research: Berkeley FIRST Powerpoint presentation. March 25th, 2008.

⁵ National Renewable Energy Laboratory (NREL) Federal Energy Management Program Maps: Solar Payback Period Maps: <http://www.nrel.gov/gis/femp.html>

respondents were asked whether they would support an intervention by the city to enact equipment and installer standards for installation, and 90 said that they would support standards, and 40% said they would support the standards specifically “due to convenience⁶,” meaning that it would save them research efforts that they would otherwise do themselves. While information search investment is not as influential a barrier as financial investments, it still remains a barrier whose removal could increase adoption of solar in Berkeley.

Furthermore, only some of the information available from websites and literature is credible and unbiased. Inexperienced property owners may become overwhelmed searching for reliable sources of information and reputable installers. When faced with differing information and conflicting data, property owners may **doubt the performance claims** of the products and service providers they encounter. The RAEL survey results reflected these misgivings: 90% of respondents said they would support equipment and installer standards imposed by the city. The level of hesitation due to performance will vary according to technology. Potential customers will have the most faith in photovoltaic technology, since the statewide California Solar Initiative maintains a list of reputable systems and installers based on a quality assurance protocol. Also, the benefits of photovoltaics are the most tangible; customers can actually see their electricity meters run backwards. Out of all three technologies, photovoltaics receive the most positive and consistent media attention.

There is more trepidation surrounding solar hot water, since these technologies were comparatively primitive when they first came out in the 1970’s, and some past customers have had negative experiences. Many people are not aware of the advancements made in the solar hot water field in the last forty years, so the field remains negatively affected by bad press from when the technology was emerging.

By far, energy efficiency upgrades garner the most skepticism from potential customers. Energy efficiency upgrades are arguably the most difficult to research since they cover a host of potential measures rather than one discrete technology. A package of energy efficiency upgrades for one home could be vastly different from those recommended for another home, so it is more difficult for property owners to compare quality of service with one another. Since the recommended upgrades will vary widely with each property, there is no way to compare one’s upgrades with those of peers. The only measurable evidence of the benefits of energy efficiency upgrades is in reduced utility bills, and this is not a comprehensive measure as many of the benefits fall within the realm of improved indoor air quality. Performance doubts affect the three technologies in order of increasing influence: photovoltaics, solar hot water, energy efficiency.

In ever-changing and innovative fields such as the renewable energy and energy efficiency industries, it is not easy to keep abreast of technological advancements. As such, the experts in the field are nearly always installers or manufacturer representatives. Since the vendor of the products and services will almost always know more about the industry than the customer, there is often **asymmetric information** conveyed to the potential customer, in that the vendor may only share information that is likely to convince the potential customer to buy the system or upgrades. In the RAEL market survey, 82.5% of respondents said that aside from financing, the most helpful role for the City of Berkeley would be to “provide fair and neutral information on the technical and financial aspects” of energy efficiency and solar renewable energy technologies.

If a potential customer senses that important information is being withheld during a sales pitch, they may suspect **opportunism** in the vendor and thus be less likely to trust them with

⁶ Out of 90% overall support of equipment and installer standards.

their business. This is in part a result of the asymmetric information presented to the potential consumer; since the contractor knows more and values making a profit, the customer may have misgivings about the quality of information conveyed and the systems offered. As such, quality standards of installers and of equipment from a third party entity would help assuage these concerns. RAEL's market survey showed that 57%⁷ of respondents said that established and enforced quality standards for solar equipment and vendors would be "very helpful," and 39% of respondents said such standards would be "somewhat helpful."⁶ A multitude of quality assurance standards already exist in established programs in California. The Berkeley Solar Initiative will make the most of these existing programs to the extent that they benefit the mission of the BSI. If there is a need to establish quality standards beyond what already exists, the BSI will develop and implement them.

An effective municipal program aimed at encouraging greater adoption of solar renewable energy and energy efficiency upgrades will seek to reduce and alleviate these market barriers. The goal of the Berkeley Solar Initiative is to create a permanent market effect that will increase installation of solar renewable energy systems and energy efficiency upgrades. To successfully change the market, The Berkeley Solar Initiative will directly address the following barriers:

- 1) Information Search Cost and Hassle
- 2) Financial Uncertainty Risk
- 3) Asymmetric Information

The Berkeley Solar Initiative will indirectly address the following barriers:

- 1) High First Cost
- 2) Perceived Performance Risk
- 3) Opportunism of Vendors

The business plan outlined in this report aims to help remove these barriers and make energy efficiency and solar energy more accessible to the property owners in the City of Berkeley.

General Program Description

In order to overcome the market barriers currently preventing the widespread adoption of energy efficiency upgrades and solar energy generation and energy efficiency upgrades, the Berkeley Solar Initiative will contain program design elements aimed at removing or reducing these barriers.

According to the market research conducted for this program, we have determined that high first cost, information research time, and risk perception associated with distrust of available information and vendors have prevented many potential property owners from embracing these technologies. The Berkeley Solar Initiative will deliver convenient, streamlined access to solar technology with access to competitive financing, thorough information and quality assurance.

⁷ 40% said the standards would be very helpful "due to convenience" and 16.7% said the standards would be very helpful due to "trust in the city's screening process."

In order to design the program effectively, the Berkeley Solar Initiative must adhere to the following Program Design Principles:

Berkeley Solar Initiative Program Design Principles

1) Utilize Existing Models

In California there is an abundance of public state and local as well as private incentive programs that present options for providing unbiased information, quality assurance, financing packages and auditing standards for energy efficiency upgrades and solar energy generation. Rather than attempting to build a successful program entirely from scratch, the BSI should attempt to utilize existing programs when they fit programmatic priorities. This strategy will ease administrative burdens for the BSI and strengthen established and successful energy efficiency and solar energy programs.

This strategy will also help to overcome information barriers and perceived performance risks in the energy efficiency and solar energy fields. Integrating existing programs will enhance the credibility of the BSI and boost the standing of existing programs with similar goals, creating a collaborative rather than duplicative effort.

The organizations the BSI will leverage are:

- Energy Efficiency The California Building Performance Contractors' Association (CBPCA), GreenPoint Rated Existing Home Program, Community Energy Services Corporation (CESC), Berkeley's energy efficiency ordinances: the Residential Energy Conservation Ordinance (RECO) and the Commercial Energy Conservation Ordinance (CECO), PG&E's energy efficiency programs and rebates
- Solar Hot Water The California Solar Initiative- San Diego Pilot Project, Solar Rating and Certification Corporation (SRCC).
- Solar Photovoltaics The California Solar Initiative, California Youth Energy Services (CYES), Rising Sun Residential Energy Services (RSRES), PG&E's solar and customer generation organizations on program offerings

The integration of these programs will create a favorable and comprehensive menu of options for the participants. The role of the BSI program will be to educate the participant on the mission and benefits of these programs, and to help them identify how they can use the programs effectively. The BSI will supplement existing models only where they are shown to be inadequate or irrelevant to the participant's needs.

2) Simplicity

The BSI must be structured in the simplest way possible for the customers and stakeholders to participate and for the City of Berkeley to administer. An overly complex system will overwhelm and deter potential customers and place resource demands on the City that will not be sustainable in the long-term. A simple, streamlined program must not add any additional research or financing application time for the homeowner. Additionally, a streamlined program will deliver results more quickly, gaining credibility amongst potential customers and generating positive publicity that will encourage lasting success of the program. Specifically, the program must provide the greatest amount of utility with the least amount of site visits or other intrusions.

Build It Green's contractor focus group results echoed this notion. The group unanimously agreed that each site visit by a program representative inconveniences the owner, so site visits should be designed to achieve maximum value and occur at minimum frequency. The contractors also agreed that compliance verification should occur as the job is being finished, as property owners would want the program eligibility process to align with installation. Simplicity and expediency will be most appealing for the participants and contractors and will thus remain the most sustainable choice for the City of Berkeley to administer.

3) Comprehensive Financing Analysis

Since high first cost is the most significant deterrent to adoption of these technologies, a financing plan that will help participants pay for their upgrades and systems in increments will be instrumental to widespread adoption of the technologies. This barrier is being addressed directly by Berkeley FIRST, a financing program independent of BIS that would initially fund the high capital costs and allow participants to reimburse the program through transferable property taxes. The comprehensive financial analysis should include estimates of monthly savings, return on investment (if applicable) and estimates of home resale value. In order to ensure the volume of participation needed to attain BSI goals, the BSI must direct customers to FIRST financing resources if this financing package would be the deciding factor in whether or not to participate in BSI.

The contractors interviewed in Build It Green's contractor focus groups emphasized the importance of having a speedy financial analysis process since the rebates for photovoltaics offered through the California Solar Initiative depreciate over time. If the financial analysis process is long and onerous, the BSI may calculate one rebate level for a customer, only to see that rebate decrease by the time the customer actually receives BSI financing. The contractors advised the BSI program designers to 'act quickly' to take advantage of the highest photovoltaic rebates.

In order to attract enough customers to participate in the program, the BSI must present the spectrum of financing models on the market and assist the customer in choosing the best option for their situation. Customers will choose the financing option that is most competitive with the market, whether it is Berkeley FIRST or a private option. While the BSI does not include Berkeley FIRST under its purview, the BSI must integrate Berkeley FIRST with other financing options and rebates to help participants successfully navigate the energy efficiency and solar energy financing field.

4) Preserves Functional Existing Market Patterns and Relationships

The San Francisco Bay Area has been a hub of solar installations and energy efficient buildings for decades. As such, a strong market contingent of vendors, distributors and retailers offer these services and sell equipment for solar energy upgrades. The BSI should complement existing market patterns and supply chains between provider companies and avoid creating new competitions or market barriers. BSI's contractor focus groups emphasized the importance of preserving functional market patterns.

The participants in BSI's contractor focus group sessions emphasized that contractors compete with one another on more than cost; they also compete on quality of service, customer relations, reputation in the field and package of services offered. If the BSI attempted to streamline bids for customers, then the lowest cost contractors would win every bid even if they were not the most appropriate for the job. The BSI should not attempt to seek bulk discounts for

equipment or otherwise restrict equipment used for installations, since contractors already get bulk discounts, and they warranty their work based on equipment to which they are accustomed.

The success of the BSI is in part hinged on contractor buy-in, since the program must utilize the best installation resources available in order to attract and maintain participation. Contractors will only support the program if the program does not disrupt functional aspects of solar energy generation and energy efficiency market.

5) Energy Efficiency and Renewable Energy as Integrated Programs

The BSI shall promote energy efficiency upgrades in buildings as a precursor to solar energy technology, encouraging customers to adopt energy efficiency upgrades as they consider photovoltaics or solar hot water. Payback periods for energy efficiency upgrades are generally shorter, and the value per dollar spent is greater, than with photovoltaics or solar hot water (Table 1.1). In 1992, California government stakeholders made a policy decision that both energy efficiency upgrades and renewable energy are crucial to lowering per capita energy demands in the future.⁸ Furthermore, studies on whole-system energy efficiency upgrade economics have shown that energy retrofits in homes and small businesses that produce savings between 50% to 90% will garner payback periods of several months,⁹ compared to several years to more than a decade for solar energy technologies. The Berkeley Solar Initiative shall encourage adoption of the technologies in the following sequence, based on payback periods: energy efficiency, solar hot water, photovoltaic arrays. However, the Berkeley Solar Initiative will only track solar technologies under BSI program goals, as energy efficiency technologies are already being tracked under the East Bay Energy Watch.

⁸ California Evaluation Framework, June 2004.

http://www.calmac.org/publications/California_Evaluation_Framework_June_2004.pdf

⁹ Lovins and Lovins, 1997 http://www.rmi.org/images/other/Climate/C97-13_ClimateMSMM.pdf

Table 1.1 Average Payback Periods for Energy Efficiency Upgrades, Solar Hot Water and Solar Photovoltaic Systems¹⁰ for Small Homes and Businesses

Technology	Average Payback Period	Reference
Energy Efficiency Upgrades	20 months to 6 years	EPA Victoria Industry Greenhouse Program http://www.epa.vic.gov.au/greenhouse/industry-greenhouse-program.asp and ICLEI: Best Municipal Practices for Energy Efficiency: http://www.iclei.org/index.php?id=1677
Solar Hot Water	5-10 years	National Renewable Energy Laboratory (NREL) Federal Energy Management Program Maps: Solar Payback Period Maps: http://www.nrel.gov/gis/femp.html
Photovoltaic Cells	15-25 years	National Renewable Energy Laboratory (NREL) Federal Energy Management Program Maps: Solar Payback Period Maps: http://www.nrel.gov/gis/femp.html

6) Effective Information Exchange, Outreach and Marketing

As stated above, another market barrier for energy efficiency upgrades and solar energy is the often intimidating and bewildering process of researching technologies and selecting contractors. The BSI intends to assist the customer in this decision-making process by providing educational materials so that the customer can reduce their research time and be assured that the system and installer they select will result in quality performance.

Recent market research has shown a demand from property owners for unbiased information on solar technologies. Build It Green (BIG), a Berkeley-based nonprofit that promotes green building in California, runs an Ask an Expert (AAE) hotline service for building professionals and property owners. BIG tracks every AAE consultation by date, inquirer name, building sector and topics covered. On average, Build It Green staff consults with 125 building professionals and property owners per month through the Ask an Expert service. BIG found that in 2007, 4.6% of total Ask an Expert queries focused on solar energy technologies: photovoltaic panels, solar hot water, or general. In 2008 through the month of May, the solar-related questions to Ask an Expert increased to 7% and BIG staff found that more questions specifically addressed photovoltaic panels and solar hot water technologies in a detailed manner, and fewer questions were general or open-ended. As the Berkeley Solar Initiative receives increased attention from the media, property owners are beginning their research processes and are requesting information and opinions from reputable, unbiased organizations.

Partnership and collaboration with PG&E will be part of these efforts as well. PG&E with its exposure and brand name can assist the BSI in promoting the efforts from Berkeley as well as bring in other best practices from around the state and provide a foundation to launch outreach efforts.

¹⁰ Does not include rebates or incentives.

Program Goals and Market Potential

Target Customers

Given the limited resources of this program, this analysis has pared the potential applicant pool down to a selected group of target customers that are most likely to follow through with energy efficiency and solar technology installation. The assumptions that define the group of target customers are applied to estimating the technical, economic and market potential for all three technologies. While the target customers are most likely to participate, the BSI is open to accommodating other types of customers. The parameters for defining target customers for each sector are as follows:

Residential

Potential residential customers in the BSI will most likely be owner-occupants of single-family homes. Only residential customers that own their own homes will be able to take advantage of the property-tax financing offered by Berkeley FIRST, which is the main driver for participation in the BSI. In renter-occupied buildings, the tenants almost always pay utilities, so the landlord has little or no incentive to reduce utility bills by investing in energy efficiency or renewable technologies. Condos and multifamily developments are likewise not included in the target customer group, but these sectors are still welcome to participate in the BSI.

Commercial

Potential commercial customers in the BSI will include all businesses in the City of Berkeley, not just businesses that own the buildings they occupy. This analysis assumes that most small businesses in Berkeley rent, and if the market potential were restricted to owner-occupied businesses, this would unrealistically shrink the applicant pool. In business spaces, energy efficiency upgrades and renewable energy technologies greatly encourage quick leasing, since the renting business can use these green features in their marketing. Thus, we assume a greater landlord interest in energy efficiency upgrades and solar upgrades for businesses than for residences.

Technical potential

Energy Efficiency

Since the breadth of energy efficiency upgrades is so wide and varied and there are no siting or roof requirements unless the house is undergoing a remodel or resale, many more properties will have potential to reduce their energy demand through energy efficiency upgrades than through solar hot water or photovoltaic technologies. According to the California Energy Commission, 44% of natural gas consumption in homes and 31.9% of natural gas consumption in businesses can be attributed to space heating, the end-use that will be most affected by energy efficiency

upgrades^{11,12}. It cannot be assumed that 100% of residences and small businesses in Berkeley will be eligible for value-saving improvements since some properties may have undergone improvements in the last few years, or may have been built energy efficient, so we will project the technical potential at 90% of properties in Berkeley. According to the 2006 Bay Area Census, there were 20,059 total owner-occupied households in the City of Berkeley, so the technical potential for energy efficiency upgrades will be roughly $(20,059 \times 0.9) = 18,053$ homes. A 2007 survey conducted by the Berkeley Department of Business Assistance reported 3,650 total businesses in the City of Berkeley, so the technical potential for energy efficiency upgrades for the commercial sector will be $(0.9 \times 3,650) = 3,285$ buildings.

Solar Hot Water and Photovoltaics

In order to accurately estimate the scale of the Berkeley Solar Initiative, it is necessary to determine the technical potential within the City of Berkeley, or the number of roofs that could feasibly fit a photovoltaic array or a solar hot water system, where the installation area would receive sufficient sunlight. The City of San Francisco has recently embarked on a solar mapping project that provides accurate estimates of roof spaces in the city. The solar mapping tool projected that 25% of roofs in San Francisco would be viable candidates for solar technology.¹³ Overall, the City of Berkeley has shorter buildings and more tree cover than San Francisco, so the adjusted roof space for Berkeley will be 20% of all owner-occupied homes. For both photovoltaics and solar hot water, the technical potential will be $(20,059 \times 0.2) = 4,012$ available roofs.

The 20% estimate will be extended to commercial entities as well as residences, making the technical potential $(3,650 \times 0.2) = 730$ commercial roofs for solar technologies.

It should be noted that since we assumed that all viable roofs for residential and commercial sectors could accommodate both solar hot water and photovoltaics, these technologies are only limited by economic and other market restrictions. This is a valid assumption since in reality some roofs are more appropriate for solar photovoltaics and others are more appropriate for solar hot water, and many can accommodate both.

Economic Potential

Energy Efficiency

Since energy efficiency upgrades are generally less expensive than renewable energy installations and can be specified on a wide scale of cost and scope, the economic potential for energy efficiency upgrades is more elusive and difficult to quantify than for solar hot water or photovoltaic economic potential.

For simplification purposes, this business plan will assume that PG&E natural gas customers¹⁴ who pay the highest rates per therm of gas will have the most economical potential for energy efficiency upgrades. PG&E has only two established tiers for residential natural gas

¹¹ <http://www.energy.ca.gov/2008publications/CEC-180-2008-005/CEC-180-2008-005.PDF>

¹² <http://www.energy.ca.gov/2006publications/CEC-400-2006-005/CEC-400-2006-005.PDF>

¹³ Correspondence with Jason Huock, Renewable Energy Associate with San Francisco Dept of the Environment, 7/23/08.

¹⁴ Only PG&E 'Core' customers, or those who get their natural gas from the PG&E distribution system, are included in this assessment. Large commercial and industrial entities with their own natural gas pipelines, or 'Non-core' customers, are not included.

rates: “Baseline” and “Over Baseline.” In Berkeley, customers paying “Over Baseline,” or Tier II are paying \$1.85 per therm compared to \$1.66 per therm at baseline. The baseline threshold is 0.69 therms per day in the summer and 1.79 therms per day in the winter. According to PG&E, the average residential customer uses 60 therms of gas per month in the winter and 24 therms per month in the summer, or about 0.8 therms per day in the summer and 2 therms per day in the winter. Both of these averages exceed the baseline rates for gas. PG&E does not have distribution data for quantities of customers in excess of the baseline, but since the summer average exceeds the baseline by about 15% and the winter average exceeds the baseline by about 25%, this business plan will assume that the average PG&E customer exceeds the natural gas baseline by 20%, that the distribution is even, and that Berkeley is representative of PG&E territory. Therefore, we will assume that 70% of Berkeley residents exceed PG&E’s Tier II for natural gas, and that 30% do not exceed. Applying this to the technical potential we found for residences, 70% of 18,053 homes is 12,637 homes with economic potential for energy efficiency upgrades.

For small commercial entities, the City of Berkeley has five natural gas payment tiers, based on average therms consumed per day. The largest price hike is between Tier III and Tier IV, so we will assume that Tier IV businesses have the highest economic potential, since they are paying \$1.69 per therm compared to the Tier III \$0.95 per therm. Unfortunately, PG&E does not publicize this information, so there is no way to quantify how many small businesses exceed this threshold. For lack of a better estimate, we will assume that like the residential sector, 70% of the of 90% of businesses are paying the highest rates. This assumption will yield (3,285 x 0.7) 2,300 possible commercial installations.

Solar Hot Water

From the Technical Potential analysis, we have determined that 4,012 roofs in Berkeley are viable for solar hot water. Payback periods for solar hot water are typically shorter than for photovoltaic systems, so the economic potential will be larger, and include even those who do not have high natural gas bills. Of these 4,012 available units, those with the highest tier of natural gas usage will have the most significant economic potential for solar hot water as well as energy efficiency. We assumed in the energy efficiency economic potential section that 70% of residential customers were in excess of the baseline rate for natural gas usage. If we project that portion to the 4,012 available roofs, then about 2,808 houses would be both technically and economically viable for solar hot water. This estimate of 2,808 will cover both gas-fired and electric hot water systems. There is no available data on the relative portions of electric and gas-fired water heating systems, but electric systems are assumed to be far less since Title 24 discourages electric hot water systems.¹⁵ The incremental addition of electric hot water systems in this estimate is assumed to be offset by the fact that PV systems garner more media attention than solar hot water, and that the pilot program for Berkeley FIRST will only finance PV systems, which may carry a precedent over into the full-scale Berkeley Solar Initiative.

The only commercial subset that would get any economic benefit from solar hot water would be those with significant and frequent hot water needs. This would relegate the economic potential for solar hot water to businesses such as restaurants, certain manufacturers, exercise

¹⁵ The minimum Energy Factor for electric water heating systems is 97, unless the occupant lives in a place where gas lines are not available. The EF threshold is made deliberately high because electric hot water systems are inherently inefficient due to transmission losses. Title 24 2005 Code: http://www.energy.ca.gov/2005publications/CEC-400-2005-005/chapters_4q/5_Water_Heating_Requirements.pdf

facilities and laundrettes. According to a 2007 census report compiled by the City of Berkeley Business Assistance Department¹⁶, there are 146 manufacturing establishments, 459 health care and social services facilities and 324 accommodation and food service entities within the City of Berkeley proper, totaling 929 businesses with significant hot water needs. This figure does not include all potential sectors that could have high hot water demands, since there is a significant undefined 'Other Services' category, but not every business within the sectors listed above will have high enough hot water demands either.

Moreover, natural gas prices have increased an unprecedented 30% in 2008, and prices are expected to increase or remain high through 2009.¹⁷ The economic potential for both the residential and the commercial sector is likely to expand because of this price increase. Since the 929 estimate was derived separately from the viable roofs assumption, we can still assume that 20% of these roofs would be technically feasible. Therefore, the technical and economic potential for small businesses would be $(929 \times 0.2) = 186$ businesses.

Photovoltaics

Of the 4,012 residential roof estimate for solar photovoltaics, a subset will gain the most from installing solar because their electric bills are high enough that the return on investment for solar would be shorter than the functional life of the solar technology. RAEL has determined that this optimal subset is comprised of the PG&E Tier III customers, or customers that use 131% to 200% of the calculated baseline energy threshold established by PG&E. Currently, PG&E Tier III customers pay \$0.22609 per kWh, compared to the \$0.1143 per kWh paid by baseline customers. The more customers pay for their electricity service, the more substantial their savings will be if they install solar photovoltaics. We will assume that solar technology will add the greatest value to properties that exceed Tier III electricity usage.¹⁸ According to a 2007 Berkeley energy usage assessment by RAEL, approximately 39% of Berkeley homes exceed Tier II range during winter, and 24% of homes exceed Tier II in the summer. Since we know that property owners' interest in solar energy and energy efficiency often surpasses the purely economical, let us assume that the winter Tier III customers, or 39% of Berkeley homeowners, have a clear economic interest in solar.

If the economic potential is 39% of the technical potential, then out of the 4,012 available roofs, roughly 1,565 homes in the City of Berkeley contain enough space and sunlight for solar technology that would be most economically viable.

Since PG&E does not make tier information for business electricity usage publicly available, we will also project the 39% economic potential rate to businesses, making the economic potential 39% of 730, or 285 businesses.

¹⁶ U.S. Census Bureau. 2007 Business Census Report by NAICS sector level for the City of Berkeley as defined by zip codes. December 12, 2007.

¹⁷ Reuters UK "PG&E says natural gas prices to spike power bills." June 11, 2008.
<http://uk.reuters.com/article/oilRpt/idUKN1038746720080610>

¹⁸ This assumption does not imply that solar technology and energy efficiency wouldn't be economically viable for Tier II and baseline usage customers; it makes for a useful threshold to evaluate the economic potential of customers in Berkeley.

Market potential

Energy Efficiency

The market potential shall be defined as the subset of potential customers within the economic potential that care strongly enough about the program that they would willingly join this emerging program. Since solar energy generation and energy efficiency upgrades cater to potential customers' environmental values, we can assume that a small subset of Berkeley citizens would want to participate in the program even if their properties do not neatly fit within the economic potential subset. We can also assume that not everyone in the technical and economic potential subsets would be interested in joining the program, since non-economic market barriers still persist. According to RAEL's market survey, 75% of the respondents said they were willing to sign up for the program within the first six months, from a survey of both Tier III customers and lower tier customers. As such, this business plan assumes that the market potential for each technology will be about 75% of the economic potential subset. The assessment above calculated the economic potential for energy efficiency upgrades to houses at 12,637, so using market study results, the market potential for energy efficiency upgrades in houses would be 75% of 12,637 or 9,478 houses.

Since there was no market survey conducted for small business owners, for this projection we will also assume that 75% of the economic potential subset will want to conduct upgrades, setting the threshold at 1,725 businesses.

Solar Hot Water

Using the 75% program interest assumption from the RAEL survey, 2,106 homes and 140 businesses will be the market potential for solar hot water.

Photovoltaics

Using the 75% program interest assumption from the RAEL survey, 1,174 homes will be the market potential photovoltaics. Similar to the economic potential projections, the assumption for market potential for commercial photovoltaics is 214.

Since the structural requirements to install PV and solar hot water are different, some roofs will be better equipped for one technology than another. However, there is no sound data to differentiate these sectors. By assuming that 100% of all viable commercial and residential roofs can and would accommodate both technologies, we capture the roofs that could only accommodate one technology. We found that 50% of all 4,012 technically viable residential roofs would opt for solar hot water and 29% of all technically viable residential roofs would opt for photovoltaics, after economic and market barriers. In the commercial sector, 19% of technically viable businesses would opt for solar hot water and 29% would opt for solar photovoltaics. Some of the customers may overlap and install both, but we assume the same amount of savings for customers who install both as for customers who install only one.

Table 1.0 Energy Efficiency Market Assessment (Number of Properties)

Sector	Technical Potential	Economic Potential	Market Potential
Residential	18,053	12,637	9,478
Commercial	3,285	2,300	1,725
TOTAL	21,338	15,192	11,392

Table 1.1 Solar Hot Water Market Assessment (Number of Properties)

Sector	Technical Potential	Economic Potential	Market Potential
Residential	4,012	2,808	2,106
Commercial	730	186	140
TOTAL	3,016	1,513	2,246

Table 1.2 Photovoltaic Market Assessment (Number of Properties)

Sector	Technical Potential	Economic Potential	Market Potential
Residential	4,012	1,565	1,174
Commercial	730	385	214
TOTAL	3,016	1,117	1,329

The total market potential for solar installations in the residential and commercial sectors is **3,575 solar installations over eleven years**. RAEL estimates that the total interest in solar from both residential and commercial entities will be 1,000 applicants in the first year. Rather than address all interest in the first year, it would be prudent to spread the total market potential evenly over the eleven years of the program to minimize administrative burdens. This will keep demand high for the BSI. There will be a first come, first serve policy established in the BSI, and program administrators will serve applicants in the order they are received.

Program Scale and Niche

As mentioned in the market context section above, the Berkeley Solar Initiative fits into the Berkeley Measure G goals. Measure G is an innovative voter-enacted legislation aimed to reduce greenhouse gas emissions within the city of Berkeley by 80% by the year 2050. In order to achieve these reductions, Berkeley has planned a host of programs promoting energy efficiency, resource conservation and renewable energy. The BSI is one of many Measure G programs and will account for the carbon dioxide offsets derived from getting electricity and water heating from a renewable source rather than from fossil fuels. Quantifying carbon reduction from solar hot water and solar photovoltaic installations under the BSI will contribute to Measure G goals. Tables 2.0 and 2.1 present the levels of carbon dioxide offset by solar installations from the BSI.

Table 2.0: Carbon Dioxide Savings of BSI Residential Solar Installations¹⁹

Technology	Market Potential (roofs)	Avg. System Size	Avg. CO2 Savings Per Installation	Market potential CO2 Savings (tons)
Solar Hot Water	2,106	13 Sq Ft. ²⁰	0.94 tons/ year ²¹	2,239 ²²
Photovoltaic Panels	1,174	1.27 kW ²³	0.79 tons/year ²⁴	927
TOTAL				2,808

Table 2.0 projects the amount of carbon savings that will result from residential solar installations under the BSI by the year 2020. If the entire market potential is addressed, then roughly 2,808 tons of carbon will be displaced.

¹⁹ The City follows the ICLEI methodology which measures average emissions, not marginal. Current average rates are .49 lbs/kwh CO2 offsets for electricity usage, to be displaced by photovoltaics. Gas emissions are calculated at 12.3 lbs/therm CO2 offsets, which will be displaced by solar hot water installations.

²⁰ U.S. Dept of Energy, Energy Efficiency and Renewable Energy. average size of solar hot water systems in the Northern U.S. are between 12 and 14 sq. ft.

http://www.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=12880

²¹ The average PG&E residential customer uses 45 therms of gas per month = 540 therms per year. 44% of natural gas usage goes to water heating (Flex Your Power) = 238 therms per year displaced by solar hot water. (http://www.fypower.org/feature/Natural_Gas_Situation.html). Assumption: a solar hot water heater covers 65% of natural gas used for hot water heating. 238 therms x 0.65 = 155 therms. 155 therms x 12.1 lbs/therm = 1876 lbs = 0.94 tons/year

²² According to PG&E, 95% of residential customers use natural gas for water heating and 5% use electricity for water heating. For 95% of the market potential, or 2,001, we will use the natural gas carbon coefficient. For 5% of the market potential, or 105, we will assume that the kWh equivalent of 238 therms would be displaced by solar hot water. 1 therm = 29.31 kWh (<http://www.convertworld.com/>) 6976 kWh displaced by solar hot water. Using the conversion factors listed in footnote 18, 1 installation displacing electric water heating = 1.7 tons of carbon dioxide.

²³ The average PG&E customer uses 6,480 kWh of electricity per year. Assumption, the PV array will offset 50% of electricity usage, resulting in 3,240 kWh of electricity covered by PV. Assuming that there are 7 useful hours in the day and that the system is operating year-round, 3,240 / (7 x 365) = 1.27 kW size system.

²⁴ The average residential PG&E customer uses 6,480 kWh of electricity per year. Assumption, the PV array will offset 50% of electricity usage, resulting in 3,240 kWh of electricity used. 3,240 kWh of electricity x 0.49 lb/kWh = 1589 lb = 0.79 tons per year per installation.

Table 2.1: Carbon Dioxide Savings of BSI Commercial Solar Installations²⁵

Technology	Market Potential (roofs)	Avg. System Size	Avg. CO2 Savings Per Installation	Market potential CO2 Savings (tons)
Solar Hot Water	140	52 sq. ft. ²⁶	3.2 tons per year ²⁷	448 ²⁸
Photovoltaic Panels	214	5 kW ²⁹	3.2 tons/year ³⁰	685
TOTAL				1,133

Table 2.1 projects the amount of carbon savings that will result from commercial solar installations under the BSI by the year 2020. If the entire market potential is addressed, then roughly 1,133 tons of carbon will be displaced. By these estimates, the BSI will displace a total of **3,941 tons of carbon over eleven years from both residential and commercial sectors.**

Of course, electricity and natural gas usage will vary widely according to property size, occupant preference and business service so these numbers should be taken as rough estimates only. The true carbon offset amount may exceed this estimate since the growing number of solar consumers could drive down prices and encourage greater acceptance, expanding the market to consumers who may not fit in the identified market potential pool.

²⁵ The City follows the ICLEI methodology which measures average emissions, not marginal. Current average rates are .49 lbs/kwh CO2 offsets for electricity usage, to be displaced by photovoltaics. Gas emissions are calculated at 12.3 lbs/therm CO2 offsets, which will be displaced by solar hot water installations.

²⁶ Assumption: small business in Berkeley will have four times the energy expenditures of a small home. Therefore, a small business will use $(540 \times 4) = 2160$ therms per year for space heating and water, and have a system four times as large.

²⁷ Flex Your Power estimates that 38% of natural gas for commercial businesses is used to heat water. 2160 therms per year $\times 0.38 = 821$ therms for water heating. Assuming 65% of hot water needs are covered, $821 \times 0.65 = 534$ therms/year covered by a solar hot water. 534 therms $\times 12.1$ lb./therm = 3.2 tons/year CO2 per installation for small businesses.

²⁸ This analysis assumes that 100% of businesses use gas-fueled water heating systems. Gas water heaters are less expensive to operate than electric water heaters, and since we are focusing on businesses with significant hot water demand, this is a valid economic assumption.

²⁹ Assumption: small businesses use 4 x as much electricity as homes, resulting in $(6,480 \times 4) = 25,920$ kWh per year. Assumption: the PV array will offset 50% of electricity usage, resulting in 12,960 kWh offset by PV.

Assuming there are 7 useful hours in the day and the system is operational year-round, $12,960(7 \times 365) = 5$ kW

³⁰ Assumption: small businesses use 25920 kWh of electricity per year and a new PV system would cover 50% of electricity usage. $25,920/2 = 12,960$ kWh. $12,960$ kWh $\times 0.49$ lb/kWh = 6,350 lb. CO2 = 3.2 tons/year per installation.

Services and Benefits Delivered

The Berkeley Solar Initiative will enable property owners within the City of Berkeley to make informed decisions on energy efficiency upgrades and solar energy technology installations through individual consultations with knowledgeable staff.

Roles and Responsibilities

The Berkeley Solar Initiative is a collaborative program carried out by multiple stakeholders. Some of these stakeholders will have direct roles in the implementation of the BSI, while others will have an advisory or adjunct role. The roles and responsibilities of the partner organizations will be as follows:

- City of Berkeley: The City will incubate the program so that it can be independently operated by partner program administrator and service providers. The City will manage the US DOE funded portion of the project and supervise an analyst who will preside over the Berkeley FIRST program and grants communications duties for the BSI.
- Program administrator: An entity will be selected to provide overall administration of program operations and coordination of services. The administrator may be one of the other partners and may share certain program responsibilities with the other partners.
- Service Provider Organization: One or several organizations will be selected to carry out individual consultations and provide director services to customers under the BSI.
- PG&E and the East Bay Energy Watch (EBEW): The EBEW is a partnership funded by PG&E which will provide ongoing funding for BSI operations and will provide marketing, referral and strategic planning support services. EBEW now includes several of the partners below. The EBEW may be receiving \$2 million in funding from PG&E for job training, and many of these trainees will be deployed to work on BSI projects through Rising Sun Energy Center (RSEC) and solar installers.
- Community Energy Services Corporation (CESC): CESC is a nonprofit in Berkeley that runs SmartLights, a turnkey program for small businesses and multifamily buildings that provides energy audits and recommendations for lighting upgrades. Under the new East Bay Energy Watch proposal, CESC will be expanding its services to some HVAC and refrigeration upgrades. A portion of the services include a comprehensive audit and completion of a checklist that could identify other potential upgrades. CESC will leverage these existing services to conduct primary consultations with potential BSI commercial customers. The energy efficiency upgrades recommended under BSI are more permanent than those offered under CESC (such as duct replacement, duct sealing, insulation, air sealing), but CESC may refer them to other building performance contractors for the actual upgrade, such as Quantum Energy Services Technologies (QuEST), Sustainable Spaces, Renu or a HERS rating company. CESC is a potential service provider organization for the BSI.
- Rising Sun Energy Center (RSEC): RSEC is a nonprofit that provides a comprehensive training program for youth and those with barriers to employment to teach them the skills needed to conduct energy efficiency and solar audits in residences. Under the East Bay

Energy Watch funding, RSEC will expand their portfolio of services into three tiers. At the Tier I level is the California Youth Energy Services (CYES) program, where youths are trained in basic home energy auditing and non-invasive energy saving strategies, such as changing to efficient light bulbs. Tier-II targets young adults ages 18-35 with barriers to employment, and teaches them how to conduct a comprehensive home energy audit under the Green Energy Training Services (GETS) program. GETS- graduated inspectors will provide consultation services to residential BSI clients interested in energy efficiency upgrades and solar technologies. Tier-III, or High Performance Homes (HPH) provides homeowners with the most comprehensive audit and suite of upgrades, including insulation, duct sealing and pipe wrapping. HPH graduates will conduct site inspections of properties where energy efficiency upgrades are planned, and may possibly do upgrades for BSI customers. BSI customers participants may choose HPH upgrades, or they may choose a combination of HPH services and more complex California Building Performance Contractors' Association upgrades.³¹ RSEC is a potential service provider organization under the BSI.

- Quantum Energy Services and Technologies (QuEST): QuEST is an engineering and research firm in Berkeley that specializes in energy efficiency upgrades to large commercial entities. QuEST has been providing consultations, faster access to financing, and recommendations for further resources for hospitals, hotels and other large commercial buildings since 2002, as part of the East Bay Energy Watch partnership with PG&E.. CESC will refer large commercial clients that could benefit from energy efficiency audits and implementation assistance to QuEST.
- Build It Green (BIG): Build It Green has recently launched the GreenPoint Rated Existing Home Program, a green building standard for existing homes or homes undergoing renovations. The program will verify green attributes of the whole home or components of homes under the Elements program. Diagnostic energy efficiency testing, water efficiency upgrades and construction and demolition debris (C&D) recycling are prerequisites for participation in the program.
- All external stakeholders will take advantage of program trainings through East Bay Energy Watch as appropriate.

Services

The main goal of the Berkeley Solar Initiative is to provide access to credible, trustworthy information in one convenient location. The BSI will achieve this goal by providing consultations tailored to each customer via the service provider. Besides offering technical and program information to customers, the BSI launch outreach campaigns to spur more demand and customer enthusiasm in the program via the program administrator. The total services under the BSI will include:

- General outreach and education: The BSI program administrator and service provider organizations will plan strategic outreach events and educational campaigns to encourage property owners in the City of Berkeley to participate in the Solar Initiative. These activities will include presentations at local environmental events, interviews on radio

³¹ All CYES Tier III upgrades will be inspected and verified by a CBPCA contractors

stations, press releases to local media, regular updates to the BSI website, and timely responses to inquiring property owners.

- Solar map: The City of Berkeley is partnering with CH2M Hill to develop a web-based solar mapping portal. This will assist property owners in assessing the overall PV potential of their property while promoting this technology's use to residents and businesses. This portal uses a methodology with specialized algorithms to efficiently generate detailed models used to calculate solar PV production potential for specific locations. Combined with a web-based solar mapping portal, businesses and residents of Berkeley will have a single place to access solar PV production potential for their respective buildings.
- Sample Bid Forms: The service provider organizations shall create sample bid forms to collect information from competing contractors. The bid forms are intended to aid service providers in assessing bids for the customers by collecting similar information from all bidders. Information collected on the sample bid forms will include but not be limited to: contractor organization, licenses and certifications, years' experience, system price, service price, applicable rebates and timeline.
- System prototypes and fact sheets (e.g., flat, tilt, siphon, pump, etc.): The service provider organizations shall collect and provide fact sheets on the most up-to-date solar technologies to help customers select models. The resources providing such information may include but will not be limited to the following organizations:
 - California Solar Energy Industries Association (CALSEIA)
 - The California Solar Initiative
 - The U.S. Department of Energy's Energy Efficiency and Renewable Energy Consumer Guides
 - The U.S. Department of Energy's National Renewable Energy Laboratory fact sheets
 - Southface Energy Institute
 - PG&E and Flex Your Power fact sheets
 - Various private industry fact sheets

If existing fact sheets are found to not adequately present the most germane information on solar technologies, the service provider organizations will craft fact sheets to fit the customers' needs.

- Assist Customer with Portfolio Choices: Service provider organizations will encourage customers to understand the most cost-effective solar installations in light of their usage and needs, and also encourage them to install energy efficiency measures that would improve the cost-effectiveness of their energy portfolio and their solar installation in particular.
- Quality Control: Service provider organizations will provide customers with assistance after the solar installation to help with trouble-shooting or intervene with the solar contractor, as needed.
- Coordination of training services for personnel: As the Berkeley Solar Initiative consultation services gain traction, the service provider organizations will need to send their employees to trainings to prepare them to give the best possible customer service. RSEC is already getting \$2 million from the East Bay Energy Watch Services, but the CESC will need funding for training under the BSI. Training provider organizations could include the following:

- CALSEIA
- Norcal Solar Energy Association
- PG&E
- California Solar Center

Benefits

The most direct benefit of the Berkeley Solar Initiative to the customer will be educational, but there may be indirect financial and quality control benefits as well. By sharing useful information on technologies and financing with the customer, they will be able to make more prudent and discerning decisions on financing packages and service providers. The Berkeley Solar Initiative will impart the following benefits to customers:

- Access to better and more complete information on technology and financing
 - Financial payback risk mitigation
 - Removal of research time hassle
 - Performance uncertainty risk alleviation
 - Cost savings through reduced utility bills
 - Potential overall cost reduction through economies of scale
 - Pride derived from participating in an innovative, forward-thinking program
-

Operational Plan

Oversight – The City of Berkeley

Initially, the role of the City of Berkeley will be to provide oversight on the Berkeley Solar Initiative, collect data, track progress and steer the initiative throughout its inception to ensure that program goals are being met in a timely manner. This role will later be assumed by the program administrator.

Once the BSI has gained traction, the City of Berkeley will meet occasionally with the program administrator and possibly with service provider representatives to collect information on goals for reporting purposes. The City of Berkeley will also respond to any inquiries from potential customers, and direct them to the appropriate service provider.

Personnel and Administrative Costs

The City of Berkeley will assume very little administrative and personnel burden from overseeing the Berkeley Solar Initiative. The staff time needed for occasional meetings and routing phone calls will be covered by existing Berkeley staff and resources, most likely the Berkeley FIRST administrator.

Administration- Program Administrator

Most program oversight and marketing and outreach services will be provided by a program administrator organization. One of the roles of this organization will be to develop the program infrastructure, including materials, policies and procedures, training plans, etc. Another role will be to maintain a database that service provider staff use to track consultations for reporting, marketing, and outreach. This database shall be a secure website accessible only to invited individuals. Authorized users will be program staff and the provider organizations handling

consultations with BSI customers. This database may be developed in conjunction with a tracking program for the new RECO and CECO ordinances. The specifications of the database are outlined under the Service Provider section.

The program administrator will also conduct all marketing and outreach under the BSI as outlined below:

Marketing

The Marketing Plan for the Berkeley Solar Initiative shall rely on both unpaid marketing and communications and paid, strategic advertising to disseminate the program's message. Since the Berkeley Solar Initiative has already received substantial media attention, the majority of marketing will rely on the current media buzz and other unpaid strategies, with moderate reinforcement from paid marketing. All marketing tasks will be conducted and facilitated by the Berkeley Solar Initiative program administrator organization.

Unpaid Marketing

Heavy reliance on unpaid media channels (in the form of news article mentions) and client upselling means that marketing material needs are relatively modest. RAEL's recommendations from the homeowner surveys concluded that only word-of-mouth marketing was needed for the first two years of the program. A significant amount of attention has been showered on the Berkeley Solar Initiative because of its use of the unique district financing program, Berkeley FIRST. Property owners in Berkeley have been informing one another on aspects of the program before the launch, based on media attention.

Indeed, the Berkeley Solar Initiative has increased property owner interest in solar technologies even before the official program launch. As previously mentioned, Build It Green analyzed the frequency of solar-related questions through their Ask an Expert (AAE) service before and after the program began receiving significant media attention at the end of 2007. In 2007, 4.6% of total questions to AAE were solar related, and in 2008 through the month of May, this figure had increased to 7%. Perhaps more tellingly, in 2007 2.5% of all solar-related questions directly addressed the Berkeley Solar Initiative, and in 2008 this figure was 12.5%, a five-fold increase. From this analysis, one can infer that the Berkeley Solar Initiative is self-marketing by media attention and conversations between property owners.

Furthermore, since many energy efficiency and solar contractors in the San Francisco Bay area will have clientele participating in the Berkeley Solar Initiative, contractors will help to spread the word in order to create more business for their companies.

Paid Marketing

Paid advertising for the Berkeley Solar Initiative will come in two formats: informative materials sent to target audiences, and press releases containing broader information sent to media outlets.

For informative marketing purposes, we will segment our target audience as follows:

- Solar and Energy Efficiency Contractors
- Homeowners
- Business Owners and Commercial Property Owners

- Public agencies
- Solar equipment product suppliers
- Builders and General contractors
- Real estate professionals

The program administrator will market the Berkeley Solar Initiative to these targeted groups through a combination of email, strategic ally communications, in-person presentations and networking, and press releases to targeted industry publications. Direct mail marketing will not be necessary since there is substantial upselling potential for getting program information to the target audience through property owner circles and contractor marketing. Direct mail places prohibitive cost and environmental burdens on the program administrators.

Email

Email campaigns will be sent to property owners, system installers and contractors, and system suppliers since these are the direct players in the program. Property owners and contractors who are on existing list-serves with the City of Berkeley or any of the provider organizations will automatically be added to a Berkeley Solar Initiative email list. BSI program staff and/or service provider organizations will send email announcements summarizing program benefits, program structure and how to join. Given client permission, program staff will add more email addresses to the Berkeley Solar Initiative list from email addresses collected from public events, callers to the BSI hotline, Build It Green Ask an Expert or Berkeley's Best Builders contacts and other sources. The emails to all of these groups shall be tailored to the interests and roles of each sector of stakeholder.

Website

All marketing campaigns and materials will direct potential customers to the Berkeley Solar Initiative program website. The website will be part of the domain of an existing website, most likely the website of the program administrator. In one to three webpages, the BSI website will provide the following information:

- Program Overview
- Program Benefits
- Participation Process
- Contact information for service provider organizations
- Contact information for Berkeley FIRST providers
- BSI news and updates

The website may be updated with case studies and model projects once the BSI is well underway. The website as well as the project database will be funded with \$68,000.000 for the first year of the program, and will subsist on an annual maintenance budget of \$40,000.00 for all remaining years.

Outreach

Ally Communications

The program administrator will work with PG&E, Alameda County and other strategic allies to publicize the BSI through their existing communication channels. In some cases, allies may be unable to share their mailing list but may be willing to send out a direct mail piece or email announcement on our behalf. In addition, strategic allies may be willing to include announcements in their regular newsletters, include links or announcements on their websites, or provide other channels. Local governments will be requested to offer program information at their building permit counters and with permit applications. We have established rapport with the following allies:

- PG&E
- General: Flex Your Power; U. S. Green Building Council, Northern California Chapter
- Public agencies: Association of Bay Area Governments, Alameda County, Contra Costa County, San Mateo County, City and County of San Francisco, U.S. EPA Region 9, California Public Utility Commission, California Energy Commission
- Solar/EE Contractors: refer to participants from contractor focus groups
- Equipment Vendors: refer to participants from contractor focus groups
- Nonprofits: California Youth Energy Services, Build It Green, Rising Sun Energy Center, SmartLights
- Real estate professionals: California Association of Realtors local chapters, Appraisers Institute
- Academic Groups: UC Berkeley Renewable and Appropriate Energy Laboratory (RAEL)
- Other organizations: Community Energy Services Corporation

In-Person Presentations

BSI staff or service provider organization staff will present and exhibit at conferences, public events, trade shows and neighborhood association meetings.

Public Relations to Media

Goals for the Berkeley Solar Initiative media effort include:

- Have a consistent and on-going effort of influencing the media to cover the Berkeley Solar Initiative's successes and the benefits of joining.
- Generate news releases, calendar items, backgrounders, and feature articles that highlight BSI's successes, through direct or indirect vehicles.
- Respond quickly to inquiries from media and marketing partners. These inquiries come from the Berkeley Solar Initiative website as well as in response to news releases and other direct communication.
- Generate four million impressions for the Berkeley Solar Initiative (Number of impressions is calculated by a BSI exposure—an article, or reference—multiplied by the circulation of the specific media.)

The primary outlet for paid advertising will be press releases to selected media and updates to the Berkeley Solar Initiative page on the City of Berkeley website. As mentioned, the majority of

marketing for Berkeley Solar Initiative will be conversations between customers and marketing activities by contractors. As such, paid media is only needed to help continue word-of-mouth momentum.

When the Berkeley Solar Initiative reaches certain program goals (program launch, pilot program participants selected, 100 properties affected, etc), the City of Berkeley will write brief press releases with summarized results of the milestone and send the releases to reputable media outlets, many of which have already published articles or featured pieces on the development of the Berkeley Solar Initiative. These media outlets could include but are not limited to:

- *The San Francisco Chronicle*
- *The Oakland Tribune*
- *The San Jose Mercury News*
- *The Contra Costa Times*
- *SF Weekly*
- *The Bay Guardian*
- *The Berkeley Voice*
- *The Daily Californian*
- *The Daily Planet*
- KPFA FM 94.1
- National Public Radio FM 91.7
- Grist.org
- Treehugger.org
- Build It Green E-news
- Other newsprint, magazine, internet and radio media

These press releases will generate informative news articles that will accurately convey the program goals and accomplishments of the Berkeley Solar Initiative at strategic times. As previous media attention has shown, these news articles and shows will generate a buzz amongst potential customers and contractors, causing an 'upselling' effect that will serve as unpaid marketing.

The program administrator will also direct callers who are potential customers to the appropriate service provider organization. This should be a minimal role in the administration, taking up to only one quarter of a support staff person's time.

Personnel and Administrative Costs

As mentioned above, the program administrator would need to account for a minimal amount of in-house administrative costs from routing potential customers to the appropriate service provider and answering basic questions.

This employee or collective team of employees would perform the following tasks:

- Respond to emails or phone calls from potential customers and route them to the appropriate service provider organization
- Meet with service provider organizations (CESC and Rising Sun Energy Group) regularly to check in on program progress, modify protocols and weigh in on the development of marketing materials
- Coordinate training
- Produce materials and tools
- Administer the overall Marketing Plan
- Prepare press release materials and be available for media interviews
- Produce outreach educational materials including brochures, PowerPoint presentations and fact sheets
- Meet with the City of Berkeley occasionally to assess goals and program progress
- Update the website with success stories and new information as necessary. The website shall be one or two pages on the existing City of Berkeley website
- Maintain an active list of participating contractors and equipment for the services under the BSI and distribute this list to the service provider organizations

We are assuming that the total resources needed to carry out these tasks would amount to one part-time employee working 20 hours a week.

Customer Service – Service Provider Organizations

The service provider organizations will interface directly with the customers under the BSI, providing individual consultations and project guidance. Service provider organizations will also track and compile project information in a database to share with the program administrator and the City of Berkeley.

Customer Service

The service provider organization will meet individually with customers to help them choose the best technology, project size and financing. One or several referral organizations could divide the customer demand by sector (residential or commercial) or by area of technology interest (energy efficiency, solar hot water or photovoltaics). Most likely, the referral organizations will divide the program responsibility by sector since some potential customers may not have decided which technologies they would like to pursue.

Once provided with a potential customer's contact information, the service provider will set up an in-person informational meeting with the customer to help plan their upgrade. The average time commitment per customer is set for two hours, though some meetings may exceed or fall short of this estimate. The service provider will ask the customer to bring materials to the meeting in order to hone the customer's interests and find the most appropriate upgrade or technology. These materials could include but are not limited to the following:

- Past electric and gas utility bills (paper copies or electronic)
- House plans
- Age or era of the house
- Orientation and roof area of the house
- Contractor bids (if at that stage)
- Results of energy efficiency audit (if available)

During the meeting, the service provider will listen to the client's interests and assess his or her materials to identify the most suitable technology package and energy portfolio. The exercises the service provider may do with the client could include:

- Technology analysis: Fully explain energy efficiency upgrades and solar energy options as they relate to the specific property. Answer any technical questions and refer the customer to other technical resources. Encourage the customer to decide on a set of technologies. If the customer has not conducted an energy audit, the service provider will encourage the customer to have one conducted and help assess the results of the audit in order for the customer to install the most cost-effective portfolio of energy efficiency measures and an appropriately sized solar project.
- Assistance evaluating installer companies or bids: Provide lists of local, licensed contractors or contractor certification companies to help the customer decide. Evaluate specific bids that the customer has already obtained based on appropriateness of technology, cost, service quality, credentials, reputation, size, responsiveness and breadth of service.
- Financial analysis: Present the customer with options for financing, including the Berkeley FIRST program. Discuss potential advantages and drawbacks of each option, including credit requirements, liens or loan securities, loan terms, interest rates and payback periods. Quantify these evaluations with RAEL's pro forma financial model or other tools and explicitly reviewing the assumptions. Thoroughly discuss available rebates and incentives and prerequisites for each.
- Discussion of benefits and potential concerns: Present the customer with benefits of the program and of the technologies, including cost savings, improved comfort, environmental benefits, and increased property resale value. If applicable, discuss potential concerns, including roof penetrations and visual impact.
- Planning for higher quality service and Professional referral: The service provider will provide the Berkeley Solar Initiative's list of participating contractors.

The customer should leave the consultation with a better idea of the upgrades or technologies that would best suit their needs, resources to learn more, professionals that can install these technologies and upgrades, and a rough financial plan that will help them comfortably fund the upgrades. The City of Madison, Wisconsin has developed MadiSun, a solar information and outreach consultation service for potential solar technology applicants in the City of Madison³². Madison's model may be used to craft protocols for BSI consultations.

Project Tracking and Documentation

In order to track projects and progress on goals, the service provider staff shall record all individual consultations in a database. The database will be a streamlined, straightforward, private website where authorized staff will fill out intake forms that compile data from each consultation. The intake forms shall include the ability to track stages of the projects from inception to completion and will be filled out by service provider organizations at the end of the consultations. The intake forms will contain fields for the following data points:

- Customer name
- Customer contact information (phone, email)
- Services rendered by BSI (discussion, financial modeling, professional referral, etc)

³² <http://www.cityofmadison.com/sustainability/City/madiSUN/>

- Date of consultation, date of installation, date of completion
- Professional referrals (California Solar Initiative, contractor lists, CBPCA, GreenPoint Rated, other professionals)
- Duration of the consultation
- Technologies and upgrades discussed and chosen
- Financing options discussed and chosen
- Contractor or installer company discussed and chosen
- Phase of project (should be able to change from 'Planning' to 'Installation' to 'Completed.')

Once an intake has been completed, the database will store the intake in a master list, which can be sorted by any of the data points above. When a project moves from one phase to another, program staff shall change the phase of the project in the database and record the date of installation or date of completion, if applicable.

The database should have the ability to compile data into reports to enable program goal tracking. Staff should be able to compile results by time period and quickly generate the number of completed projects, number of projects in installation phase, number of completed projects or total projects for a given amount of time that the user can specify. The reports shall be turned in to the program administrator or the City of Berkeley at any time.

Program staff shall compile data at given intervals in order to report goals to PG&E, the program funder under East Bay Energy Watch. In addition, old reports will be stored in a paper archive by the City of Berkeley.

Personnel and Administrative Costs

In order to successfully provide these services, the service provider organizations will need to have trained and qualified staff, and adequate time and meeting space for the consultations. According to the market analysis, 3,575 projects will occur over eleven years, or 325 projects annually. We are assuming that 50% of all applications will result in projects, which means that 650 consultations are expected every year. If each consultation lasts two hours, then about 1,300 hours of consultation time would be needed. Assuming that 35% of every employee's time will be spent doing outreach and administration and 65% of each employee's time will be spent doing consultations, the total human resources needed for consultation work would be one full-time employee working a 40 hour workweek³³. The service provider organizations will have to plan for the following qualifications, staff and capacity:

- Staff trained in Berkeley Solar Initiative program options, broad technical aspects of the relevant technologies, familiarity with installer and professional training organizations, available rebates, financial modeling using RAEL's pro forma model, and providing in-person consultations
- Staff trained in giving presentations and doing customer outreach
- Staff trained in marketing materials development, graphic design, HTML and advertising writing
- A small, uncluttered meeting space with room to spread out plans and utility bills and a space for reference literature

A computer, preferably a laptop (for pro-forma financial modeling and updating the BSI program database) with various program software

³³ Based on a 2,000-hour work year per employee with no time off.

Customer Participation Process

In keeping with the simplicity and accessibility goals of the program, the customer participation process should be very straightforward. The participation process shall be outlined on the Berkeley Solar Initiative website as well as the websites of the program administrator and the service providers.

There will be one central hotline or email service for potential customers to inquire about the program. This central resource will be run by one of the service provider organizations. The hotline or email service should be set up to be staffed by one part-time staff person. This staff person will collect baseline information on the inquirer's needs, and then answer questions or make a referral to the appropriate service provider. The baseline information collected will be as follows:

- Name
- Contact information (phone, email)
- Address
- Sector (residential or commercial)
- Program interest (energy efficiency, solar hot water, photovoltaics)

If the inquirer has questions about the program, the hotline staff should be prepared to answer questions about the mission of BSI, program accomplishments, services covered, and Berkeley FIRST. This resource is not a consultation service, so hotline staff should attempt to keep phone conversations brief and to the point.

If the inquirer is certain that they would like to participate in the BSI, the staff person will send their information to the appropriate referral organization, and the referral organization will respond to the potential customer within 2-3 business days to help them progress on their project.

Financial Plan and Timeline

Program Budget

The Berkeley Solar Initiative will rely on funding from several public agency grants. The primary monetary source for the BSI is the U.S. Department of Energy, which is providing \$200,000 for program design and initial operations; the City of Berkeley is providing another \$80,000 in cash match. \$52,000 of the \$280,000 will have been used by the time this Business Plan is released. The remaining \$228,000 will cover the first year costs of the BSI. The balance of the first year budget and the full amount of subsequent years operating budget will be sought from PG&E through the EBEW. Note that the City of Berkeley has secured technical assistance from the NREL Tiger Team through DOE support and separate funding from the US EPA and the Bay Area Air Quality Management District for development of the FIRST program, which will be integrated into the BSI program. For the succeeding years, we will assume a steady source of funding of \$150,000 to \$200,000 from other public agencies. The additional \$28,000 the first year will be used to draft the BSI website and project tracking database. To draft this budget, we made the following assumptions:

- The administrative burden on the City of Berkeley will fall under the auspices of the Berkeley FIRST Coordinator. The Berkeley Solar Initiative funding will not cover the salary of this employee, as this is covered under the FIRST business plan, but this budget does include \$800 per year to the City of Berkeley for equipment.
- CESC and REREC will need funding for staff training.

- For the eleven years of the program until 2020, we are assuming that there will be a total of 3,575 successful installations from both the commercial and residential sectors, encompassing both solar technologies. Assuming that one half of all consultations will result in an installation, we will assume that 7,150 consultations will be held over eleven years, averaging 650 consultations per year. We will assume an average of 650 consultations per year throughout the duration of the program.
- The average consultation time will be two hours. Consultations that result in installations will probably take longer, as ample time will be needed to evaluate bids, discuss technical aspects of the installation and run a financial analysis. Consultations that do not result in an installation will take less time. The total hours per year spent on consultations will be 1,300 hours per year.
- The total workload required to conduct consultations for the service provider organization will amount to one full-time employee, assuming the employee works 2,000 hours per year and that slightly over half the workload amounts to consultations and the remainder will be spent doing data entry and administrative tasks. In reality, this workload may be shared over several employees who also have other roles, since several organizations are currently candidates for program implementation.
- The service provider full-time employee will perform at a level of expertise that warrants a salary of \$60,000.00 per year. \$35,000 per year in wages will be allocated to the part-time work of administrating the BSI.
- The total workload required to conduct marketing and outreach, and provide direction on development of the BSI database and website at the program administrator organization, will be one part-time employee working 20 hours per week with an equivalent full-time salary of \$70,000.00 per year.
- For all salaries under the BSI, benefits will be 30% of the salary. Payroll taxes will be 15% of the salary.
- The BSI website and project database will require an annual budget of \$40,000.00 to revise and maintain. For the first year of the BSI, \$68,000.00 will be used to build the website and database.

The first balance sheet below projects the program budget per year for the first year of the program. There is about \$28,000.00 more allocated for the first year than for all subsequent years since the initial website and marketing costs will be greater in the first year.

The second balance sheet projects costs for all subsequent years of the program, 2010 through 2020. Note that this balance sheet does not include inflation. In order to capture inflation, costs should rise an average of 5.5% annually.³⁴

³⁴ Taken from U.S. Department of Labor Statistics, inflation calculator. The 2007-2008 inflation rate was 5.5%. Assume this stays constant for the duration of the program. http://www.bls.gov/data/inflation_calculator.htm

Berkeley Solar Initiative Budget 2009

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Oversight- City of Berkeley					
Equipment	200	200	200	200	\$800
Personnel Total	\$200	\$200	\$200	\$200	\$800
Program Administrator					
Salaries, wages	8,750	8,750	8,750	8,750	\$35,000
Benefits	2,625	2,625	2,625	2,625	10,500
Payroll taxes	1,313	1,313	1,313	1,313	5,252
Commissions and bonuses					0
Personnel Total	\$12,688	\$12,688	\$12,688	\$12,688	\$50,752
Service Providers					
Salaries, wages	15,000	15,000	15,000	15,000	\$60,000
Benefits	4,500	4,500	4,500	4,500	\$18,000
Payroll taxes	2,250	2,250	2,250	2,250	\$9,000
Equipment	1,000	500	500	500	2,500
Training (CESC only)	1,000	1,000	1,000	1,000	4,000
Personnel Total	\$23,750	\$23,250	\$23,250	\$23,250	\$93,500
Marketing Communications					
Marketing Research	200	200	200	200	\$800
Product Development	2,000	1,000	1,000	1,000	5,000
Printing	600	200	200	200	1,200
Web sites and Database	17,000	17,000	17,000	17,000	68,000
Press relations (aside from BSI personnel salary)	800	500	500	500	2,300
Public relations (aside from BSI personnel salary)	800	500	500	500	2,300
Events (aside from BSI personnel salary)	800	800	800	800	3,200
Marketing Communications Total	\$22,200	\$20,200	\$20,200	\$20,200	\$82,800
Total BSI Budget	\$58,838	\$56,338	\$56,338	\$56,338	\$227,852

Berkeley Solar Initiative Annual Budget 2010-2020

	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Oversight- City of Berkeley					
Equipment	200	200	200	200	\$800
Personnel Total	\$200	\$200	\$200	\$200	\$800
Program Administrator					
Salaries, wages	8,750	8,750	8,750	8,750	\$35,000
Benefits	2,625	2,625	2,625	2,625	10,500
Payroll taxes	1,313	1,313	1,313	1,313	5,252
Commissions and bonuses					0
Personnel Total	\$12,688	\$12,688	\$12,688	\$12,688	\$50,752
Service Providers					
Salaries, wages	15,000	15,000	15,000	15,000	\$60,000
Benefits	4,500	4,500	4,500	4,500	\$18,000
Payroll taxes	2,250	2,250	2,250	2,250	\$9,000
Equipment	1,000	500	500	500	2,500
Training (CESC only)	1,000	1,000	1,000	1,000	4,000
Personnel Total	\$23,750	\$23,250	\$23,250	\$23,250	\$93,500
Marketing Communications					
Marketing Research	200	200	200	200	\$800
Product Development	2,000	1,000	1,000	1,000	5,000
Printing	600	200	200	200	1,200
Web sites and Database	10,000	10,000	10,000	10,000	40,000
Press relations (aside from BSI personnel salary)	800	500	500	500	2,300
Public relations (aside from BSI personnel salary)	800	500	500	500	2,300
Events (aside from BSI personnel salary)	800	800	800	800	3,200
Marketing Communications Total	\$15,200	\$13,200	\$13,200	\$13,200	\$54,800
Total BSI Budget	\$51,838	\$49,338	\$49,338	\$49,338	\$199,852

Program Timeline

The Berkeley Solar Initiative will adhere to the following timeline, providing deliverables to funders by the target dates listed below:

August 2008 – Finalized Berkeley Solar Initiative Business Plan is turned into the Department of Energy for review.

October 24, 2008 – Berkeley FIRST financing plan is launched.

November 2008 – Roles and responsibilities of participating organizations in the Berkeley Solar Initiative are defined.

December 2008 – Berkeley Solar Initiative personnel are identified and trained.

January 2009 – Berkeley Solar Initiative officially launched. All consultations conducted by service provider organizations are counted under the BSI.

January 2009 – March 2009 – BSI program materials and tools are developed.

August 2009 – Berkeley FIRST pilot close-out. All pilot projects are tracked under the Berkeley Solar Initiative database. Berkeley FIRST launches full-scale program.

Quarterly thereafter – Program administrator collects reports from the service provider organizations, compiles them and turns them into the City of Berkeley and/or BSI program funders.

December 2009 – BSI Pilot Project close out and final report to funders.

Auxiliary Reports

Finance White Paper

Development of Finance Mechanisms
Background for the Berkeley Solar Initiative

DRAFT

Executive Summary

The purpose of this background paper is to explore viable financial mechanisms for the City of Berkeley Solar Initiative (BSI). The Berkeley Solar Initiative will combine energy efficiency upgrades and renewable energy generation in a streamlined delivery package to customers within the City of Berkeley, CA. The primary goals of this program are to reduce up-front costs to the participants, inform and advise participants through the upgrade process and ensure quality installation and operation of the technologies. The BSI will stimulate the local energy efficiency and renewable markets, making these energy-saving technologies more affordable in the long-term. This paper presents the data needed to explore available financing options and find the most feasible way to reduce up-front costs to the customer without causing any negative market effects.

The first part of this paper investigates existing financial mechanisms, incentives and barriers that will influence the financial scheme chosen for this project. The second part of this paper explores and evaluates potential financial models suggested by the BSI planning team. These potential mechanisms will be evaluated within the context of the existing mechanisms, the client's needs, the current market and the scope of the project to determine viability.

The existing financial mechanisms making up the policy and regulatory climate are the Federal Residential Solar and Fuel Cell Income Tax Credit (Federal ITC, the Energy Efficient Mortgage Program through the Federal Housing Administration, and the Residential Energy Conservation Subsidy Exclusion.

The potential financial mechanisms explored are direct incentives to contractors, direct incentives to property owners, low-interest loans, district financing, equipment lease, power purchase agreements and bulk equipment purchase agreements. The basis for the analysis includes the scope and budget of the BSI, feedback from potential customers from a survey administered by UC Berkeley's Renewable and Appropriate Energy Laboratory (RAEL), contractor focus groups and other parameters.

According to a 2002 renewable energy case study conducted by RAEL, a successful financing mechanism for high capital cost renewable energy technologies contains as many of the following four attributes as possible:

- 1) Long term: at least a 10 year loan period
- 2) Low interest rate: below that of a 30 year second mortgage
- 3) Low hassle and administrative fees
- 4) Unsecured: no debt provisions or added liens on the property

The selected financial mechanism will attempt to achieve these attributes in order to deliver the best benefit to the customer.

Existing Finance and Incentive Mechanisms

Federal

1) Residential and Business Solar and Fuel Cell Income Tax Credit (IRS)

a. Mechanism structure

With the Residential Solar and Fuel Cell Income Tax Credit (ITC), applicants receive an income tax credit of up to 30% of the cost of a residential photovoltaic or solar water heating system, capped at \$2,000. This tax credit is set to expire for both homeowners and businesses in December 2008. Applicants with both a PV system and a solar hot water system can apply twice. For PVs and solar hot water systems, the credit applies to all associated labor, onsite preparation, assembly and modification to the current electrical or heating system. The credit does not cover the actual price of the equipment. In order to be deemed eligible for the solar water heating system credit, the applicant's property must be certified by the Solar Rating and Certification Corporation or other organization endorsed by the state. At least half of the water heated for the home must come from the solar hot water system, with pools and hot tubs exempt.

b. Participatory Barriers

Aside from logistical and organizational barriers that are inherent to tax credits, the main barrier to this program is that the Federal credit covers expenditures excluding any additional subsidized energy financing, which is defined as "financing provided under a Federal, State, or local program a principal purpose of which is to provide subsidized financing for projects designed to conserve or produce energy."³⁵ Thus, if the consumer can only use the ITC for renewable energy costs that are not under additional subsidized programs. The IRS defines "subsidized" as an incentive mechanism or loan interest rate that is more appealing to the customer than other commercially available financial mechanisms. If the financial mechanism chosen by the Berkeley Solar Initiative meets this definition of "subsidized," and this financial mechanism covers the total system and installation cost, then the Federal ITC would not be available to the participant. There is an effort underway to seek a waiver from the IRS that would allow the ITC to be taken with a low-interest rate District Financing mechanism. It should be noted that the Federal ITC as it currently stands will expire at the end of 2008. Congress is considering renewing the credit for further years, but if no changes are made, the ITC will become defunct in 2009.

c. Incentives

The primary incentive is to reduce total system costs to the participant for expenditures associated with installing a PV or solar water heating system. The participant will realize delayed benefits as they will get the credit during income tax assessments and must still initially pay for the system in its entirety, but the ITC still significantly reduces total system cost. Additionally, if the credit exceeds tax liability, the remainder carries over to subsequent years, allowing lower tax bracket consumers equivalent benefits.

³⁵ IRS Form 5695: Residential Energy Credits: <http://www.irs.gov/pub/irs-pdf/f5695.pdf>

2) Renewable Energy Production Incentive

a. *Mechanism structure*

The Renewable Energy Production Incentives (REPI) are rebate incentives offered to new renewable energy production facilities. Both solar hot water and photovoltaic systems can qualify for this rebate of 1.5 cents per kilowatt hour of power produced. This incentive is available to nonprofits, public utilities, state governments, Commonwealths, territories, possessions of the United States, the District of Columbia, Indian tribal governments, or a political subdivision thereof and Native Corporations. The rebate can only apply when the electricity is provided to another entity.

b. *Participatory Barriers*

The main participatory barriers are that this credit could only feasibly apply to nonprofit energy cooperatives in Berkeley, being as there are no other public agencies in the City that could qualify. Private businesses could not legally take this credit.

3) Energy Efficient Mortgage (FHA)

a. *Mechanism structure*

The Federal Housing Authority's Energy Efficient Mortgage program offers dual benefits to low and moderate-income homeowners by insuring them for loans for which they may not be eligible otherwise, and allowing home performance upgrades to be wrapped into these loans. EEMs will allow lenders to cover up to 100% of energy efficiency measures on loans to on new or existing homes up to 5% of the home's appraised value or \$4,000.00, whichever is greater, capped at \$8,000.00. Essentially, this mortgage loan covers the up-front costs of energy efficiency upgrades by projecting and leveraging savings on energy bills. The interest rates on these FHA loans tend to be higher than commercial loans, but downpayments are typically lower, as little as 3%. The total cost of the improvements must not exceed the total projected savings over the useful life of the system, and these figures must be confirmed by a HERS rater or other qualified consultant. Borrowers must qualify for the FHA's popular Section 203(b) fixed-rate mortgage loan. There are capped mortgages for every county in every state. The lending limit for Alameda County, CA is \$729,750.00 for a single family home³⁶.

b. *Participatory Barriers*

The primary barrier for participating in EEMs is the income requirement mandated by FHA Section 203 (b). To ensure that these loans will go to low or moderate-income participants, the FHA has placed caps on dollar values of homes that can be eligible, striated by state and county. Alameda County's lending cap has just been increased by almost \$400,000.00 to a total of \$729,750.00 to increase the number of eligible candidates for these loans. By financing a greater portion of the home than most loans, and by insuring the loan, the FHA program helps avoid homeowner defaults, a growing crisis in the recent real estate market.

c. *Incentives*

This program eliminates the need for homebuyers or homeowners to take out additional mortgage loans to finance the up-front costs of energy efficiency measures. Energy Efficient Mortgages increase the buying power of purchasing an energy efficient home by allowing the lender to increase the borrower's income by a dollar amount equal to the

³⁶ As of March 28, 2008. http://www.fha.com/lending_limits_state.cfm?state=CALIFORNIA

estimated energy savings, thereby qualifying the borrower for a larger loan than they would be able to get otherwise.

State

1) The California Solar Initiative (PUC and CEC)

a. Mechanism structure

Financial

The California Solar Initiative's Million Solar Roofs program has set aside \$3.3 million of state revenue to generate 3,000 MW of solar energy capacity by the year 2017. The program targets existing homes and commercial spaces through the CPUC's California Solar Initiative and new homes through the New Solar Homes Partnership, run by the CEC. Currently, the residential incentives are for single-family residences, but there are proposals under review for multifamily and low-income family rebates. The PUC portion of the CSI will be administered through the regional investor-owned utilities: PG&E, SCE and SDG&E³⁷. PG&E currently oversees 43.7% of the CSI budget, a total of \$946 million. The budget for CSI is paid entirely by investor-owned utility electric customers.

Under the PUC program, incentives are divided into expected performance-based buydown incentives (EPBB) -or one-time payments- for smaller systems and performance based incentives (PBI), to be paid monthly over a period of five years for larger systems. Customers on the EPBB scale (less than 50 kW) will receive one rebate of up to \$2.50 per watt based on expected performance, evaluated through a multitude of factors including equipment ratings, orientation, installation factors, tilt and shading. Most residential systems will EPBB. The PBI system is a flat-rate cents-per-kilowatt-hour based payment disbursed monthly. The starting PBI rate \$0.39 per kilowatt-hour for systems generating between 50 kW and 1 MW³⁸, and for all building-integrated photovoltaic systems. The actual incentive that the customer receives is adjusted for the design correction and a geographic correction, which are ratios of actual output and orientation compared to an optimal measure of output and orientation for the system³⁹. These ratios are then multiplied against the step incentive, to give the customer the total eligible incentive. All solar systems must install separate metering devices in order to be eligible. In 2010, all systems greater than 30 kW must receive performance-based rebates.

Since more solar systems are expected to be installed over the next 10 years, the California Solar Initiative has designated an incentive reduction schedule based on quantity of systems installed statewide. The decreasing incentive rates are based on a series of 10 steps representing increasing capacity of solar power. Incentives vary according to the utility in which the system is located. As of July 2008, PG&E is in step 4 for residential solar systems, meaning there are 130 MW installed in the territory, and customers can receive \$1.90 per watt under the expected performance system and \$0.26 per kWh on the performance-based system. SCE is in step 3, where there are 70 MW

³⁷ Starting in 2008, the publicly-owned utilities must enact their own programs under CSI.

³⁸ Performance-based cutoff levels effective January 1, 2008. Prior cutoff levels were 100 KW systems. (CSI Handbook Section 1.4.2)

³⁹ Calculated by the Expected Performance-Based Buydown calculator: <http://www.csi-epbb.com/>

installed and customers can receive \$2.20 per watt under the expected performance system and \$0.34 per kWh under the performance based system⁴⁰. Under CSI, customers can opt for flat rates or time-of-use rates from their utility. PG&E has just adjusted their time-of-use rates to be more solar-friendly.

Until recently, the PUC program only provided incentives for solar electric systems, but on December 20, 2007, the program was expanded to include solar systems that displace electricity, designated as solar thermal, solar forced air heating and solar cooling and air conditioning technologies⁴¹. These technologies are being evaluated for their capacity to displace electric power for inclusion in EPBB and PBI programs under CSI. The expansion to solar thermal would include only systems that displace electricity, not gas.

The California Energy Commission's New Solar Homes program under the CSI provides rebates to customers in new construction, including single family, multifamily, affordable housing and residential portions of new mixed use housing.

Home Requirements and Auditing

Starting January of 2007, all participants in the CSI must undertake an energy audit of their home in order to confirm compliance with baseline energy efficiency requirements. Accepted audit formats are online or phone protocols, but utilities can opt for more extensive audit formats. Customers are exempt from conducting the audits if the customer 1) has had a home energy audit from a local utility, independent consultant or HERS rater in the last three years, 2) can provide documentation of Title 24 energy compliance from within the last three years⁴² or 3) is certified through Leadership in Energy and Environmental Design (LEED) or Energy Star. Details on PG&E's home energy requirements are outlined in the Local/Jurisdictional existing mechanisms section.

Utility program administrators will inspect all EPBB systems between 30 kW and 100 kW to ensure that the system is operational and interconnected. For systems under 30 kW and for PBI, utility program administrators will conduct random sampling inspections.

Customer, Installer and Equipment Requirements

The customer must be in the territory of or receive service from the investor-owned utilities PG&E, SCE or SDG&E. The customer is designated as the Host Customer and the System Owner (unless the equipment is leased) and will appear on all the documentation and contracts with the utility. The applicant, however, can be the Host Customer or a third party, such as the installer.

Application Process

In order to apply for the program, the customer must work with their solar installer to initially apply for the rebate by submitting a Reservation Request including a description of the system, electrical sizing documentation and other information. The participating utility then evaluates the application, deems eligibility and sets aside funds for the applicant. The utility then sends a reservation confirmation. If the project is PBI or non-residential, the customer and installer then have 60 days to provide "adequate proof of

⁴⁰ Rates determined by the CSI Statewide Trigger Point Tracker: <http://www.csi-trigger.com/>

⁴¹ CPUC Energy Division Resolution E-4131

⁴² For residential customers: Title 24 CF-1R form; for commercial customers, one or more of the following forms: ENV-1-C, MECH-1-C, LTG-1-C, OLTG-1-C. Only Certified Energy Plans Examiners (CEPE) or California Association of Building Energy Consultants may provide documentation.

progress” towards installation to the program administrator at the utility. Upon receipt of the reservation confirmation, the customer has 12 months to install the system and submit an Incentive Claim Form, including cost documentation, in order to hook the system up to the grid and receive the rebate. Non-residential customers must pay an application fee of 1% of the requested amount.

PG&E administers the CSI under PG&E the electric customer territory. PG&E has divided the process into six steps:

- 1) Conduct an energy audit PG&E requires an energy audit before applying for the CSI, either over the phone or through their web program, Energy Analyzer. Customers are exempt from the audit if they meet the exemption requirements listed in the CSI section above. Currently, there is no action required on the audit, though action is recommended.
- 2) Choose an installer to do a site survey PG&E requires that customers work with an installer to determine the best system for the site. Installers must be listed and certified by the CEC, but there are no further restrictions.
- 3) Complete the CSI Application Customers must enter into an Interconnection Application Agreement with PG&E. PG&E requires a Net Energy Metering (NEM) application to fulfill this requirement, and has a standard form for systems under 30 kW and an expanded form for systems over 30 kW. Customers can either elect a flat-rate metering rate or a time-of-use rate. New customers planning their systems after January 1, 2008 will have to pay reprogramming fee of \$228.00 if they elect PG&E’s time-of-use rates: the E7 or newer E6 schedule. The standard NEM application includes a standard form application, a drawing, a building department permit and a fee, if applicable. PG&E will inspect for the NEMs and install the grid-connected meter for the customer, though the customer must pay for the meter. Once the application is received, PG&E will interconnect within 30 days.
- 4) Final Building Inspection If the customer’s local jurisdiction requires a building inspection, PG&E requires that this must be conducted before the utility on-site inspection.
- 5) Final Utility Inspection PG&E will conduct a free, on-site inspection of the system before the CSI rebate can be claimed. As the CSI mandates, PG&E inspectors will inspect all systems between 30 kW and 100 kW, and randomly inspect systems under 30 kW. The only protocol requirement of these random inspections is that they be “statistically reasonable.” Per the guidance of the CPUC, PG&E inspects one out of every seven systems under 30 kW. PG&E inspectors ensure that the design factor, tilt, orientation, shading and azimuth match the specifications in the EPBB calculation, and that the system is operational. All field inspections are performed by PG&E staff
- 6) Claim Incentive The customer can then submit the CSI Incentive Claim form to PG&E.

b. Participatory Barriers

The CSI contains a number of eligibility restrictions which can discourage participation. CSI requires that total incentives do not exceed total project costs, so all applicants must provide paperwork of all other financial incentives. Deductions are made to CSI incentives only when customers are receiving incentives for the solar system that

are funded by investor-owned utility ratepayers. The CSI Handbook gives utility or CEC programs as examples of incentives that would be deducted, and Federal and state incentives as those that would not be deducted. If the customer is receiving federal and other state incentives, the CSI remains the same, unless the other incentives cause total incentives to exceed total costs. Total eligible costs include the capital cost of the system, engineering and design costs, construction and installation costs, interconnection, permitting, sales tax and use tax.

The main participatory barrier under PG&E's interconnection requirement is the reprogramming fee of \$228.00 to join the time-of-use net energy metering system from a standard net metering system. However, the new rates will benefit the customer over time, which may eventually pay for the reprogramming fee. In addition, all customers must pay for monitoring of their systems under the Performance Monitoring and Reporting Service (PMRS) at the customer's expense for five years. For systems under 30 kW, the cost of performance monitoring over five years must not exceed 1% of the cost of the system, and for systems over 30 kW, the performance monitoring over five years must not exceed 0.5% of the cost of the system, and if the customer can prove that the PMRS service would exceed the cost cap, the customer is exempted from this requirement. The CEC maintains a short list of approved PMRS service providers, and the customer must contact an organization from the list in their area.

c. Incentives

Incentives for customers include reduced cost of operation of PV panels, which will help assuage the additional up-front capital costs of the system. EPBB Customers who install systems of less than 50 kW will realize savings more quickly than PBI customers who have installed systems of greater than 50 kW, since the former customers still receive a one-time up-front cash rebate, while the latter will experience more incremental savings, as their rebates will be paid in monthly parcels. PBI customers will have a greater incentive to focus on efficiency, maintenance and long-term performance of their systems. In addition, recent modifications to the program have removed all insurance-related eligibility requirements except those associated with installation⁴³.

When PG&E customers agree to interconnect, they must select an otherwise applicable rate schedule, which determines what rate (\$/kwh) they will be charged for additional grid usage, and how much credit they will receive when exporting power to the grid. When the customer is generating more power than they are using, the meter runs backwards, subtracting total kW hours. When the customer is using more power than they are generating, the meter reading increases. If at the end of the month, the customer is a net energy user, they first pay a baseline rate, which is the lowest possible rate capped at a certain level, and then TOU rates, if applicable. If the customer is a net energy generator at the end of the month, the excess energy will carry over as a credit to the next month, valued at the TOU rate during which the energy was generated. The higher the TOU rate during generation, the more credit gets carried over to the account for the following month. All accounts are zeroed at the end of the year, and surplus generation disappears, regardless of the use rate of the generator. Currently, PG&E customers can opt to select a time-of-use rate, which charges more for peak electrical usage hours. As of January 1, 2008, PG&E customers enrolling in CSI will have their time-of-use rate schedules change from EL-7 to EL-6 and from E-7 to E-6. E-7 and E-6

⁴³ Included in the CA Solar Initiative Public Forum, hosted by PG&E. January 17, 2008.

are the residential time-of-use rates for PG&E customers. The time-of-use rates EL-6 and E6 were designed to be responsive to the needs of residential solar generators. The new rates will have a high differential between peak and off-peak times, in addition to a shoulder peak, where those generating in the morning will receive a partial peak rate rather than an off-peak rate. This is an important shift, as generation in the morning under E7 considered off-peak, and could not accumulate as much credit. It may be too soon to determine whether or not these new rates will prove an incentive, but PG&E is actively marketing them to potential solar customers.

2) CSI- Pilot Solar Hot Water Heating Program

a. Mechanism structure

In January 2006, the San Diego Gas and Electric Company adopted a pilot program to offer utility rebates to customers installing solar hot water heating systems on their existing homes. The CPUC authorized the program as a precursor to a statewide solar hot water heating incentive program to be enacted after the pilot had closed. In October 2007, the Governor signed AB 1470, authorizing a \$250 million dollar budget to install 200,000 solar hot water heating systems under a statewide incentive program. This budget would be paid by natural gas customers of the investor-owned utilities; but the incentive would only apply to systems that displace electricity, meaning systems that are paired with a conventional electric water heater.⁴⁴

The SDG&E 18-month pilot program allocates rebates for solar hot water system installations for existing residential and small commercial customers. The goal during the pilot period was to install 750 residential systems and 20-30 commercial systems. The rebates are divided into a prescriptive method for residential and small commercial systems, and an area, or performance, method for large commercial systems. Rebates for prescriptive method systems can be up to \$1,500.00 based on expected performance, which is calculated using the SRCC OG-300 rating and a solar orientation factor for the site. The area method caps the rebates at \$75,000.00 per installation and calculates the rebates on expected performance using the SRCC OG-100 rating. The minimum energy offsets for systems to be eligible for the rebates are 60 therms for gas and 1,200 kWh for electric. All systems must contain a 10 year warranty, with warranties between one and five years on individual parts. The California Center for Sustainable Energy (CCSE), the pilot program administrator under SDG&E, will install metering devices on 100 of the residential and small commercial pilot systems for performance quality control. In addition, CCSE will inspect all systems receiving rebates. The rebates are intended for retrofit projects where the solar hot water heaters would supplement or replace existing electric hot water heaters. The incentive is a one-time payment disbursed 30 days after the system is approved. Contractors must have an A, B, C-4, C-36 or C-46 license and carry liability insurance of \$1,000,000 per occurrence or \$2,000,000 aggregate. Newly constructed homes are not eligible. The \$2.6 million dollar budget is entirely funded by ratepayers.

b. Participatory Barriers

Currently this program is only available to customers of the SDG&E, but the CPUC considers it a vehicle to evaluate potential structures of a statewide solar hot water

⁴⁴ Clarified in the CPUC's Energy Division Resolution E-4131 December 20, 2007:
http://docs.cpuc.ca.gov/PUBLISHED/COMMENT_RESOLUTION/75456.htm

heating incentive program. When the statewide program is enacted, the main barrier will be the fact that this incentive program only allows reimbursement for technologies that displace customer electric purchases from the grid, so systems that only displace gas would not be eligible for the rebate. A recorded discussion with CPUC staff on the proposed CSI revisions to include non-PV technologies included the following concern: “Currently, only solar water heating systems that displace the output of a conventional electric powered water heater are eligible for a CSI incentive. The concern is that CSI incentives may defray a very large percentage of the total system cost of a solar water heating system, thereby making it economical to switch from a natural gas to electric powered water heater and then install a solar water heater.¹¹” Since gas-fired water heaters are significantly more energy-efficient than electric water heaters as well as more common, this restriction could undermine the energy-saving intent of the CSI, and prove a participation disincentive for potential customers.

c. *Incentives*

The primary incentive of this program is that customers will receive one-time or performance-based rebates to displace the cost of energy-saving solar thermal devices. Since solar thermal systems tend to naturally pay off more quickly than photovoltaic systems,

3) Property Tax Exemption for Solar Systems

a. *Mechanism structure*

This property tax exemption applies to all systems on new homes that are “thermally isolated from living space or any other area where the energy is used, to provide for the collection, storage, or distribution of solar energy.⁴⁵” Eligible systems include both photovoltaics and solar thermal systems. The property tax exemption includes both operational equipment of the systems and the infrastructure needed to install the systems, including storage devices, power conditioning equipment, transfer equipment and parts related to functioning of those systems. The property must be evaluated by a county assessor. Currently, the California Constitution caps ad valorem taxes on real property to 1% of the full cash value of the property, an amount to be determined by the assessor. California Assembly Bill 1099 excludes the value of all active solar systems on newly constructed homes from property taxes through the end of 2008. In the words of Plant It Solar, a California-based solar retailer and advocacy group: “by law (CA Tax Code Section 73) the increased property value from a solar system installed before January 1st, 2010 is exempt from property tax. That’s right: increased property value without increased property tax. Due to expire at the end of 2005, this state property tax provision was extended through 2009.”⁴⁶

b. *Participatory Barriers*

Since taxes are based on the full cash value appraised during new construction or change of ownership, this program would only be applicable to new homes or existing homes that are being purchased by a new owner. Homeowners installing solar systems on existing homes cannot apply for the tax exemption.

⁴⁵ California Assembly Bill No. 1099 Chapter 193, section 73: http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_1051-1100/ab_1099_bill_20050906_chaptered.pdf

⁴⁶ <http://www.planitsolar.com/index.html>

Additionally, it is unclear whether participants in a District Financing plan where solar installments are paid for through property tax assessments would be eligible to take a further property tax exemption. This may be a non-issue if all participants in the District Financing program are upgrading their existing homes and not occupying new homes or changing ownership.

c. Incentives

This tax incentive would only be applicable to customers installing solar energy on their new homes or buying existing homes participating in the FIRST program.

Appendix 1: Stakeholder Definitions

- 1) PV/ Solar Thermal Installers- Contractors or organizations specializing in solar electricity or solar thermal installation, or employees of companies specializing in solar electricity or solar thermal installation. The individual must be in possession of a A,B, C-10 or C-46 license for photovoltaics and be listed on the CEC's list of approved contractors.
- 2) Contractors- contractors or organizations who would potentially collaborate on a solar installation project, as part of a larger remodel, or contributor to the auxiliary parts of a solar installation, such as a roof remodel, pre-plumbing or pre-wiring.
- 3) Property Owners- homeowners or proprietors of commercial spaces in Berkeley, CA who are potential customers of the Berkeley Solar Initiative and the CA Solar Initiative.
- 4) Lenders- Financial professionals who are potential lenders to homeowners for their solar projects.
- 5) Real Estate Professionals – Real estate agents, landlords and all other professionals involved in building sales and trades.
- 6) Local Government Contacts- local government or state employees other than those employed by the City of Berkeley
- 7) City of Berkeley- employees of the City of Berkeley
- 8) Appraisers- a professional building appraiser who evaluates homes and commercial spaces for tax purposes. These individuals could be public or private employees.

Appendix 2: Analysis of Potential Finance Mechanisms

Direct Incentives to Contractors

a. Mechanism Structure

This financial mechanism would be in the form of rebates or subsidies routed directly from the City of Berkeley to contractors to finance solar technologies for property owners. These would be defined as a set price cap or percentage of the cost of the system, capped at a certain price. Since contractors would broker directly with the City of Berkeley, property owners would not need to front any costs for future reimbursement. These direct incentives would not include third party lenders. The City could potentially fund these incentives through bonds or tax hikes, but there would be no eventual reimbursement to the City from the contractors or the property owners.

b. Stakeholders and Roles

1) Property Owners

i. Risks

The risks to property owners would be minimal, since a portion of their installation costs would already be paid by the time the contractor bills for the work. The only risk to property owners would be that the contractor screening process would fall on the City of Berkeley, and if there are not proper quality controls in place, the property owner could fall victim to inferior installation.

ii. Benefits

The benefits to property owners would be great, as the participants would have all or most of the system costs covered, and enjoy the benefit of not having to pay a principal and interest rates on a long-term loan.

If the incentive is routed directly to the contractor, then the responsibility for applying for this incentive would fall on the contractor, and the property owner need only to arrange the installment with the contractor.

2) PV/ Solar Thermal Installers/ Contractors

i. Risks

There would be no regulatory risk to the contractor for a direct incentive. The only potential restriction would be any system or auditing protocols placed on the contractors by the City of Berkeley.

ii. Benefits

The benefit to contractors would be a streamlined, basic reimbursement mechanism from the program administrator. Ideally, they would not experience a delay in fund reimbursement, as they might for conventional installations using commercially available financing, and receive payment as soon as they begin the installation.

3) The City of Berkeley

i. Risks

The City of Berkeley assumes the greatest risk in providing direct incentives to contractors, since there is no assurance of quality of installation. To minimize risk of corruption or inferior work, the City would need to structure this incentive carefully to ensure that the contractor is installing operational systems to meet the expectations of the City and of the property owner, or that the funding would only be provided after adequate work has been completed and audited.

ii. Benefits

There would be little benefit to the City of Berkeley, other than the fact that this incentive program would be easy to sell to contractors. The only benefit to this would be that the City could presumably set up a rigorous screening process for contractors so that only the most reputable could receive incentives. There also may be less administrative burden on the City than with other incentive programs such as the district financing, since there are fewer parties involved with direct incentives.

Direct Incentives to Property Owners

a. Mechanism Structure

Direct incentives to property owners would be in the form of rebates or subsidies that the City of Berkeley would route directly to property owners to finance their energy efficiency

upgrades and solar systems. These would be defined as a set price or percentage of the cost of the system, capped at a reasonable price. These direct incentives would not include long-term loans or third-party lenders.

b. Stakeholders and Roles

1) Property Owners

i. Risks

The main financial risk to property owners is that they would have to deduct this direct incentive from their Federal ITC, since direct incentives would be considered “subsidized energy financing” from a local jurisdiction⁴⁷. As discussed in the Federal ITC summary, if Berkeley’s program offers a more appealing finance mechanism than those available commercially, then the City’s program shall be considered subsidized and the Federal ITC would not be an option. Of course, this point would be moot if the Federal ITC is not renewed by Congress for 2009. A direct rebate would definitely be more appealing than commercially available incentives, since the property owner would not have liens placed on the property, and would not have to pay interest on a loan.

ii. Benefits

The benefits to the property owner would be a reduction in the capital costs of purchasing and installing a solar system, but this may be tempered by the deduction of the personal Federal tax credit. Even if this direct incentive would preclude participation in the Federal tax credit, property owners would still see it as advantageous, since it would be a direct relief from the initial cost.

2) PV/ Solar Thermal Installers/ Contractors

i. Risks

The risks to contractors would be minimal if property owners receive direct incentives, since the financial standing of the property owner would improve as a result of the incentive and the risk of non-payment would be lessened.

ii. Benefits

Since these incentives would presumably go to property owners who have already been pre-approved for the solar systems (i.e. they’ve had the necessary energy audits and may have already applied for the CSI), the risks to contractors would be lessened since the customer would be further invested and prepared for a solar system than other customers just beginning the process. This level of preparedness would attract contractors to become pre-approved for Berkeley’s program.

3) The City of Berkeley

i. Risks

The City of Berkeley would take on a hefty financial burden in offering direct incentives to property owners since city funds would have to back the financing for these incentives. The City could potentially come up with these funds by enacting a bond program or by raising property taxes, but it would be difficult to quantify or project how many funds the City would need. Since the administrative burdens on property owners would be low, it can be assumed that many

⁴⁷ According to IRS Code Section 136 Energy Conservation Subsidies Provided by Public Utilities, an energy conservation subsidy can be in a direct or indirect form, and ‘public utilities’ include local government agencies. http://www.taxalmanac.org/index.php/Internal_Revenue_Code:Sec.136_Energy_conservation_subsidies_provided_by_public_utilities

people would want participate in this option, and the City may risk not allocating enough funds. If this system is not structured judiciously, the City could be at risk for litigation by property owners, if they have already partially financed their systems and the City runs out of funds. The City could avoid this issue by only providing funds after the system has been installed, or by providing the property owner with a percentage of funds in the beginning, and the remainder once work has been completed and audited.

The perception risks to this option would be high for City officials since they would have to sell this idea to taxpayers who would not be affected by the Solar Initiative. The bond program, tax hike or other fund allocation mechanism would receive resistance from those property owners not interested in becoming solar customers, or who have already installed solar or done energy efficient upgrades on their properties. Additionally, all administrative burdens to direct incentives would fall on City officials, requiring a maximum amount of staff and resources to implement the program.

ii. Benefits

The main benefit to City officials in enacting this program would be that it would be an easy sell to potential solar customers. However, this would not be outweighed by the added administrative burden on the City.

Low-Interest Loans

a. Mechanism Structures

Low interest installment loans would allow customers to purchase solar systems at interest rates equivalent to or below market interest rates for similar loans. The lenders would most likely be private financial institutions partnering with the City of Berkeley. These loans would be repaid through an adjusted property tax assessment through Berkeley's district financing model, through a home equity line of credit or through another consumer loan. The monthly installments would be paid to an approved financial institution or directly to the City of Berkeley partnering with financial institutions.

The loans could be designated secured or unsecured, or the mechanism could allow for both under certain provisions. A viable secured loan could be home equity line of credit, where the owner would use the cost of the home as collateral on the loan, with the added value of the solar equipment wrapped into the equity credit line. An unsecured loan that could be appropriate for this program could be a non-recourse loan, wherein the lender would only get reimbursed based on the relative energy savings that the loan is funding, not the assets of the borrower. In this case, the non-recourse loan would still most likely garner high interest rates and rigorous credit requirements, as energy savings alone couldn't finance the principal and interest of the system. The loans would be repaid on an annual basis at rates generally at or below aggregated energy savings, and at below-market interest rates. The city and any financial partners would have to determine the interest rate schedule (fixed or variable), the reimbursement mechanism, financial prerequisites for the borrower, securities required on the loan (if any) and administrative and underwriting fees.

In order to secure low interest rates for property owners, the City of Berkeley and the financial institutions must design a mechanism to lower interest rates to equivalent to or below market levels. There are several potential routes the City and the financial institutions could follow:

1) Fund low interest rate loans with municipal bonds

The City of Berkeley would issue municipal bonds to qualifying borrowers in order to provide loans to property owners to finance their solar systems. Interest rates on these loans would be set at several points above the bond basis but below market interest rates for regular home equity loans. A reference estimate for a public bond interest rate is the Clean Renewable Energy Bond rate for a 10-year maturity bond at 4.99%⁴⁸. As of January 28, 2008, the estimated interest rate on a 30-year second mortgage in Berkeley, CA was 6.875%⁴⁹. If the city of Berkeley were to finance below-market interest rates to solar customers and still manage municipal bonds, the interest rate it or its financial institution partners would charge would be between about 5% and 6.875% to property owners, using these estimates. Since the bonds would presumably go to fund private projects, these bonds would be taxable, so the bond interest rate estimate would probably exceed 5% and the loan interest rate would then be closer to 6.5%. In preliminary meetings with financial institutions, Cisco DeVries from the City of Berkeley got an estimate of between 1-1.5 points below prime⁵⁰ and 2% above the 10 Year Treasury Bond yield. As of February 13, 2008, the Wall Street Journal prime rate was 6%⁵¹ and the 10 Year Treasury bond yield was 3.6%⁵². Using these estimates, the interest rates available to customers would be between 4.5% and 5.6%. These rates correlate with a February 2008 report by the Renewable and Appropriate Energy Lab on property tax assessment finance mechanisms. However, since Berkeley must still manage the taxable bond payoff, the interest rates may need to be raised above 5%, if we use the Clean Renewable Energy Bond program as a reference rate. This leaves available interest rates on the loans at the narrow range of between 5% and 5.6%. These rates are still much lower than the interest rates available for second mortgages or home equity lines of credit in this area.

The California Energy Solar Industries Association claims that any further tax-exempt low-interest loans to consumers through a public entity would preclude eligibility for the Federal Income Tax Credit (ITC).⁵³ If the loans were garnered through approved private financial institutions, or if through a market-rate taxable loan from the City of Berkeley, the Federal Income Tax Credit might still be available. An informal exchange with the IRS has confirmed that as long as the bond interest return was below the applicable Federal level, this would not constitute 'subsidized energy financing' which would need to be deducted⁵⁴. However, if the terms of these loans are more favorable to solar customers than those commercially available, then the loans would be considered subsidized financing, and the ITC would not be an option. A tax professional must be consulted to resolve this issue.

2) Fund interest rate buy-down at the city level

⁴⁸ The Clean Renewable Energy Bond program is a series of Federal bonds issued to electric power cooperatives and public power agencies to finance renewable energy projects as the equivalent of an interest-free loan.

⁴⁹ MortgageLoan.com estimate for Berkeley, CA:

[http://www.mortgageloan.com/Rates/California/Berkeley/Second Trust Deed 30 Year Fixed/](http://www.mortgageloan.com/Rates/California/Berkeley/Second_Trust_Deed_30_Year_Fixed/)

⁵⁰ Email correspondence from Cisco DeVries to Stephen Compagni Portis (Renewable and Appropriate Energy Lab) January 18, 2008

⁵¹ <http://www.bankrate.com/brm/ratewatch/leading-rates.asp>

⁵² <http://www.treas.gov/offices/domestic-finance/debt-management/interest-rate/yield.shtml>

⁵³ Comments of the California Solar Energy Industries Association for Consideration in the Performance Based Incentive Workshop Proceedings Commencing March 16, 2006

⁵⁴ Email correspondence from Stephen B. Tracy (Novogradac & Co LLP) to Stephen Compagni Portis (Renewable and Appropriate Energy Lab) January 15, 2008

Using this model, the City of Berkeley would partner with several financial institutions to offer low-interest rate loans to property owners. The financial institutions would still be guaranteed reimbursement at the open market rate for these loans, and the City would fund the difference between the rates paid by the homeowners and the market rates. This model follows the model used by the New York Department of Energy Smart Loan Program. The potential borrowers would find an approved lender through the City of Berkeley and arrange for the loan using the lender's fees and credit requirements. Once the loan is approved, the lender would apply for an interest rate reimbursement from the City of Berkeley. Upon receipt of reimbursement, the lender would offer the borrower a low-interest loan to finance the solar equipment. The interest rates to the customer would most likely mimic the interest rates cited in the municipal bond example above, since the City would most likely enact bonds to buy down the interest rates to the lenders.

3) Fund low interest rates with linked deposits

The City of Berkeley could fund reduced-rate certificates of deposit (CDs) for lenders participating in the program, which would allow the lenders to offer below-market interest rates. The City of Berkeley would be the sole purchaser of these CDs, and would seek funding for these purchases through bond programs similar to those described above.

b. Stakeholders and Roles

1) Property Owners

i. Risks

The primary risk to property owners is that the administrative hassle of getting pre-approved for these loans may discourage property owners from participating, especially if they can find competitive loan rates outside the program. The pre-approval process for the loans must be as time-intensive as or less time-intensive than commercial loan approval processes or this may prove a significant deterrent.

The premise of these loans is that the energy savings that the homeowner would realize would exceed the interest that must be paid on the loans to the lending entity. One potential risk is that the equipment would not garner the projected energy savings during the life of the equipment. There would be minimal security risk to the property owner for accepting a low-interest loan, since the interest paid on the principal to this loan would be lower than interest rates for a home equity loan or other type of loan. The only risk is that overall interest rates could fall, and the property owner could be paying more than other adjustable-rate loan programs. However, since these interest rates are much lower than other fixed-rate loan programs, there is very little risk of this.

The other main uncertainty is that the low interest loans would be considered "subsidized energy financing," and that customers would have to be excluded from the Federal Income Tax credit for solar, thus far the largest incentive to homeowners to purchase solar power. If these loan interest rates at the buy-down level are more attractive than those available commercially, then they would be considered subsidized energy financing and the Federal ITC will not apply.

ii. Benefits

The benefit to a low-interest loan would be the initial ease of paying the up-front capital cost of a solar system with a loan. An added long-term incentive would be that the loan interest would be less than market-rate and that the homeowner would still realize energy savings larger than the amount owed for the loan. The incremental savings over time would eventually pay for any capital cost not covered by the loan. Additionally, since interest is charged on the unpaid

principal computed from the date of each disbursement to the borrower, the total interest paid by the property owner would decrease with each installment paid. This must be taken into consideration with the fact that utility rates will naturally escalate annually. These two trends will potentially reduce the payback turnaround time.

2) PV/ Solar Thermal Installers and Contractors

i. Risks

Contractors would not face much risk under this program, since property owners and lenders participating in these programs would be pre-approved and therefore invested in and prepared for installation of solar equipment. The potential risk to contractors may be amplified if the contractor performs work before the property owner is approved for the loan. However, the likelihood of this scenario depends on how the loan mechanism is structured.

ii. Benefits

As mentioned above, the benefits to contractors would be that property owners would be in a more advanced stage of the preparation process for solar systems than other potential customers, since they would have to undertake energy efficiency audits and other financial pre-approval processes.

3) The City of Berkeley

i. Risks

Assuming that the City of Berkeley finances the administration and initial loan principal through municipal bonds, the greatest risk would be that the bond payout would not be sufficient to cover the investment. The possibility of this risk depends on bond interest rates as well as FIRST interest rates. In order to Berkeley not to incur debt, the FIRST interest rates would have to be set above the bond basis. According to the analysis above, an estimate of a reasonable bond interest rate would be 5%, so the FIRST interest rates would have to fall several points above 5%, especially since Berkeley needs some extra funding to cover the administrative costs of the program.

Also, Berkeley needs to stimulate enough interest in the program to garner enough bond holders to continue to fund the program, even if unforeseen costs arise. This will require substantial press and marketing, as well as confidence in Berkeley's bond administration. A substantial amount of interest in the program will weigh on whether or not property owners can take the Federal ITC. A tax consultant must confirm the final outcome of this.

ii. Benefits

The benefits to the City of Berkeley will be that a bond-based low-interest rate program is a reliable and recognized method of funding municipal programs, so it will inspire confidence amongst potential customers and financial partners.

4) Lenders

i. Risks

The risk to lenders will depend on the provisions of these loans, namely the entity that will reimburse the lender, the credit requirements imposed on the borrower, the level of security of the loan. If the lender is reimbursed by the loan program administrator – in this case the City of Berkeley – there is minimal risk to the lender, as the financial reliance on the borrower shifts to the loan program administrator. The New York Energy Smart Loan Fund follows this model, reimbursing financial institutions when loans are secured. This may be the most viable route to

attracting participation in the program, as the lending institutions are guaranteed reimbursement to compensate for the artificially low interest rates. However, the City must prove that projected participation in the program would exceed the profitability thresholds for the financial institutions, or there may not be enough incentive to participate.

If the City chooses to reimburse the financial institutions with municipal bond reimbursements, the risks are considerably less, since the City can call bonds back from bondholders if bond interest rates plummet and reimbursement to financial institutions becomes more difficult.

If the lender has direct contact with the borrower, the risks depend on the credit checks the lender is allowed to impose on the borrower and the security level of the loan. If the loans are secured and the lender may place a lien on the property or other similarly valued collateral, the lender assumes less risk. If the loan is unsecured, the lender assumes more risk, and typically charges higher interest rates. The Renewable and Appropriate Energy Laboratory has determined that a combination of unsecured loans with low interest rates are the most attractive to homeowners seeking loans for high capital cost energy-saving investments,⁵⁵ though since this is the riskiest package for financial institutions.

ii. Benefits

The benefit to lenders would be a secured and committed set of loan customers pre-approved by the City of Berkeley who would patronize their services. The benefits will vary according to the lines of credit and credit checks imposed on the customers. The safest and most ideal scenario would be loan reimbursements set up as property tax assessments paid to the City of Berkeley, which repays the financial institutions.

c. Case Studies/Examples

1) The California Energy Commission runs a simple low-interest loan program for solar systems eligible to schools, hospitals, cities and counties. These low-interest energy efficiency loans can cover the costs of building envelope improvements as well as the cost of solar generating equipment. Interest rates for these loans are as low as 3.96%, where the average market rate is 4.5%.⁵⁶ The only restrictions are that the loans must not exceed \$3 million, the retrofits must have a 10-year payback period of energy savings and the loan term cannot exceed the life of the equipment. The loans are paid back on a reimbursement basis and the interest is paid on the remaining principal.

2) The Oregon Office of Energy (OOE) offers loans to renewable energy projects that are generated from general obligation or private bonds. The larger scale projects are financed using tax exempt bonds. The interest rates on these loans are based on current state bond rates. A study conducted by the Renewable and Appropriate Energy Laboratory in 2002 found that the interest rates tended to be 100 to 150 points above the bond yield, between 5.0% and 6.0%. The current interest rates are 6.0% to 6.5% for residential and commercial customers⁵⁷. These loan terms are set at a 15 year maximum and must be secured. For local governments receiving these loans, the equipment being financed is usually sufficient collateral, but for commercial and residential borrowers, a second mortgage is usually taken for the loan, using the property as the

⁵⁵ Bolinger, M. and Porter, K. Berkeley Lab and Clean Energy Group. *Case Studies of State Support for Renewable Energy* September 2002.

⁵⁶ CEC Energy Partnership Program: <http://www.energy.ca.gov/efficiency/partnership/>

⁵⁷ The Oregon Department of Energy: Energy Loan Program rates: <http://egov.oregon.gov/ENERGY/LOANS/rates.shtml>

loan collateral. There is an application fee of 0.1% of the loan, an underwriting fee of 0.5% of the loan (\$500 minimum) and a loan fee of 1% of the loan. The underwriting fee less \$500 and all loan proceeds can be used to pay the loan fee at closing. According to a case study conducted by the RAEL, these administrative fees make the program prohibitively expensive for individual residential customers.

3) The New York Energy Smart Loan Fund partners with financial institutions statewide to buy down interest rates for borrowers financing renewable energy projects. These strategic partnerships with financial institutions reduce interest rates by 4.0% (400 basis points) of the participating lender's interest rate, with interest rate reductions up to 6.5% for certain utility territories in the state. The New York State Energy Department reimburses participating lenders with a lump sum after a reduced interest rate has been secured to the borrower. This Lump Sum Interest Reduction Payment is calculated as the present value (discounted at the base interest rate) of the difference of the interest paid under the base value and the interest paid at the reduced rate, not to exceed 10 years. The eligible loans are capped at \$20,000.00 and must have at least a 10 year payback period. The participating lender conducts credit assessments of the borrower according to the standard practices of the lending institution. While the state charges no fees to the lender or the borrower, the lender may charge the borrower any fees that are typically obligated to the borrower. These loans are calculated to exclude other subsidies at the state or utility level. Legally, these loans are structured as leases, in which the participating lender finances and owns the equipment, and the borrower has the option to purchase the equipment at the end of the loan period. The lease term must be up to 75% of the estimated equipment life. The present value of the minimum lease payments must sum to at least 90% of the value of the property at the inception of the lease, with the discount rate typically used by the lender. While the low-interest rates seem attractive to potential customers, participation in this program is low, due to difficulty in getting approved for loans and burdensome application paperwork.

City of Berkeley District Financing

a. Mechanism structure

Financing

The City of Berkeley's proposed district financing program, Berkeley FIRST, would allow customers to finance their new photovoltaic systems through a 20-year tax assessment on the property. Berkeley FIRST may be launched on October 24, 2008, with at least 25 pilot homes. The full-scale district financing program may follow based on the results of the pilot. The city would secure capital for the system and the installation costs for each participant, and the consumer reimburses the city through their property tax, including administrative fees and interest. Interest paid on these property tax assessments are tax deductible, given that the interest component is broken out on the property tax bill.⁵⁸ The interest rates are expected close to what the consumer could get on their own through mortgage loans, possibly exempting this structure from the Federal ITC's "subsidized energy financing" stipulation, so that the ITC would be fully available to participants, assuming the Federal ITC does not expire. Participants in the program would be able to prepay the portion of the bond attributable to the cost of their solar project, but

⁵⁸ Email correspondence between Stephen Compagni-Portis (Renewable and Appropriate Energy Laboratories) and other stakeholders in the Berkeley Solar Initiative, January 11, 2008

they must pay the outstanding principal, the accrued interest and a premium based on the number of years they have been participating in the District Financing.

The property tax would be passed between homeowners if the property is sold before the 20-year assessment is completed.

When a participant opts into the program as a solar customer, a tax lien is placed on the property, which ensures that the participant is obligated to pay the special tax with higher priority than the property's first mortgage. The County would foreclose a property in the event of nonpayment taxes after five years.

The city secures their funds through tax bonds similar to Mello-Roos municipal bonds in that the bond proceeds will be used to make commercial and residential improvements, and that interest and principal on the bonds will be payable through special taxes paid by those who wish to participate in the Financing District. The bonds are issued with a 20-year term and will be transferable to the investors by the bond transferee, most likely a partnering private financial institution.

The Finance District has delegated the financial liaising with the bond holders to a Bond Trustee, and institution that collects the special tax payments from the City (which receives revenues from the County) and issues payments and pro rated interest rates to the bond holders. The Bond Trustee handles any bond prepayments.

The estimated bond interest rate paid to the City of Berkeley is estimated to be between 6% and 8%.

Administration

Potential participants in Berkeley FIRST financing would send in a copy of their Reservation Request Form for the California Solar Initiative and sign a contract with their installer before they can apply to request a reimbursement from the Berkeley Finance District. The Finance District will also charge an administrative fee to each participant. The Berkeley FIRST administrators will check to see that the participant holds a clean title to the property and that mortgages and taxes on the property are current. Since the participant needs only to request their funding with the CSI and have a signed contract with their installer, they might be able to avoid paying any up front costs to the system before their application is reviewed by the Berkeley FIRST administrators.

Under the initial phase, Berkeley FIRST would only covers the reimbursement for solar PV applications. Berkeley FIRST requires energy efficiency testing and upgrades before participants can receive funds. In the future, FIRST may allow financing of solar thermal and efficiency.

1) Property Owners

i. Risks

As outlined in the 'Benefits' section, there is minimal risk to the property owner under this financial mechanism. As with most financial mechanisms, a risk to the property owner would be a default on the special taxes, which could result in foreclosure of the property after three years of nonpayment. The payment obligation for the district financing would take precedent over a first mortgage loan, so there could be an increased risk of defaulting on a mortgage loan, since it would become a lower priority.

Depending on how the financing district is structured, there is a potential issue of when the check is awarded to the participant. If the installer requires payment before the FIRST application can be reviewed, the participant must pay up front costs and will thereby miss out on

the primary program benefit of not having to pay for the system up front. If the participant must pay for the full energy efficiency upgrade, then make a downpayment to the contractor for the solar installation, the benefit to participating in the Berkeley FIRST would be greatly reduced. This sentiment was echoed at contractor focus groups hosted by the City of Berkeley and Build It Green aimed at gathering feedback from professionals on program options.

Another potential concern would be if this district financing would be considered “subsidized energy financing” by the IRS, precluding the property owner from taking advantage of the Federal Income Tax credit. The Renewable and Appropriate Energy Laboratory (RAEL) has explored this issue, and determined that if the interest rates FIRST assessments are set at the interest rate level for the most appealing 20 year commercial mortgage loans, the ITC would be available. RAEL determined in a recent study that if the ITC was not available, customers may be able to find more appealing low-interest mortgage loans, even if FIRST interest rates were lower than those commercially available loans. However, not all customers will be eligible to take mortgage loans.

ii. Benefits

There are a multitude of potential benefits to the property owner under this mechanism. The property tax assessment can be transferred between property owners, meaning there is less commitment to remain with the property than with traditional home equity lines of credit. Even property owners who are not sure if they plan to keep their homes for the tax assessment period would still be encouraged to participate in the program. Unlike many other finance programs, Berkeley FIRST is a fixed-cost tax rate, and the 20-year period would ensure low monthly payments for the assessment’s duration.

Further, the tax amount would be tied to the property owner’s tax standing rather than credit status or property equity, a more accurate reflection of the owner’s financial standing and income. The February 2008 RAEL report ventures that interest paid on property tax assessment payments would be tax deductible, though the principal on these payments would not be. This makes property tax assessments much more attractive than consumer, non-home equity loans, which generally do not offer tax-deductible interest.

RAEL projected benefits to residential customers using a pro forma financial model, simulating cost projections for a 1 kW system, a 2 kW system and a 3 kW system, where the property tax assessment would pay for 100% of the cost. The property tax assessment is fixed at a 5.0% borrowing rate for a period of 20 years. The model analyzed the benefit for when the ITC is taken at the current cap (\$2,000.00) when the ITC is taken at an elevated cap (\$4,000.00) and when it is not taken. The model assumes that the alternatives are a 20-year fixed rate mortgage loan taken at 5.5% interest rate, a 15-year home equity loan at 7.75% interest rate, a 10-year secured consumer loan at 7.75% interest rate and a 5-year unsecured consumer loan at 12.5% interest rate. Interest on the mortgage loan and the home equity loan is assumed to be tax deductible but interest on the consumer loans were not. RAEL concluded that the property tax finance mechanism is the most attractive to customers when the ITC is available, but only slightly more attractive than the 20-year mortgage. If the ITC is not available, the 20-year mortgage loan exceeds the property tax assessment appeal, and customers will opt out of the Berkeley program. However, customers may not be eligible for this mortgage loan, especially in a retrofit, as this type of retrofit may not be deemed substantial enough to warrant a home equity line of credit. RAEL discusses the possibility of inducing a downpayment of \$6,666.67 (\$2,000.00/30%) on the customer that would not be included in the property tax in order to take advantage of the ITC. This may be a viable option if the Berkeley program does preclude

participation in the ITC. However, this negates the primary benefit of financing promised by the Berkeley program, which is to significantly reduce or eliminate up-front costs.

2) Installers and Contractors

i. Risks

Our understanding of current renewable energy markets is that installers get reimbursed by their clients at various stages throughout the project. There is usually a downpayment made after the contract is signed and before the contractor procures the equipment, so the contractor does not have to pay out of pocket for the equipment. Often there is another payment made before the installation begins, and then the difference would be paid at the close of the contract. Given this assumption, there could be a risk to the contractor if they were not paid on the schedule to which they are accustomed. If the finance district does not review the application until after the equipment is installed, the contractor may need a payment advance secured by the program in order to agree to participate in the program.

ii. Benefits

The benefits to PV and solar contractors would be that the property owners are financing their systems with the assistance of the city, and with a relatively secure financial mechanism. PV and solar contractors could be assured that they would be reimbursed for their services even in a default or foreclosure situation. Moreover, the City of Berkeley would most likely pre-approve a list of contractors to help streamline the process for customers. Inclusion on such a list would be a boon to the contractors' business. The feedback from the contractor focus groups unanimously showed support for the program.

3) The City of Berkeley

i. Risks

The main risk to the City of Berkeley is that the reimbursement projected under the property tax assessments would not cover the costs of issuing the bonds and running the program. If the City set their special tax rates too low, the program would not be fiscally sustainable and customers would be less likely to take the Federal ITC, but if the interest rates are too high, property owners might opt for private financing options. The City of Berkeley needs to ensure that the fixed interest rates on the special taxes are above the bond prime and competitive but not much below commercially available mortgage loan interest rates.

On a more individual level, the City is at risk if property owners are late with paying the special taxes, since the City will rely on the special tax payments to reimburse the bond holders. If too many customers are late, then the City will either be late with its reimbursements or be forced to take funds from other programs to pay bond holders.

Of course, Berkeley needs to enlist creditworthy financial institutions as the bond transferees. This will take a significant amount of research and administrative costs.

ii. Benefits

The City has already benefited from this proposed program by the momentum of the positive press it has received for conceiving of this innovative program. The City has presented itself as an incubator to test the efficacy of property tax financial incentives to property owners. The local and national attention will secure a baseline amount of participation in the program.

Another benefit would be the relative ease of administering a program through an existing financial mechanism –property taxes- rather than planning the loan or other incentive structure without a preexisting infrastructure.

4) Lenders

i. Risks

In a February 2008 assessment of property tax-based financial mechanisms, the Renewable and Appropriate Energy Laboratory determined that these present the least amount of risk to lenders, since in a default situation the property tax would get paid even before mortgage payments.⁵⁹ The only potential risk to lenders would be that the loans to the customers would be determined based on tax standing rather than credit standing, so there remains a chance that these incentives could be given to customers with poor credit. However, since property taxes would be paid first in a default situation, this remains a minimal risk. Since this is a turnkey program in which City of Berkeley is administering the loans, the private lenders would most likely have minimal contact with the customers. The burden for reimbursement to private lenders may fall entirely upon the city, which is the safest option for the lender. If the bonds are general obligation and/or insured, there would be almost no risk to lenders. If the municipal bonds are revenue bonds and not insured, there would be slightly more risks to lenders if the City cannot pay back the interest and principal to investors, most likely as a result of program participants who are late in paying their special taxes.

ii. Benefits

The benefit to the lender would be the economy of scale at which this program is implemented; perhaps the City of Berkeley is reimbursing the lenders at interest rates below what the lenders would normally fix for a 20-year home equity loan, but the lenders would automatically realize an increase in business after joining the initiative partnership.

5) Appraisers

i. Risks

Appraisers would have to have prior experience in the solar market to accurately assess the value added of solar generating technologies on properties.

ii. Benefits

There would be a net benefit to appraisers under this system, as the City would partner with established home appraisers, presumably through Alameda County, to assess properties installing solar technologies. The increased demand for appraisers under this City-sanctioned program would establish greater job security and employment.

Home Equity Loan or Line of Credit

a. Mechanism Structure

A home equity loan, or second mortgage loan, would allow the homeowner to place their home as a security on a loan to finance the solar or energy efficiency upgrades. Since home equity loans are commonplace and secured, they are typically available from any major credit union. These are offered as lump-sum loans or revolving home equity lines of credit, with fixed interest rates or adjustable interest rates. Home equity lines of credit are credit thresholds from against which the homeowner can borrow for major expenses. Credit limits are usually set at a percentage of the home's appraised value (say, 60%) less the balance owed on the existing mortgage. For lines of credit, there is usually a 'draw period' of a set number of years that the

⁵⁹ Bollinger; February 2008

home owner can borrow against the credit, follow by a payment period, either a set number of years to pay back the credit with an adjustable interest rate, or the option to pay the loan back in full. We are assuming that home equity loans or lines of credit would be financing options available through private lenders in lieu of financing through the Berkeley solar initiative.

Fixed rate mortgage loans are the most popular choice, comprising 75% of all mortgage loans in the U.S.⁶⁰, most likely because the interest rate can be projected for the duration of the loan, making long-term financial planning easier for the customer. Adjustable rate home equity loans have interest rates that change according to a designated index: one year treasury bills, Federal Housing Finance Boards National Average mortgage rate, or average loan rates for the specific lender. Adjustable rate mortgages are more risky for property owners, since interest rates fluctuate, but they are easier to qualify for, which may render them the only option for customers with poor credit or those wanting large mortgage loans.

As of April 2008, an average fixed-rate interest rate on a 20-year home equity loan for \$25,000 was xx% for a home valued at \$640,000.00, the average home selling price in Berkeley, CA for Spring 2008⁶¹.

The appeal of home equity loans to property owners is that since they are secured with the property's real value, the property owner can usually get a competitive interest rate, depending on credit history. Home equity interest rates are usually tax deductible.

b. Stakeholders and Roles

1) Property Owners

i. Risks

The main risk to home equity loans, of course, is that there is a lien placed on the home, and the homeowner will default if they cannot pay the installments. This is a greater risk for adjustable rate loans than secured rate loans.

Since availability of loans and interest rates are directly tied to the homeowner's income, property value and credit rating, homeowners with poor credit will be at a disadvantage, since there is a possibility that they may not qualify for any loan, or that they will be forced to accept an adjustable rate loan with greater risk. Homeowners with poor credit would most likely prefer a financing district, since those special taxes are based on property value, not income or credit score, so they would more easily qualify for the option.

Of course, with any type of loan compared to a downpayment option, the interest rate payments would erode the potential monetary savings of the system or upgrades itself.

ii. Benefits

The benefit to a home equity loan or line of credit is that since these are secure loans, the interest rates tend to be lower and more competitive than other unsecured loans. The interest rates are also tax deductible, making these loans even more appealing to customers in good credit standing. In fact, a RAEL report recently estimated that a home equity loan could be more appealing than the financing district if the participants in the financing district cannot take the Federal Income Tax Credit.⁶²

2) PV/ Solar Thermal Installers and Contractors

i. Risks

⁶⁰ April 10, 2008 report from MortgageLoan.com : <http://www.mortgageloan.com/Rates/fixed-mortgage-rates>

⁶¹ Calculation from <http://www.mortgageloan.com>; Average home selling price and median household income for Berkeley, CA from <http://www.trulia.com>

⁶² Bollinger; February 2008

Since this financial mechanism would be administered through a private credit union as opposed to the City of Berkeley, the homeowner would be obligated to the loan terms regardless of whether or not the work gets done. Thus, the contractor would not be affected in any way other than standard business practice. If the homeowner qualifies for the loan, the homeowner can arrange a contract at his or her own discretion.

ii. Benefits

Similar to risks, there would be no adverse affects on the contractor with home equity loans, as these types of loans are how homeowners typically finance home improvements.

3) The City of Berkeley

i. Risks

The City of Berkeley would presumably prearrange loan packages with lenders, and potentially assist in approving homeowners for loans, but aside from the liaison role, there would be no financial risk to the City of Berkeley. If the homeowner defaults on the loan, the lender will seize the property as stated in the loan terms, and the homeowner would be fully liable for the default.

The main risk would be that by relying on lending institutions to design the loans, the Berkeley Solar Initiative may lose some credibility by not supplying participants with the promised up-front financing. If some potential customers cannot finance the entire cost of the upgrades with a home equity loan, or if they are not approved for a loan, then the City would not be providing the full up-front cost coverage that was originally promised at the outset of the program.

ii. Benefits

The clear benefit to the City of Berkeley would be that the lending institutions would handle most of the administrative handling of the loans, including customer approval and finalizing loan conditions. This example does not assume that Berkeley will be reimbursing the lending institutions with bonds, so there would be minimal administrative costs and funding to the City.

4) Lenders

i. Risks

The risks to lenders are minimal for secured home equity loans for solar installments, since there is a lien placed on the home, and the value of the home presumably would greatly exceed the loan principal. In a default situation, the lender would be able to recover costs by foreclosing homes.

The main risk would be that too many homeowners would default on their loans and that the lender would be the force behind foreclosing homes, which then will not sell on the plummeting market: a reflection on the national current real estate market pattern. In order to avoid this scenario, the lenders must be judicious in their loan approval process and set caps on draw-down amounts for equity lines of credit.

ii. Benefits

The benefits to lenders in a typical home equity loan scenario compared to a financing district is that the lender would be able to use their standard approval process for granting loans rather than solely relying on property value and tax assessments. The lenders would be able to take credit ratings and income into account as well as the estate value, which is not the case with the finance district.

c. Case Studies/Examples

In the San Francisco Bay Area, the New Resource Bank has partnered with SunPower Corporation to offer competitive home equity loans to homeowners wishing to install photovoltaic panels. The bank offers a 25-year term hybrid rate loan with an adjustable interest rate for the first seven years and adjustable rates for the remainder of the loan term for solar loans between \$25,000.00 and \$250,000.00.⁶³ The customer only pays interest for the first 10 years of this loan, with the amortizing period covering the remaining 15 years. The average interest rate for this loan is 5.2%. There are also a 15- and 25- year fixed-rate loans available for the same loan range at 6% interest. New Resource Bank has streamlined the process such that the approval and application process is simple and there are no up-front fees. Potential customers are usually given a consultation by New Resource Bank representatives to determine the best package for them prior to filling out the application, usually using their PG&E bill.

Commercial Loans or Lines of Credit

a. Mechanism Structure

Commercial lines of credit for solar installations are offered through most lending institutions, and can be secured or unsecured. Secured commercial loans are structured similarly to home equity lines of credit, except that businesses use their accounts receivable or their inventories as collateral instead of the property. The interest rates can either be fixed or adjustable. For lines of credit, the interest rate is usually adjustable. Typical prerequisites for commercial loans or lines of credit are that the business reaches a certain sales revenue amount, the business is in good credit standing and often that the businesses amortize their balance for a certain period annually. Loan terms for businesses are typically shorter than loan terms for homes.

b. Stakeholders and Roles

1) Property Owners

i. Risks

The main risk for taking any kind of second loan for a business is the threat of nonpayment, and losing part of the collateral or being forced to close the business. This risk will vary depending on each business's solar needs and their total revenues; as a general rule, small, newer businesses are at greater risk for nonpayment than larger and older businesses. This risk is somewhat offset by the fact that system improvements and solar technologies will reduce operating costs.

ii. Benefits

Benefits to property owners are that they have the option to finance improvements that will save on operating costs without having to save up for a downpayment. Also, these loans are based on the businesses' revenues and credit standing, rather than their property taxes, such as for district financing. This could stand as a benefit for companies with large revenues but relatively modest real estates, as they may be able to garner lower interest rates and more appealing loan terms.

2) PV/ Solar Thermal Installers and Contractors

⁶³ Cohen 2007 and <http://newresourcebank.com/personal-banking/loans-and-financing.php>

i. Risks

The risks to installers depend on when the contractors arrange to be reimbursed; if the contractor demands a downpayment and waits until the loan is approved before doing significant work, then loss risks are small. However, if the contractor procures the necessary equipment before the business is approved for the loan, then there is a larger risk of financial losses.

ii. Benefits

Contractors benefit from these loans because more businesses become candidates for system improvements or solar installations. An increase in business may allow for price increases, more discernment in client selection and carving market niches.

3) The City of Berkeley

The City of Berkeley would presumably prearrange loan packages with lenders, and potentially assist in approving homeowners for loans, but aside from the liaison role, there would be no financial risk to the City of Berkeley. If the property owner defaults on the loan, the lender will seize the property as stated in the loan terms, and the business would be fully liable for the default.

The main risk would be that by relying on lending institutions to design the loans, the Berkeley Solar Initiative may lose some credibility by not supplying participants with the promised up-front financing. If some potential customers cannot finance the entire cost of the upgrades with a home equity loan, or if they are not approved for a loan, then the City would not be providing the full up-front cost coverage that was originally promised at the outset of the program.

ii. Benefits

The clear benefit to the City of Berkeley would be that the lending institutions would handle most of the administrative handling of the loans, including customer approval and finalizing loan conditions. This example does not assume that Berkeley will be reimbursing the lending institutions with bonds, so there would be minimal administrative costs and funding to the City.

4) Lenders

i. Risks

The risks to lenders are minimal for secured business loans for solar installments, since there is a lien placed on the accounts receivable, inventory or other assets, and the revenues of the business presumably would greatly exceed the loan principal. In a default situation, the lender would be able to recover costs by seizing collateral.

However, the lender does take on more risk with unsecured loans, as part of the principal may not be recoverable in a default situation, and the lender's only recourse would be to sue for losses, an expensive process in itself.

As with home equity loans, another risk would be that too many business owners would default on their loans and that the lender would be the force behind closing businesses. However, with Berkeley's relative economic comfort compared to the rest of the country, this is probably not a significant risk.

ii. Benefits

The benefits to lenders in a typical home equity loan scenario compared to a financing district is that the lender would be able to use their standard approval process for granting loans rather than solely relying on property value and tax assessments. The lenders would be able to

take credit ratings and income into account as well as the estate value, which is not the case with the finance district.

c. Case Studies/Examples

Comerica Bank has partnered with Akeena Solar of Los Gatos, CA to offer businesses loans to cover solar installation expenses of up to \$25 million per business.

Equipment Lease

a. Mechanism Structure

In an equipment lease, a customer rents solar equipment from another entity for less than the market price of the equipment. The customer may or may not agree to rent the equipment for a set amount of time, and takes on responsibility for maintaining and operating the equipment. The leasing entity could partner with installation and sizing companies, or this responsibility could fall on the customer. Typically, the leasing entity offers the customer a complete package, wherein the leasing entity sizes the system and decides on the model, completes the paperwork with local utilities, arranges for interconnection and determines the rental rates for the customer. The lease is paid in monthly installments determined by the leasing entity, taking the performance of the system and current and historical energy rates into consideration. Usually, at the end of the lease, the customer can choose to buy the equipment from the lessor, at a total above-market price, but with the lease payments deducted from the final price. The feasibility of this option under the Berkeley Solar Initiative would hinge on how many vendors would agree to lease their equipment rather than sell it. Also, if the district financing an approved mechanism, then the 20-year term on the property tax assessment will most likely exceed the lease term for this option, and most customers would opt to buy.

b. Stakeholders and Roles

1) Property Owners

i. Risks

The potential financial risks depend on the structuring of the mechanism, but if the customer agrees to a fixed, flat-rate monthly payment to the leasing entity, the financial risk is that utility rates in the area will not increase, or will decrease, in which case the customer will realize a negative financial outcome compared to a non-participation scenario. If the monthly rent agreement is scheduled to increase, the risk is that the utility rates will not increase, or increase at a lesser rate.

However, there is essentially no security risk for the property owner, since all liability for maintaining the system falls on the purchasing entity. Thus the property owner avoids potential unforeseen costs of having to repair and maintain the system. Even if monthly rates for the equipment lease do surpass energy savings due to utility rate decrease, the property owner still has an increased sense of security.

The only perception barrier may be that the customer is somewhat restricted in choices for solar systems, and forgoes individual choice in choosing installers and components. However, this can also be seen as a benefit, since it eases administrative burdens and reduces time spent on research.

The other potential risk to the property owner would be that if the owner/purchaser of the equipment is separate from the property owner, whether or not all the applicable rebates will apply. The CSI would probably still be an option, as there are separate roles and responsibilities

in this program for the system owner and the host customer. However, it is unclear whether or not the property owner could take the Federal ITC.

ii. Benefits

Under this mechanism, the customer avoids paying an up-front capital cost of solar equipment, but realizes all other savings and benefits associated with owning a system. The customer is typically relieved of responsibility for maintaining, operating and repairing the system, thereby avoiding unforeseen costs and time sinks. There is also a comfort benefit in that the customer entrusts the experienced entity to lend a reliable system, thereby avoiding the risk of researching different types of systems.

2) PV/ Solar Thermal Installers and Contractors

i. Risks

The risk for solar contractors under this plan would be that the equipment available may not meet the specifications to which the contractors are accustomed. The approved equipment may severely restrict the contractors who can then participate in the program, which may then restrict consumer choice. If we take the case study of Citizenre as an example of equipment lease, all the installers are provided in-house. If the City of Berkeley would like to take advantage of the diversity of solar installer experience in the Bay Area, it would have to get the buy-in of all the contractor stakeholders as to which systems could be approved for lease. The contractor focus groups reiterated that in order for the program to be a success, the current market supply chains should not be disrupted or restricted, and equipment leases and bulk purchase agreements would disrupt existing functional market patterns.

Also under an equipment lease program, contractors would be more obligated to perform repairs and maintain systems than they typically would if the customer were to buy the system. This may mean that they would expect more compensation than they would under a more traditional contract.

ii. Benefits

The advantage of this mechanism, as with many of these mechanisms, is that the contractors would enjoy a steady stream of committed customers, and presumably they would have to spend less time advertising and selling their services than they would if operating independently. If their vendor usually sends out sales representatives to stimulate and find business, this marketing arm might be rendered obsolete.

3) The City of Berkeley

i. Risks

This model assumes that the City of Berkeley would partner with a private company or series of private companies to implement an equipment lease agreement. This model could be structured such that the City partners with a series of approved system retailers and solar contractors, such that the customer rents directly from the system retailers, or the City could partner with fewer private companies who already specialize in solar equipment lease. If the City chooses the first option, the added administrative burden of approving partner companies could add to cost and ensuring that these companies comply with the provisions of the agreement. If the City were to partner with one company already implementing equipment lease, these administrative burdens would be reduced. The City may take on all or part of the financial burden of initially renting the equipment, though this expenditure could be reduced if the equipment lease were paired with a bulk purchase or rental agreement at a reduced cost.

Furthermore, if the City is paying the difference for any savings the customers would realize by paying a flat or reduced monthly rate, this would add to the financial burden of the City. Finally, as with bulk purchase agreements, the City would have to ensure that the equipment available and designated for rent would fit the projected demand of the customers. If there is not enough equipment, the credibility of the program could suffer, and if the City designates too much equipment, it may incur losses.

The regulatory risks are that the City may be perceived as endorsing one private company or type of solar system over another, depending on how this mechanism is structured. Furthermore, contractor feedback from the Berkeley Solar Initiative reflected a strong resistance to disrupting current solar supply chains with exclusive leases or bulk purchase agreements.

ii. Benefits

The benefit to the City under an equipment lease would be that the City may incur less administrative burden if this mechanism requires that the City partners with fewer solar providers than with other financial mechanisms. Since this program requires the least amount of commitment and maintenance on behalf of the customer, it would be a relatively easy sell.

c. Case Studies/Examples

Citizenre, a solar rental corporation, contracts with individual residential customers to provide them with a properly-sized solar PV system, to be paid for through monthly installments. The equipment is sized according to the customer's average electricity utilization for the past three years. The monthly rent paid to Citizenre is based on the expected performance of the system and the energy historical energy costs of the market in the customer's area, and remains at a fixed rate throughout the rental period for the equipment. Customers can opt for a year-to-year, five-year or twenty-five year agreement with Citizenre; if shorter leases are chosen, the monthly rent is recalculated at the end of the lease period. Customers are encouraged to choose the longer lease times, as the fixed rates would garner more cost savings over time as projected utility rates rise. Citizenre takes on all operation and maintenance responsibility.

e. Applications in Other Areas

There is a possibility of entering into a bulk purchase agreement in concert with the equipment lease, if there is one purchasing entity of all leased equipment. If the equipment is leased from individual retailers at a set price, a bulk purchase agreement would not be possible.

Power Purchase Agreements

a. Mechanism Structures

In a power purchase agreement (PPA), is a long term contract between a customer and a third party acting as a system owner to run a solar generating facility on a customer's site. Typically, a local utility or other third party finances and installs a solar generating system on a customer's site, and enacts an agreement with that customer that the energy can be used by the customer, with excess sold back to the third party. The third party operates and maintains the facility, and takes on the responsibilities of the turnkey agreement. Power purchase agreements can be planned for a number of years, usually ranging from 10 to 25. Typically, the third party and the customer agree upon price per kilowatt hour payback rate which would escalate over the power purchase time frame. At the end of the power purchase agreement, the customer can purchase the system back from the third party for a market value price that takes the system's depreciation into account. The property owner would take advantage of the other rebates and credits applicable to the system. Power purchase agreements are allowed under the CSI structure, with

the third party designated as the System Owner and the homeowner or business designated as the Host Customer. In this case, the City of Berkeley would most likely be the third party owner of the system, and would coordinate equipment purchases with vendor partners. The main difference between the power purchase agreement and the equipment lease system is that with PPAs, the customer pays a predetermined rate to the system owner that takes rates and system cost into account, and the system owner would pay back investors and program debts, while with the equipment lease agreement, the customer still pays utility rates, plus a rental that would pay for the cost of the system. In most examples available, the customer of these purchase agreement is a large-scale commercial or industrial entity, and the system owner is a major solar vendor. Similar to the equipment lease structure, the City would most likely seek reduced rates for system purchases through bulk purchase agreements.

b. Stakeholders and Roles

1) Property Owners

i. Risks

The main risk to homeowners is the possibility that the price-per-kilowatt/hour payback rate set by the PPA would rise more quickly than the utility's price-per-kilowatt/hour rate. Thus, the customer would have realized savings more quickly had he/she purchased the solar system independently and then used the offset costs of avoiding energy usage and utility's time-of-use rates to pay for the system.

ii. Benefits

The main benefit to the customer is an immediate decrease in energy costs without the up-front capital investment. Under most PPA agreements, the Host Customer, or homeowner, would not take on the insurance liability and technical management of the system. The customer would avoid maintenance time and costs for operating the system, and potentially liability if the system fails.

2) PV/ Solar Thermal Installers and Contractors

i. Risks

Contractors involved in PPAs would most likely be employees of the vendors that the City selects for its program. The main risk in this structure, as with equipment lease, is that the available pool of contractors would shrink, and that certain contractors who are not included may lose business. Also, the contractors may sign on for more maintenance responsibility under this program, since the customer would not initially buy the system.

ii. Benefits

The benefits, of course, would be a predetermined group of costumers that have signed on to the power purchase agreement. As with the equipment lease program, contractors may be able to reduce their marketing and sales efforts, as the City of Berkeley would take care of this for them.

3) The City of Berkeley

i. Risks

The risks to the City for power purchase agreements would be that the chosen rates would end up being higher than PG&E's, and that customers may opt out of the FIRST program. However, this may be offset by the reduced property owner risk that comes with not purchasing the equipment initially. Also, most available case studies of power purchase agreements include large-scale commercial or industrial companies as the customer, and a major solar vendor or

renewable energy investor as the system owner⁶⁴. If Berkeley takes on this program with a diverse set of residential and commercial customers as well as a group of solar and energy efficiency contractors, the administrative burden of this program may become prohibitive. The City could arrange for another third-party organization to be the System Owner, but this would still require much administrative coordination.

ii. Benefits

As with equipment lease, the aspect of this program that doesn't require customers to buy their systems up-front will make it an easier sell.

4) Lenders

i. Risks

In this example, the 'Lenders' are the third party financiers of the solar systems, that sell the power back to the Host Customer homeowners. Typically, these lenders do take on insurance and technical liability of the system. In this example, the City of Berkeley would most likely serve as the 'lender' and cover their up-front costs with bond payments. The main risk is described in the 'City of Berkeley' section, that the city would not set its PPA rates competitively. The City would have to work closely with PG&E to ensure that it offers rates that could sustain the program and be competitive for customers.

ii. Benefits

The benefit to the City as the main lender in this agreement is that it can finance the PPA with bond payments, slashing its own costs so that it can provide competitive rates to customers. This affords the City an advantage over private lenders setting up PPAs.

c. Case Studies/Examples

SolarCity, a Bay Area-based program, offers power-purchase agreements to individuals and communities wanting to install solar panels but risk-averse to purchasing their own solar panels. SolarCity is able to garner commercial rebates and incentives for solar and pass the savings on to the customer. The program participants begin saving immediately rather than waiting for a return on an investment, since the new low energy bills combined with the solar lease agreement fees are less than the customer's old energy bills. SolarCity guarantees quality performance by ensuring a repair and monitoring service for all customers. The group packages are considered bulk purchase agreements as well, since SolarCity can purchase solar equipment in bulk and get discounts, which are passed on to the customers.

Bulk Equipment Purchase Agreements

a. Mechanism Structures

In a bulk purchase agreement, a purchasing entity would procure solar systems in a large quantity at a discounted price, and redistribute the systems to property owners who had made prior reservations. The discount could either be in the form of a percentage deduction of the purchase or a rebate if the purchase exceeds a certain amount in cost or in quantity. The purchasing entity would take a small percentage of the savings as incentive to act as the purchaser. Property owners would still realize savings on their systems compared to individual

⁶⁴ GreenTech Media, "Power Purchase Agreements to Spike." <http://www.greentechmedia.com/articles/power-purchase-agreements-to-spike-591.html>

retail prices. In this case, the purchasing entity would be a third party, such as CESC, which would interface with the vendors through every step of the process to save property owners time and reduce risks associated with finding a reputable vendor. The City of Berkeley would have an administrative role in researching system prices, contractor screening and connecting participants to the purchaser.

b. Stakeholders and Roles

1) Property Owners

i. Risks

There would be essentially no financial risk to property owners, as the price they pay for their system would be an agreed-upon price set by the City and the purchasing entity. If the bulk purchase agreement lowers the price of the equipment significantly below the current market rates, the customer may have to deduct the difference from the Federal ITC.

The security risk to the property owner could vary depending on how the bulk purchase is set up. If the property owner has to provide the up front cost before receiving the system, there is a slight risk that the purchasing entity will not procure the price for the systems that they initially promised, and the property owner will have to pay full retail prices or not receive the system at all. If the property owner pays the purchasing entity after the system is received, there is essentially no security risk.

There would be minimal perception risk to the property owner. The only potential reservation would be that a bulk purchase agreement would restrict the variety of systems possible under the Solar Initiative. A property owner who desires more personal choice may not appreciate having their options limited.

ii. Benefits

The obvious benefit to the property owner would be the opportunity to pay a below-market price for their solar system. Also, if the initial price is reduced, this may still be allowed under the Federal personal tax credit, so the property owner would not have to choose between the two incentives.

2) PV/ Solar Thermal Installers and Contractors

i. Risks

Since the bulk purchase agreement structure aims to impart economies of scale to the buyer for purchasing the same item in bulk, contractors could risk a restriction on the equipment that they are allowed to install under this program. If the City of Berkeley only purchases one brand of equipment, contractors who have experience or exclusive contracts with that distributor will have an automatic advantage over contractors who are accustomed to working with different types of equipment. The contractor focus group participants were strongly opposed to this option.

ii. Benefits

As mentioned above, contractors who have experience working with the chosen equipment will have a clear advantage. Other benefits could include the avoiding time spent in helping the customer decide which vendor or brand of equipment to purchase; if the equipment type has already been selected, the contractors may be able to expedite installation.

3) The City of Berkeley

i. Risks

The risks to the City depend on whether the City acts as the purchasing entity, or whether this is delegated to another entity. If the City acts as the purchasing entity, the City must raise the initial funds to purchase the equipment, which could incur financial risks, especially if the property owners could reserve the equipment with no collateral. This risk to the City would be reduced if the property owners had to make down payment for the equipment initially, and the City reached a quota before making a purchase of equipment. Still, this option may require initial costs and administrative fees that the City would have to pay for through bond programs, program cuts or raised taxes. The financial risks would be minimal if the City of Berkeley delegated the purchasing to another entity.

If the City of Berkeley acts as the purchasing entity, there might be some regulatory risks if the City must choose a certain system or consortium of systems, which would seem like endorsement of a specific product. Because of this potential legal constraint, the purchasing entity would probably have to be another financial institution.

ii. Benefits

The main benefit to the city would be that the price discounts for the solar systems would translate into reduced financing burdens under the FIRST program. The City would also solidify partnerships with solar vendor and contractor organizations, lending credibility to the program.

Conclusions and Next Steps

The analyses outlined in this background paper will serve as a reference and data source for the recommended finance mechanism that will lend the most value to customers and remain feasible for the City of Berkeley and its finance partners to implement.

Regulatory White Paper

Regulatory Factors Affecting the Berkeley Solar Initiative
Background Paper

DRAFT

Executive Summary

Numerous regulatory issues impact the adoption of solar electric or water heating technologies in the City of Berkeley. Many of these regulations reduce barriers for residential and commercial customers looking to install solar systems, while others make the adoption of solar technologies more difficult or less attractive for customers or potential program partners. This section introduces key regulations that affect the installation of solar technologies and offers practical recommendations for reducing barriers.

Existing Regulations

1) State and Local Policies and Ordinances

State and local policies and ordinances provide strong protections to customers who wish to install solar systems in Berkeley, or have existing systems in place. None are expected to act as significant barriers to installing solar.

a. Design review

California Assembly Bill 2473 encourages solar installations by removing permitting obstacles and minimizing permitting costs. The bill states “it is the intent of the Legislature that local agencies do not adopt ordinances that create unreasonable barriers to the installation of solar energy systems, including, but not limited to, design review for aesthetic purposes...” and “A city or county shall administratively approve applications to install solar energy systems through the issuance of a building permit or similar nondiscretionary permit...” The bill also limits aesthetic restrictions to revisions that cost less than \$2000.

In the City of Berkeley, for projects that are subject to design review for reasons other than the solar equipment, Land Use Planning staff provides the following services:

- Zoning Certificates or other over-the-counter approvals: Voluntary review by design review staff. While not required, design options that do not significantly increase the cost of the installation or decrease its efficiency might be suggested.
- Administrative Use Permits or Use Permits: Design Review Staff will need sufficient information on the proposed solar equipment to evaluate how the solar equipment works with the proposed building design.

b. Solar access and easements

California Public Resources Code 25980, the Solar Shade Control Act, states that “no person owning, or in control of a property shall allow a tree or shrub to be placed, or, if placed, to grow on such property, subsequent to the installation of a solar collector on the property of another so as to cast a shadow greater than 10 percent of the collector absorption area upon that solar collector surface on the property of another”.

California Civil Code 801.5 states that “direct sunlight to a specified surface of a solar collector, device, or structural design feature may not be obstructed”. The City of Berkeley expands and strengthens these solar rights in Municipal Code Chapter 12.45, Solar Access and Views; and Section 21.36.040, Solar access easements. However,

Ordinance No. 6462-N.S., the Oak Tree Removal Ordinance, would seem to directly contradict solar rights ordinances in some situations. This ordinance places a moratorium on the removal of certain Coast Live Oak trees and does not provide an exception for solar access or easements. It is not clear whether solar rights or oak trees would take precedence, but the Municipal Code does provide guidance in how to handle related disputes.

c. Covenants, Conditions, and Restrictions (CC&Rs)

AB 2473 states that homeowner associations' CC&Rs that prohibit or unreasonably restrict the installation or use of solar energy systems are unenforceable. Reasonable restrictions (defined as those that do not increase the cost or reduce the output of a solar system from the original design by more than 20%) are allowed and include:

1) that the owner of the system take responsibility for roof maintenance, repair and replacement and 2) that the installers indemnify the association for any damage caused by the installation, maintenance, or use of the solar energy system.

As significant costs might be incurred for roof maintenance, a homeowner should negotiate with an HOA about this issue before proceeding with a project. Any homeowner with a roof directly above their unit can use the roof for a solar installation.

d. Other issues

Solar energy equipment is exempt from Berkeley's Creek Ordinance (BMC Section 17.08.045), which limits construction near creek culverts. Berkeley's Zoning Ordinance (BMC Title 23) also excludes solar energy equipment from 1) height limits for main buildings, and 2) lot coverage limits. However, an AUP must be requested if solar energy equipment is to encroach into required setbacks.

e. Permit approval

California Health and Safety Code 17959.1 states that "a city or county may not deny an application for a use permit to install a solar energy system unless it makes written findings based upon substantial evidence in the record that the proposed installation would have a specific, adverse impact upon the public health or safety, and there is no feasible method to satisfactorily mitigate or avoid the specific, adverse impact".

2) Building Codes and Permits

Solar installations must meet building and safety codes. To apply for state, federal, and local incentives, permits must be obtained. Please reference Berkeley's Applicant Check List for Solar Panel Installations.

a. Electrical

An electrical permit is required for solar electric installations. The electric code does not specifically address solar projects, so these regulations should not unduly impact installation.

b. Plumbing

A plumbing permit is required for solar hot water installations.

c. Structural

A building permit is required if a structural plan check is needed (eg, for structural framing upgrades to the roof assembly).

d. Fire

In most cases, fire codes should not impact solar hot water installations. For solar electric installations on one- and two-family residences with sloped roofs, 18” of clearance is required on either side of the ridge. If that clearance cannot be provided, the Fire Department must review the plans. For commercial occupancy or residential structures with 3 or more living units, the Fire Department must review all solar electric permit applications.

e. Permit Fees

The City of Berkeley encourages solar installations by waiving building permit fees for solar installations on single-family homes and duplexes, which typically range from \$100 to \$200 per installation. Permit fees for solar projects for one and two-family dwellings are as follows:

- Solar Hot Water - Plan check fees are waived unless structural work to the roof assembly is required. A plumbing permit and minimum plumbing permit fee are required. Plans are required.
- Solar Electric - Plan check fees are waived unless structural work to the roof assembly is required. An electrical permit and minimum electrical permit fees required. Plans are required.
- If structural plan check is needed, a building permit fee shall be charged based on the valuation of the structural work and associated work related to installation of the solar panels.

Building permit fees for solar installations on structures other than one- and two-family dwellings include plan check fees based on the valuation of the project, excluding equipment. The City is encouraged to consider offering similar fee waiver incentives to small businesses.

3) City of Berkeley Contractor Requirements

Should the City enter into contracts with installers or other contractors to implement this program, the contractor will be impacted by various requirements including:

- a. Berkeley Living Wage Ordinance (BMC Chapter 13.27): ensures that businesses contracting with the City pay employees a wage that will support a family at or above the poverty level.
- b. Berkeley Equal Benefits Ordinance (BMC Chapter 13.29): protects the public health, safety and welfare by prohibiting discrimination in the provision of employee benefits by City contractors between employees with spouses and employees with domestic partners, and/or between domestic partners and spouses of such employees. “Contractor” refers to any person or persons, firm, partnership, corporation, or combination thereof, who enters into a contract with the City.
- c. Berkeley’s Non-Discrimination Ordinance (5876-N.S.) assures that contractors for the City of Berkeley do not discriminate against any employee or applicant for employment. City contracts for construction projects valued at over \$100,000 are required to contain a First Source Agreement except if the contractor has less than

five employees. By signing a First Source Agreement, local employers agree to let the City know about available jobs, and the City of Berkeley then recruits qualified workers for referral to the employer.

- d. Local vendor preferences: The City extends a 5% preference on bids to local business enterprises for supplies, equipment and nonprofessional services from \$100 to \$25,000.
- e. Business license and taxes (BMC Chapter 9.04): The City requires that businesses in Berkeley have a current Business License, pay annual Business License Taxes for each location, and pay other taxes specific to certain types of businesses. These requirements are standard and not expected to place undue burden on solar-related businesses.

4) Distributed Generation

- a. PV interconnection and net metering

California Rule 21 requires that customers operating a generating facility (eg, solar panels) in parallel with the utility grid receive written authorization to do so. Also, for homes to participate in the California Solar Initiative (CSI) incentives program, eligible renewable energy systems must be permanently interconnected to the electrical distribution grid of the utility serving the customer's electrical load.

Net metering provides a way to measure the difference between electricity purchased from a utility and the electricity produced using non-utility owned generating equipment. An electric meter keeps track of this "net" difference. In California, any residential or small commercial electricity customer who generates at least some of their electricity from solar energy and does not exceed 10 kW of peak output is potentially eligible for net metering.

PV systems under 10 kW qualify for net metering and "simplified interconnection" (no supplemental review or interconnection studies are required). These systems must comply with the requirements in National Electrical Code Article 690 and UL 1741. Utilities are required to provide a bi-directional meter for net-metered systems, but system owners who choose to employ time of use (TOU) metering will have to pay for the new meter.

An interconnection agreement with PG&E is entered into by submitting appropriate application forms, and the Net Energy Metering (NEM) application is required to install a PV system that will operate in parallel with the utility grid.

- b. Energy audit

In addition to other program requirements, CSI requires an online or phone energy audit in all but these three cases:

- Energy audit has been completed within the past 36 months
- Home is ENERGY STAR or LEED certified
- Home complies with the 2001 or 2005 CA Title 24 Energy Code

PG&E does not require action on audit results but recommends that energy efficiency improvements be made. A certified building inspector must approve the solar installation, and compliance documentation and performance specifications must be submitted to PG&E. PG&E engineers will then complete an on-site inspection and install the net energy meter.

c. Contractor licensing/credentials, product specifications, and other auditing requirements: see Audit Standards White Paper

d. Insurance/risk management

The CSI incentive program has no insurance requirements for systems <30 kW. For systems 30 kW or greater, CSI requires that the Host Customer and System Owner have minimum levels of homeowner liability insurance or commercial general liability insurance for the term of the CSI program contract.

Non-residential projects must also show: 1) proof of Worker's Compensation or self-insurance indicating compliance with any applicable labor codes, laws, or statutes at the Site where Host Customer or System Owner performs work; and 2) business auto coverage at least as broad as the Insurance Services Office California Business Auto Coverage Form (CA 00 01 03 06) covering Automobile Liability symbols 7, 8, and 9 for autos that will be used in connection with the project.

Utility companies typically require proof of insurance coverage for an interconnection agreement. Most standard homeowner insurance policies provide adequate insurance protection and generally meet a utility's minimum requirements. However, PG&E does not require purchasing of any additional liability insurance assuming that a system meets applicable safety and performance standards.

For additional information, please see the Existing Finance and Incentive Mechanisms – State – The California Solar Initiative section.

Conclusion and Recommendations

Numerous regulatory issues impact the adoption of solar electric or water heating technologies in the City of Berkeley. Many of these regulations reduce barriers for residential and commercial customers looking to install solar systems, while others make the adoption of solar technologies more difficult or less attractive for customers or potential program partners.

In terms of state policies and local municipal codes and zoning ordinances, the City of Berkeley is very encouraging of solar technologies for both single-family homeowners and those covered by homeowner associations. However, at least one local ordinance seems to contradict solar rights: the Oak Tree Removal Ordinance, which places a moratorium on the removal of certain Coast Live Oak trees and does not provide an exception for solar access or easements. It is not clear whether solar rights or oak trees would take precedence in the case of a dispute, and we encourage the City to develop clear guidance regarding this issue.

Solar installations must meet building and safety codes. The City should review its Fire Department review standards and processes and ensure they are not overly restrictive.

The City of Berkeley encourages solar installations by waiving building permit fees for solar installations on single-family homes and duplexes and is encouraged to consider offering similar fee waiver incentives to small businesses.

If the City wishes to enter into contracts with installers or other contractors to implement this program, certain City contract requirements might make program implementation more complex and limit the pool of available expertise. It is probably in the program's best interest to model the program in a way that avoids contracting directly with installers and contractors.

Audit Standards White Paper

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Audit Standards for the Berkeley Solar Initiative
Background Paper

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Executive Summary

In order to uphold quality standards and maintain credibility of the Berkeley Solar Initiative, the program team has researched audit standards for the analysis, installation and operation stages of upgrades for the Solar Initiative. These audit standards include auditor credentials, data collected and analyzed in audits, third party verifications of auditors, QA/QC programs, conflict of interest protocols, sampling and customer feedback.

The Berkeley Solar Initiative is structured such that participants will be encouraged to implement energy efficiency upgrades before they can qualify for financing assistance under the Financing Initiative for Renewable and Solar Technology (FIRST). The Berkeley Solar Initiative team believes that a handpicked set of audit standards that borrows the most germane parts of existing standards will deliver quality installation and performance while allowing participant flexibility and keeping current supply chains intact. The following analysis outlines existing audit and verification standards for energy efficiency upgrades, solar PV and solar hot water systems. This background paper describes and analyses audit standards in the following programs: The California Solar Initiative, PG&E's photovoltaic interconnection process, the Home Energy Rating System (HERS) requirements through Title 24, the California Building Performance Contractor's Association (CBPCA) Home Upgrade program, GreenPoint Rated for Existing Home Program, the Residential Conservation Ordinance (RECO) through the City of Berkeley, the Commercial Conservation Ordinance (CECO) through the City of Berkeley, and plumbing inspections for solar hot water within the City of Berkeley. This background paper will inform the final decisions made for the audit standards and verifications used in the Berkeley Solar Initiative.

Berkeley Solar America Initiative- Information Requirements to be Assessed through Audits

Customer

The intention of the Berkeley Solar Initiative is to make energy efficiency and solar technologies more accessible to a wider cache of customers, especially those who would not have pursued solar without a convenient one-stop source of information. As such, the BSI services should be available to as many interested parties as possible, so auditing for customer viability should only extend to financing. The Berkeley Solar Initiative Team has evaluated the possibility of pre-screening customers for participation in the program and has decided that pre-screening would be overly disruptive to existing sales mechanisms of solar contractors and would detract from the efficacy of the program. Berkeley Solar Initiative contractor focus groups have unanimously expressed that rigorous customer selection would serve as a disincentive for participation in the program.

Installer

From these contractor focus group feedback meetings, the Solar Initiative Team has determined that instituting a quality assurance requirement with inherent audits for contractors would add value and credibility to the program. Contractors must have the minimum credentials in order to legally perform their services, as well as additional certifications by third party organizations that we have identified as setting quality standards for installing energy efficiency and renewable

energy. Additionally, the California Solar Initiative has designed customer feedback mechanisms to evaluate quality of contractor services. The Berkeley Solar Initiative plans to create a local customer feedback mechanism to further assess contractor performance and determine minimum criteria for participation in the Berkeley Solar Initiative.

Property

Property specifications and current energy performance greatly impact the type and quantity of technologies that can be feasibly implemented under the Berkeley Solar Initiative. As such, audit standards and minimum information gathering are essential to installing systems effectively and appropriately. We have identified information needed from the property in the following chronological steps for each technology option under the Berkeley Solar Initiative:

Energy Efficiency

- 1) Current energy usage- may involve a series of diagnostic tests including but not limited to: duct blaster tests, blower door tests, visual inspection of HVAC and building envelope, thermal leakage tests and indoor air contaminant tests. This audit may include an analysis of energy bills.
- 2) Final energy usage- a final analysis of energy use and systems operation after upgrades and improvements have been completed. Will most likely involve the same tests used in the diagnostic and a comparison of current and past energy bills.
- 3) Installation verification- the installation of new equipment and upgrades will be inspected for quality.

Solar PV

- 1) Roof Orientation
- 2) Azimuth
- 3) Roof Area
- 4) Roof shading
- 5) Electrical Setup – an evaluation of current electrical systems and prewiring for solar.
- 6) Equipment standards verification- an assessment of whether the equipment meets CSI baseline standards, or other standards promulgated by the Berkeley Solar Initiative.
- 7) Installation verification
- 8) Operation status

Solar Hot Water

- 1) Roof Orientation
- 2) Azimuth
- 3) Roof Area
- 4) Shading
- 5) Plumbing Setup- an evaluation of current plumbing systems and water heating storage capacity to assess compatibility for a solar heating system. If the plumbing and water heating system needs to be modified, the auditor shall make a recommendation.
- 6) Equipment standards verification- an assessment of whether the equipment meets SRCC baseline standards, or other standards promulgated by the Berkeley Solar Initiative.

- 7) Installation verification
- 8) Operation status

Equipment

The quality of the equipment to perform these technologies is crucial in delivering the benefits to customers in participating in the Solar Initiative. As such, there must be standards for equipment that will be verified by auditing. Equipment standards must be checked during the application stage to see that equipment specifications meet the requirements of the program, and after the system is installed and operational, to ensure that the installed system is the same as recorded on the application, and that the system is installed correctly.

Interconnection/ Operation

Customers will not realize any benefit from the program unless the equipment and services are in full operation and interconnected, if applicable. Audit standards for the Berkeley Solar Initiative must include a confirmation that the system or technology is operating within its fully capacity, and that the customer is experiencing expected benefits.

Analysis of Existing Audit Standards Requirements

Whole House Systems Audit Standards

1) GreenPoint Rated Existing Home Rating System

Purpose

GreenPoint Rated is Build It Green's residential green building program for new construction, a rigorous point-based program aimed at building homes at least 15% more energy efficient than current California energy code. GreenPoint Rated Existing Home will be available for use in July of 2008 to assess and evaluate environmental performance of existing homes for the whole home or components of homes. The evaluation tool for GreenPoint Rated is the GreenPoint checklist, a point-based chart summarizing suggested measures for increasing environmental and energy performance of homes. To assure quality and impartial evaluation of green building techniques and upgrades, Build It Green has designed a third party verification and quality assurance protocol in the GreenPoint Rated process. The purpose of the third party rater is to verify whether or not the applicant has successfully achieved the measures stated on the project's initial GreenPoint checklist, and to provide an unbiased evaluation. The third-party verification preserves the integrity of the GreenPoint Rated program.

Depending on the extent of the green home improvements, the home will receive either an Elements or Whole House consumer label. An Elements label is provided to homes that meet basic requirements in each of the five environmental categories and are on track to make additional improvements over time. A Whole House label is awarded to homes that meet more extensive requirements and have made comprehensive green improvements.

Auditor Credentials

GreenPoint Raters for Existing Home, must meet the prerequisites set forth by Build It Green. First, the auditor must be a certified GreenPoint Rater. Second, the rater must also complete the GreenPoint Rated Existing Home training and pass the exams. The auditor must also possess at least one of the following licenses:

- 1) Home Energy Rating Systems (HERS) Rater by CHEERS, CalCerts or CBPCA
- 2) CBPCA training certification
- 3) CHEERS for existing homes training certification

When these provisions are met, the auditor receives a GreenPoint Rater Existing Home certification valid for two years. In order to maintain certification, the auditor must conduct at least two ratings and achieve 16 continuing education units (CEUs) as identified by Build It Green over within two years of certification. The GreenPoint Raters must comply with Build It Green's code of conduct.

Verification Requirements

The auditor is obligated to conduct a non-invasive physical examination of the building systems, structures, materials and components to evaluate its energy efficiency, water efficiency, indoor air quality, resource conservation efficacy of materials and construction practices and construction quality. As with GreenPoint Rated for New Construction, these verifications may include paper documentation (invoices and purchase orders), visual inspections and/or testing protocols. A new development in the Existing Home rating system is that the Rater can allocate a measure based on a percentage of the home if the measure does not apply to the home as a whole. Detailed verification protocols are described in the GreenPoint Rated Existing Home Rating Manual.

Before a home can be deemed viable for the program, the home must meet all baseline prerequisites. The Rater will verify that these prerequisites are met or can be met before rating the entire home.

The prerequisites for the Whole House rating include but are not limited to recycling construction and demolition debris generated from any remodeling project, installing water efficient plumbing fixtures with no leaks, ensuring basic electrical integrity, conducting an energy consumption evaluation, combustion backdraft testing and conducting diagnostic tests of the home energy performance and HVAC system. The home energy performance prerequisite is carried out by a home performance contractor who may, under certain circumstances be the GreenPoint Rater. This requirement consists of a visual inspection of insulation and the HVAC system and an air leakage test. The intent of this measure is to ensure that the HVAC system is properly installed and operating correctly, and that the home is sufficiently tight and ventilated. The home performance contractor will also evaluate utility bills if appropriate. At the end of diagnostic testing and remedial actions, the duct leakage must be less than 15% and the total air leakage of the home must be less than 0.5 air changes per hour (ach)⁶⁵ or 50% improvement. The home must be modeled by Build It Green's energy modeling package or other an approved energy software package. The home performance contractor must provide a report on the overall home performance to the Rater for verification.

⁶⁵ Prerequisite J.1 HVAC Diagnostic Evaluations for GreenPoint Rated Existing Home

The baseline requirements for the Elements program are less rigorous and extensive than those required for Whole House. The Rater will verify that these prerequisites are met or can be met before rating elements of the home. These prerequisites include but are not limited to: and energy survey, recycling construction and demolition debris generated from any remodeling project, no plumbing leaks and passage of a combustion backdraft test. The energy survey encompasses a blower door test and visual inspection of the HVAC system and thermal envelope. As with Whole House rating, the property must meet minimum thresholds set in each green building category. At the end of the rating, the rater will provide the homeowner with a progress report that acknowledges green improvements across categories, provides a home energy survey and calculates additional points or measures needed to achieve an Whole House rating.

Sampling

The sampling protocols for GreenPoint Rated are developed for the new construction production built environment. There are no sampling protocols for the Existing Home market. Each home is different and must be evaluated separately.

Third Party Audits and Conflict of Interest Provisions

Build It Green maintains conflict of interest provisions to deter auditors from having a stake in the projects they are evaluating. The conflict of interest provisions for GreenPoint Rated require that auditors cannot:

- 1) Perform or offer to perform repairs on a project that has been evaluated by the rater in the last year,
- 2) Rate any project where the auditor's company has a central role (other than the HERS Rater or Home Performance Contractor),
- 3) Rate any property in which the auditor has any financial interest, as a lender or investor,
- 4) Rate any project in which the auditor has financial or familial ties with the builder, architect, contractors or subcontractors,
- 5) Rate any project for which the auditor has regulatory oversight,
- 6) Offer to compensate the client for referral of the auditor to any other project or business,
- 7) Rate homes where the contract or fee of the auditor is contingent on the result,
- 8) Accept compensation for recommending contractors, products or suppliers.

To clarify the role of the GreenPoint Rater and the Home Performance Contractor in the Existing Home rating system:

- 1) The GreenPoint Rater and the Home Performance Contractor can be one and the same given the Home Performance Contractor is not making upgrades to the home.
- 2) If the Home Performance Contractor is making upgrades to the home, the GreenPoint Rater must conduct or visually verify the "test out" procedure by the Home Performance Contractor.

In general, auditors must be honest and objective with their clients. Auditors must not disclose ratings or other details of evaluated projects to any third parties other than Build It Green.

Quality Assurance

Build It Green conducts quality assurance of the auditors by conducting a documentation review of every project that is GreenPoint Rated for existing homes. The Rater must submit hard copies of all supporting documentation to Build It Green for each project. If the home passes and becomes GreenPoint Rated, Build It Green will keep the documentation for five years.

Build It Green also field verifies the greater of one home or one percent of the Rater's projects per year. The independent Build It Green verification must confirm that the auditor's work adhered to the correct GreenPoint Rated verification protocols, that at least 90% of the credits awarded were accurate and that Build It Green and the auditor reached the same final outcome (pass or fail). If these provisions are not met, Build It Green will conduct three more verifications of the auditor's work at the auditor's expense. If the auditor fails two quality assurance reviews, he or she must retake the training and other requirements.

Build It Green has an in-house Oversight Committee to investigate client complaints and take enforcement action if necessary. The Committee may choose to investigate a client complaint, and will notify the Rater if it chooses to do so, and describe the nature of the complaint. The Rater has two weeks to respond to the charge in writing and submit relevant data. No response will be taken as an admission of guilt. The Rater's projects and the home in question will be suspended until the investigation is resolved. The Oversight Committee will determine whether a misconduct has occurred and will enforce penalties as appropriate. The Rater may appeal to the Committee if they believe the judgment was in error, and this will result in a hearing with the Committee.

Raters must comply with Build It Green's code of conduct and logo restrictions.

Cost

GreenPoint Raters set their own rates so it is difficult to estimate a cost range for a complete rating. For new homes, rates tend to range from \$800 to \$1,500. The fees for GreenPoint Rated Existing Home will vary dependant on, among other things: 1) the role of the rater and home performance contractor, 2) the extent of the rating (Elements rating or Whole House rating).

PV/ Solar Thermal Audit Standards

1) California Solar Initiative- Photovoltaics

Purpose

The purpose of audit standards under the CSI is to ensure that all systems comply with local, state and Federal regulations, and that the systems are operational, interconnected and meet all the criteria promulgated under the CSI program. The Program Administrators of the investor-owned utilities are tasked with conducting or delegating audits of eligible systems.

Auditor Credentials

All auditors must be trained by the Program Administrator's department in the applicable investor-owned utility. The utility must submit its inspector training program for review and approval by the CEC. The auditors are typically interconnection inspectors, utility personnel or other contractors.

Installer Credentials

The installer must have an A, B, C-10 or C-46 license for photovoltaics, and their company must be listed with the utility Program Administrator. To remain eligible, a company must resubmit all information annually by March 31. This annual submittal is required even if the information identified in the company's prior submittal has not changed. In addition, a company must submit updated information any time its reported information has changed. The

updated information must be submitted to the Program Administrator within 30 days of the change of any reported information.

. Installers are allowed to stay in the database based on performance; if an installer accumulates three “strikes” for faulty system installations, they are removed from the eligibility list for one year and must reapply. Installers must prove worker’s compensation insurance, auto insurance and commercial general liability insurance of \$1,000,000 for each occurrence and \$2,000,000 aggregate. The CEC maintains a searchable database of installer organizations that continue to meet the CEC’s performance criteria. Please see Appendix 1 for a list of approved installers within a 20-mile range of Berkeley, CA⁶⁶.

Equipment Standards

Equipment vendors must be certified by the CEC, and are required to submit an application with their licenses and proof of good standing annually, consistent with the requirements for installers. The CEC maintains a list of eligible equipment on their website, which is evaluated based on warranty, testing and performance criteria. Starting in 2007, all systems must have a 10-year warranty. Please see Appendix 2 for a list of CEC-eligible equipment.

In addition, the CPUC mandates that every CSI participant arrange a Performance Monitoring and Reporting Service (PMRS) device that will collect instantaneous data and make this data available to the System Owner or Program Administrator upon demand. This minimum data shall be AC kW and net kWh collected no less frequently than every 15 minutes. The data will be aggregated at least once a day. The device must be able to send data electronically, and archive compiled data for at least two years for EBPP participants and five years for PBI participants. For systems under 30 kW, the cost of the PMRS may not exceed 1% of the system cost, and for systems over 30 kW, the cost of the PMRS may not exceed 0.5% of the system cost. If the applicant can prove that any PMRS will exceed these thresholds, the applicant is exempt from the PMRS requirement.

Data Collection

The host or the applicant must be present for the inspection or if they are not present, they must notify the inspector in writing beforehand. The auditor will ensure that the following criteria are met:

- 1) Every unique PV array has a different EPBB calculation. This includes arrays with separate PTC rated outputs, sections with different tilts or azimuth angles, arrays with different inverter models.
- 2) The model, manufacturer and number of modules in the system match the application. The nameplates on the equipment must belong to the System Owner.
- 3) The equipment is on the CEC list of approved equipment for the CSI
- 4) The AC output sum of the equipment matches that of the application.
- 5) The inverter peak efficiency meets that of the application
- 6) The site electric meter meets the net energy consumed at the site, as determined by the auditor. The net generation meter must match the total output of the PV modules at 2% accuracy for PBI systems and 5% accuracy for EPBB systems.
- 7) The modules are permanent and not mobile

⁶⁶ Based in zip code 94702

- 8) The modules serve the host site
- 9) The attachment method of the module is noted (anchored, racked, self-ballasted, building-integrated) and the location is noted.

The auditor will also conduct the following tests:

- a. True azimuth documentation: the auditor will conduct an independent assessment of the azimuth, or horizontal direction, of the system. The auditor will perform the readings using a handheld compass, and correct the reading to the true azimuth by adding the magnetic declination of the region to the reading.
- b. Tilt documentation: the auditor will determine the tilt of the module compared to the sloped edge of the panel, using a inclinometer or digital level.
- c. Shading documentation: Use an approved tool⁶⁷ to conduct a shading analysis by taking shading measurements at the major corners of the array. Objects in the northerly direction of the array between 305 and 55 degrees of the northerly points of the array do not count against minimal shading requirements, nor do objects whose distance from the array is more than twice the object's height. If shading objects have elevation angles of less than 26.6 degrees, these are not considered shading objects.
- d. Measure sky cover, temperature and time of day of the inspection. Take an irradiance measure in the plane of the array.
- e. Confirm all documentation with photos

Verification Requirements

As mentioned, the inspectors are checking to see that systems are operational and interconnected as represented in the CSI Incentive Application.. The criteria for this inspection are described under the 'Data Collection' section.

A system may fail the CSI Audit for either a mechanical failure or a compliance failure. A mechanical failure is the result of one or more system components not operating properly. A compliance failure is defined as a situation where the purchased system does not match the system on the application or does not meet the CSI eligibility criteria.

The auditors, at the discretion of the Program Administrators, must also determine if these failures are *material*, meaning they result in a decline in the system's expected performance, or *immaterial*, meaning the fault is minor and repairable within 60 days. The Applicant, Host Customer, and/or System Owner will then have 60 calendar days to bring the system into compliance or the application will be cancelled, determined to be a failed inspection, and a strike will be imposed. For a mechanical failure, the field inspector and/or the Program Administrator will determine if the strike is imposed against the Installer, Applicant, seller, or other responsible party, subject to appeal. For a compliance failure, the strike is imposed on the entity that signed and submitted the erroneous information on the project application and/or subsequent incentive claim form, unless the Installer or Applicant can demonstrate that another party, such as a seller or consultant, is responsible. However, if a system's *material* failure is due to gross negligence or intentional fraud, the responsible party is immediately prohibited from participating in the CSI for one year

If an applicant, installer or seller fails two inspections, they are placed on probation, wherein every project involving that party will be inspected. If they fail three inspections, they

⁶⁷ Solmetric SunEye or Solar Pathfinder with assistance software

are disqualified from participating in the CSI for one year. For high-volume installers, a strike may expire after one year under certain conditions.

Home Requirements

Beginning January of 2007, all participants in the CSI must undertake an energy audit of their home in order to confirm compliance with baseline energy efficiency requirements. Accepted audit formats are online or phone protocols, but utilities can opt for more extensive audit formats. Customers are exempt from conducting the audits if the customer 1) has had a home energy audit from a local utility, independent consultant or HERS rater in the last three years, 2) can provide documentation of Title 24 energy compliance from within the last three years⁶⁸ or 3) is certified through LEED or Energy Star. PG&E only requires a phone or energy audit through their Smart Energy Analyzer.⁶⁹

Customer, Installer and Equipment Requirements

The customer must be in the territory of or receive service from the investor-owned utilities: PG&E, SCE or SDG&E. The customer is designated as the Host Customer and the System Owner (unless the equipment is leased) and will appear on all the documentation and contracts with the utility. The applicant, however, can be the Host Customer or a third party, such as the installer.

Application Process

In order to apply for the program, the customer must work with their solar installer to initially apply for the rebate by submitting a Reservation Request including a description of the system, electrical sizing documentation and other information. The participating utility then evaluates the application, deems eligibility, and sets aside funds for the applicant. The utility then sends a reservation confirmation. If the project is PBI or non-residential, the customer and installer then have 60 days to provide “adequate proof of progress” towards installation to the program administrator at the utility. Upon receipt of the reservation confirmation, the customer has 12 months to install the system and submit an Incentive Claim Form, including cost documentation, in order to hook the system up to the grid and receive the rebate. Non-residential customers must pay an application fee of 1% of the requested amount.

PG&E administers the CSI within their service territory. PG&E has divided the process into six steps: 1) Conduct an energy audit; 2) Choose an installer to do a site survey; 3) Complete the CSI application; 4) Arrange a final building inspection; 5) Arrange a final utility inspection; 6) Claim incentive.

1) Conduct an energy audit

PG&E requires an energy audit before applying for the CSI, either over the phone or through their web program, Energy Analyzer. Customers are exempt from the audit if they meet the exemption requirements listed in the CSI section above. Currently, there is no action required on the audit, though action is recommended.

2) Choose an installer to do a site survey

PG&E requires that customers work with an installer to determine the best system for the site. Installers must be listed and certified by the CEC, but there are no further restrictions.

3) Complete the CSI Application

⁶⁸ For residential customers: Title 24 CF-1R form; for commercial customers, one or more of the following forms: ENV-1-C, MECH-1-C, LTG-1-C, OLTG-1-C. Only Certified Energy Plans Examiners (CEPE) or California Association of Building Energy Consultants may provide documentation.

⁶⁹ <http://www.pge.com/myhome/saveenergymoney/analyzer/en/>

Customers must enter into an Interconnection Application Agreement with PG&E. PG&E requires a Net Energy Metering (NEM) application to fulfill this requirement, and has a standard form for systems under 30 kW and an expanded form for systems over 30 kW. Customers can either elect to continue service with their applicable standard rate or a to choose a time-of-use rate. New customers planning their systems after January 1, 2008 will have to pay reprogramming fee of \$228.00 if they elect PG&E's time-of-use rates: the new E6 schedule. The standard NEM application includes an application form, a single-line diagram of the installation, a building department permit and a fee, if applicable. PG&E will inspect any NEM installation and install the appropriate meter for grid-connection, although the customer must pay for the meter itself. Once the application is received, PG&E will interconnect within 30 days.

4) Final Building Inspection

If the customer's local jurisdiction requires a building inspection, PG&E requires that this must be conducted before the utility's on-site inspection.

5) Final Utility Inspection

PG&E will conduct a free, on-site inspection of the system before the CSI rebate can be claimed. As the CSI mandates, PG&E field inspectors will audit all EPBB systems between 30 kW and 100 kW, and randomly inspect systems under 30 kW. These random inspections must represent a "statistically reasonable" Sample. Per the guidance of the CPUC, PG&E inspects one out of every seven systems under 30 kW. PG&E inspectors ensure that the design factor, tilt, orientation, shading and azimuth match the specifications in the EPBB calculation, and that the system is operational. All field inspections are performed by PG&E staff or approved subcontractors.

6) Claim Incentive

The customer can then submit the CSI Incentive Claim form to PG&E.

Sampling

Program Administrators must conduct audits of all systems between 30 kW and 100 kW, and will inspect one out of every seven systems under 30 kW, per the requirement of the CSI program. From this threshold, we can assume that most commercial installations and some residential installations will be audited. All large commercial installations will be inspected.

Third Party Audits and Conflict of Interest Provisions

All CSI systems selected for inspection are inspected by investor-owned utility staff members or approved and trained subcontractors. This provision provides enough distance between the inspector and the customer as to avoid a conflict of interest.

Quality Assurance

There are several mechanisms at play in this structure that ensure quality equipment specifications and installation. The equipment must be on the CEC's approved list of solar equipment before the applicant can qualify for the rebate under CSI, thereby ensuring that the equipment is reliable and well-researched. The contractor and associated company must also meet the minimum performance criteria of the CEC; if the contractor fails three inspections, they cannot install for the CSI. Finally, PG&E's audits of one in seven systems under 30 kW instills enough concern that an individual system might be selected to ensure quality installation.

2) California Solar Initiative- Solar Hot Water Pilot

Purpose

The Solar Hot Water Pilot program under the California Solar Initiative is intended to be a scaled-down trial program that will inform a future expansion to become a statewide incentive program, much like the existing CSI program for photovoltaics. The 18 month pilot program began over the summer in 2007 and will officially end in January of 2009. Currently, the solar hot water pilot is underway in the San Diego Gas and Electric Co. service area. The program is funded by San Diego Gas and Electric Company and is administered by the California Center for Sustainable Energy, a San Diego-based nonprofit. The program is designed to encourage adoption of solar hot water heating systems to offset all types of water heating systems by offering educational and financial rebates to property owners. Results from the pilot program will inform state policy makers of the barriers and challenges to a widespread solar hot water program, and how to overcome these barriers.

The program budget for this pilot program is \$1.5 million dollars, of which \$900,000 is reserved for residential and small commercial systems, and \$600,000 is reserved for innovative and large commercial systems. There are two installation choices in this pilot project: prescriptive method and area method. Small commercial and residential systems will use the prescriptive method, which is based on the Solar Rating Certification Corporation (SRCC) and the solar orientation factor (SOF). Since the City of Berkeley program will cater mainly to residential and small commercial, this analysis will focus on the prescriptive option.

Auditor Credentials

CCSE program staff performs all application reviews and building inspections.

Installer Credentials

Contractors must be licensed by the California State Contractors' Licensing Board. The contractor must have a valid license A, B, C-36 or C-46 license. They must also be registered CCSE, and must meet the requirements in the contractor participation guidance. Contractors are encouraged to become certified by the North American Board of Certified Energy Practitioners (NABCEP). Contractors must have at least \$1 million in general liability insurance, worker's compensation insurance and auto insurance. The contractor must re-register to CCSE once a year. The contractor may not also sell equipment to the participant. Additionally, the CCSE holds contractor trainings at its headquarters every two months to ensure that contractors are installing systems correctly.

Equipment Standards

As a preliminary rule, all equipment must be new and must not have been installed at a previous location. For the prescriptive option, all major components of systems must meet a SRCC OG300 rating, and have the ability to offset at least 60 therms of gas or 1,200 kWh of electricity. Normal sizing for a single residential home would be one SRCC OG300 system per home. Area method systems must have a SRCC OG100 rating. Area systems are sized according to an applicable ASHRAE method or a bedroom sizing method.⁷⁰ Systems may be required to have

⁷⁰ The first bedroom would consumer 20 gallons per day, the second would consume 15 GPD and each additional bedroom would consumer 10 GPD.

freeze control systems depending on climate zone. All systems must have at least a 10 year whole system warranty. All systems in the pilot will require metering to calculate energy savings (flow meter, data logger, infrared meter and temperature sensors), which the CCSE will fund and install.

Furthermore, CCSE requires that all locations be tested with a Pathfinder or Solmetric SunEye to determine shading. No system may be located in a place where it would be shaded from 10:00 AM to 3:00 PM year-round. This is only the minimum threshold.

Data Collection

During the initial application process, CCSE requires the following information from the contractor:

- 1) Completed program application
- 2) Copy of signed contract with customer
- 3) Warranty
- 4) Authorization to act on a customer's behalf
- 5) Complete copy of the SDG&E bill for the last six months
- 6) Preliminary design (area method only)
- 7) Load calculation
- 8) Size calculation
- 9) Incentive estimate calculation. The contractor completes this calculation with estimates of the SOF, shading and system type. CCSE will not pay an incentive higher than this estimate.

The customer must also own a gas, electric or propane water heater that can be retrofitted to accommodate a solar hot water heating system to supplement hot water heating needs. Once CCSE has accepted the application, the customer can begin work with the contractor, and CCSE sends out a reservation confirmation and an incentive claim form.

Next, the contractor and the applicant must fill out the incentive claim form to get the incentive reimbursement. The complete package to apply for the rebate includes:

- 1) The Incentive Claim Form
- 2) Final inspection permit from the City
- 3) Project cost affidavit
- 4) Project cost summary
- 5) Final building permit

Before the incentive is given, the CCSE will do the field inspection. If the installation passes, the incentive is sent directly to the contractor.

Verification Requirements

CCSE will inspect 100% of the systems in the pilot program and verify them based on an inspection checklist. The inspection checklist ensures the following:

Sampling

There is no sampling method since 100% of the homes are inspected.

Third Party Audits and Conflict of Interest Provisions

Since CCSE performs the audits of the contractors, this is automatic assurance that a third party audit will be conducted.

Quality Assurance

In addition to 100% project inspection, the solar hot water pilot program maintains a contractor database that is in part based on performance. Much like the CSI program for photovoltaics, contractors can accrue strikes for faulty performance including fraud, gross oversizing, and repeated customer complaints. If there is a malfunction or error in the installation that is identified and not fixed within 30 days, the contractor will accrue a strike. If a contractor accrues three strikes, he or she is prohibited from participating in the program. The CCSE will maintain an informal customer feedback mechanism.

Cost

For the prescriptive method, the incentive for the system and installation is capped at \$1,500.00. The incentive will likely be less than the cap, being as the incentive is calculated as the cap multiplied by coefficients determined with the solar orientation factor and the type of water heating system the customer has. This incentive, combined with the Federal Income Tax credit, may not cover the entire cost of the system. The customer must pay back any remainder.

3) PV Interconnection

Purpose

As mandated by the CEC, all the investor-owned utilities (IOUs) must administer interconnection requirements for their customers who wish to install electricity-displacing solar devices that would divert power back to the grid. All IOUs must enforce California Rule 21 Interconnection Application for solar clients in their territories. This rule applies to all systems up to 10 MW, with special exemptions for systems under 10 kW and net-metering allowance for systems up to 10 MW. Typically, customers apply for net metering tariffs at the same time as the interconnection agreement. Net metering allows customers to waive interconnection studies and application fees for systems up to 1 MW. Under PG&E, systems under 30 kW are eligible for a standard net metering agreement, and larger systems must fill out an expanded net metering agreement.

Auditor Credentials

Under PG&E's interconnection administration, utility staff performs the reviews, audits and studies.

Data Collection

The first step in the PV Interconnection agreement is that the applicant submits project plans, which are reviewed by the IOU in their Initial Review Process. If the system passes all the screens, then the applicant goes through a 'simplified interconnection,' where no further screens are needed. If the system fails any screen, the utility does a Supplemental Review Process. The Supplemental Review Process can lead to a simplified interconnection, or if the system still fails, the utility performs an interconnection review at the cost of the system owner. Under the simplified review, the customer need only provide the following:

- An official agreement application. In this application, the customer determines their otherwise applicable rate schedule (OAS), the agreement that describes how the customer's generation will be charged or credited.

- A single-line diagram of the system.
- A complete description of the system and the inverter. Both must meet CEC's equipment specifications.
- A copy of the building permit
- A copy of the electric bill to verify the site

Interconnection Agreement: All PG&E customers wishing to interconnect must design, operate and maintain their own systems. PG&E will install the metering device free of charge for customers using standard rates but customers using time-of-use rates must pay for their meters, which will track the times when systems are either consuming or contributing to the grid. The current charge for metering using time-of-use rates is \$228.00.

Verification Requirements

The PG&E auditor will conduct a site visit to verify that the meter can be installed in a PG&E-accessible location and that the meter can be maintained at all times for meter readings. PG&E may inspect the system after the meter is installed. If PG&E personnel determine that the system poses a risk to the customer or the inspector, or that the system may endanger reliable operation of the electrical system, PG&E staff has the right to disconnect the system at any time.

Sampling

PG&E will install meters on all applicable systems. A utility staff person will come out to the site to install the meter. Additionally, one in seven systems under 30 kW will be inspected more thoroughly under CSI's system inspection protocol.

Third Party Verification and Conflict of Interest Provisions

All CSI systems selected for inspection are inspected by PG&E personnel. This provision provides enough distance between the inspector and the customer as to avoid a conflict of interest.

Quality Assurance

PG&E inspects and installs every net metering device for self-generators. Customers may not operate their systems until they receive permission from PG&E for parallel generation, which comes after the inspection.

PG&E ensures that the net meter is accessible, that the system is operational and that it poses no harm to PG&E personnel. All installed equipment must be certified by the CEC.

Cost

The only cost associated with PV interconnection is the fee of \$228 if the applicant is to change from standard rates to time-of-use rates. Time-of-use rates are no longer required for CSI, so this fee may not apply to all applicants.

4) Solar Plumbing Inspection

Purpose

If a home's plumbing system is altered to accommodate a solar thermal hot water system, the system will require a building permit and an inspection from the City of Berkeley Permit Services Center.

Auditor Credentials

The City of Berkeley building inspectors are trained and sanctioned by the City of Berkeley. There are currently five building inspectors operating in Berkeley.

Data Collection

For a solar thermal plumbing inspection, the City of Berkeley Planning and Development Department enforces the same requirements as any other building permit. The applicant must submit:

- A site plan with distances to property lines- show all buildings on site, parking areas, lot coverage calculations and street orientations.
- Architectural details- elevations and floor plans as well as plumbing details that will include the roof assembly, extra storage tank and any other piping put in to accommodate the solar hot water system.
- Accessibility details
- Structural plans- these may be the same as architectural details.
- Civil plans and other supporting documentation

The applicant must turn in all of this information with a permit application that includes the plumber's name and information. A building inspector from the City of Berkeley will do an on-site inspection of every new plumbing addition. The applicant must submit a permit fee based on the valuation of the project.

Verification Requirements

The Berkeley building inspectors will ensure that all plumbing systems installed for solar hot water are compliant with the International Building Code and the California Building Standards Commission Code. This includes a visual inspection of all new systems.

Sampling

Since every solar thermal application is inspected and all permit plans are reviewed, the sampling protocol is 100% in Berkeley.

Third Party Audits and Conflict of Interest Provisions

The City of Berkeley Conflict of Interest Code mandates that the building inspectors and building inspection supervisor disclose their economic interests in businesses and nonprofits, particularly if these businesses are in the housing and construction industry. Inspectors may not inspect a building that is associated with a project in which the inspector has an economic interest.

Quality Assurance

The City of Berkeley has an in-house QA process for their building inspectors.

Cost

The only costs are applicable permit fees with the Berkeley Permit Service Center.

Energy Efficiency Audit Standards

1) Home Performance with Energy Star

Purpose

EnergyStar, a national energy efficiency rating program developed by the EPA and DOE, has been rating home appliances and home components for energy performance for many years. Recently EnergyStar has expanded to include an integrated, whole-house approach to energy efficiency, the Home Performance with EnergyStar program. Home Performance with EnergyStar encourages adoption of a host of home improvements and appliance upgrades that make sense for the individual home from an energy-savings and value-added standpoint. The services are delegated to locally-trained contractors who will diagnose homes and make performance recommendations. The only accredited organization in California for EnergyStar training is the California Building Performance Contractor's Association (CBPCA), which is described later in this report.

Auditor Credentials

Audits of individual installers are carried out by Home Performance with EnergyStar training providers in their respective states. The providers shall audit the work of individual contractors, and EnergyStar audits the work of the providers. The program partner is evaluated by EnergyStar in its entirety, and must meet the following requirements:

- 1) Independent from contractors performing the home improvement work.
- 2) Provide the EPA with a list of qualified representatives on a quarterly basis
- 3) Must develop a certification program that is reviewed and approved by EPA, or reviewed and approved by an EPA partner.

Installer Credentials

EnergyStar does not explicitly state installer credentials for a home to be rated. Rather, EnergyStar accredits providers of trainings for EnergyStar Home Performance, and these providers will determine installer credentials, if any. In California, the only EnergyStar Home Performance provider is CBPCA. At a minimum, EPA Home Performance requires the following of the installer accreditation process:

- 1) The certification process must be at least as technically rigorous as the Building Performance Institute (BPI) certification program, and must include written and performance-based tests.
- 2) The ongoing program must include oversight by the training provider, including job inspection and customer feedback.

Equipment and Performance Standards

EnergyStar does not mandate equipment, but a blower door test, a duct blaster test and a combustion appliance test must be conducted. The contractor then uses the data from these tests to make recommendations for improvements. There are no required upgrades under the Home Performance with EnergyStar program, but common recommendations pertain to the building envelope, the HVAC system, windows and lighting. If the contractor opts to use the EnergyStar Home Sealing Specification, there are minimum upgrade and performance standards. These Home Sealing Specification standards are as follows:

- 1) Insulation must meet R values recommended by the Department of Energy Insulation fact sheets. For Berkeley, CA, this translates to R-38 insulation for attics, R-11 for walls and R-131 for floors for consumers with gas heating.
- 2) The home must achieve a tightness of 0.50 air changes per hour (ACH) at 50 pascals or less. If the home is tighter than 0.35 air changes per hour, then mechanical ventilation must be installed.
- 3) Combustion safety must be verified by ASTM Standard E1998-99 “Standard Guide for Assessing Depressurization-Induced Backdrafting and Spillage from Vented Combustion Appliances” or other approved standard
- 4) 80% of the home’s windows must exceed EnergyStar Windows criteria for that climate zone. For Berkeley, CA, this means that windows must have a U factor of less than 0.4 and a Solar Heat Gain Coefficient of less than 0.4.

Data Collection

A specialist trained in building science must do a visual and diagnostic testing inspection of the home that includes the home’s thermal and mechanical systems including attics, exterior walls, foundations, basement, windows, building envelope and hot water systems. Diagnostic testing must include a blower door test, a duct blaster test and a combustion appliance test at a minimum. Inspection of lighting and appliances is optional but encouraged. The contractor must report results and recommendations, complete with costs, and provide the report to the homeowner. Recommended upgrades typically cover insulation, air sealing, duct sealing, HVAC improvements and energy efficiency upgrades. The upgrades will either be done by the initial auditor or by a qualified contractor connected with the program.

Verification Requirements

EPA mandates that all program providers for Home Performance with EnergyStar develop a verification process wherein program provider organizations review the work of contractors. The provider organizations must review no less than 1% of every contractor’s work by field inspection. For multifamily developments, the sampling rate must be no less than 15%.

Third Party Audits and Conflict of Interest Provisions

EnergyStar for Home Performance does not require that a third party inspect work conducted by contractors. The inspections and job oversight are done by the certification provider organization, which is not technically a third party. EnergyStar does have a conflict of interest provision wherein the provider organization cannot have any economic interest in work conducted by the contractors.

Quality Assurance

Every certification provider must have a quality assurance protocol, and this protocol must be approved by the EPA. As mentioned, the provider must inspect at least 1% of each contractor's jobs in the field and maintain at least a 15% sampling rate for multifamily. The provider must either institute a rigorous training program approved by EPA or ensure that a EPA-qualified third party will inspect all work. CBPCA, the California provider, has chosen the former option, being as the final test-out is done by the same contractor that conducted the work. The provider must include a customer feedback mechanism in the program plan. In addition, EPA requires that the program providers submit the following data quarterly to EPA:

- 1) Number of consumer initiated calls and contacts
- 2) Number of participating individual contractors
- 3) Number of successful referrals
- 4) Number of jobs completed
- 5) Actual or estimate number of home improvement actions initiated as a result of participating in EnergyStar for Home Performance
- 6) Consumer and program costs
- 7) Description of quality control activities and outcomes
- 8) Narrative of partner's contribution to furthering EPA's message

Cost

Costs will vary with location.

2) California Energy Commission Home Energy Rating Systems (HERS) Program

Purpose

The Home Energy Rating Systems (HERS) program is a CEC-run initiative to ensure and verify Title 24 compliance for home energy systems. HERS inspection regulations are required by Public Resources Code Section 25942 to provide complete energy verification systems according to California Building Code. HERS applies to residential and non-residential buildings, both new construction and HVAC remodels. The HERS program divides California into sixteen Climate Zones, each with their own requirements. Property owners have the choice of either choosing a prescriptive package (Package D), where the property must adhere to a predetermined set of requirements, or they can choose a performance package where some measures from package D can be foregone in place of other voluntary measures to give the builder more flexibility. For the performance package, the overall energy performance must be verified by approved energy modeling software. New energy standards for Title 24 will be required by the CEC effective 2009. These new standards will mandate a higher level of efficiency, as well as encourage renewable energy generation, including photovoltaics. These upgrades are summarized in the section below, as well as 2005 standards that are still applicable.

Auditor Credentials

All HERS raters must be trained and certified by one of three CEC-approved providers: The California Certified Energy Rating and Testing Services (CalCERTS), The California Building Performance Contractors Association (CBPCA) and the California Home Energy Efficiency

Rating Services (CHEERS). This audit standards assessment is based on the CHEERS training and certification module. The trainings include comprehensive instruction in heat transfer, energy feature design, audit procedures, energy calculations and use of diagnostic tools. The training programs must either require both a written and practice test, or a challenge test for each area of the training. Once the raters have completed the trainings, they must satisfactorily perform ratings of at least two homes under the supervision of the provider's trainer⁷¹. Each provider keeps and maintains a registry of raters.

Data Collection

Each Rater verifies compliance for energy efficiency requirements of the space heating, space cooling, building envelope, service hot water systems and lighting in new buildings and retrofits. Every building under the purview of Title 24 compliance must implement certain mandatory measures. Beyond this, the project managers can either choose a prescriptive package (Package D) with discrete actions, or choose a more flexible performance package where some upgrades may be exchanged for others. The mandatory measures for existing buildings are: duct insulation of at least 4.2 R-value, 100% ducted systems and ducts must be sealed with mastic or approved tape. There is a multitude of mandatory measurements for new construction, pertaining to insulation, lighting, ducting, flooring and other conditioning and building envelope efficiency techniques.

The efficiencies of space heating, space cooling and service hot water are combined to produce an annual energy source efficiency rating on a scale of 0 to 100. All energy improvements that require field testing are documented in the field verification and diagnostic testing on the HERS Rater's certificate of compliance (CF-1R). Raters must fill out a compliance supplement with this information as well, and certify that the applicant is in compliance with an installation certificate (CF-6R). The CF-6R form is the verification form from the installer that equipment is installed according to the design. The builder and installer must conduct pre-HERS rating diagnostic testing which is the basis for the CF-6R form. The rater uses the CF-6R form as a reference for field verification. For remodels or additions to existing homes, the builder or owner completes applicable sections of the CF-1R and the rater performs the appropriate diagnostic tests. The HERS rater also completes and signs CF-4Rs, the Certificates of Field Verification and Diagnostic Testing, for various components of the building. The builder provides the final CF-4Rs to the building inspectors for their inspections.

The following measures require field testing by the HERS raters:

- 1) Duct sealing: ensure that ducts are sealed according to Alternative Calculation Methods Approval Method (2005). Required in for residential applications Climate zones 2 and 9-16 and commercial applications in all Climate zones, this measure requires a visual inspection and duct blaster test to determine leakage. Leakage must not be more than 6% on new homes and must not exceed 15% on existing homes. If the 15% threshold is not reached, the leakage must be improved by 60% from the original test-in.
- 2) Duct sizing and location: If the applicant claims compliance credit for improved supply duct location, R value and surface area, the HERS rater must verify that it was installed according to design.

⁷¹ California Code of Regulations, Title 20, Chapter 4, Article 8, Sections 1670-1675. California Home Energy Rating System Program, 1673 (a)(3)

- 3) Improved air conditioner refrigerant charge: If compliance is claimed for cooling, the rater shall run tests and verify that the system has the correct refrigerant charge or that there is a thermostatic expansion valve (TXV). In residential applications, this compliance can only be claimed in Climate Zones 2 and 8-16.
- 4) Adequate air flow: determine that the air flow in the HVAC fan is adequate according to the size, refrigerant charge and capabilities of the system. For heating only systems, the fan flow must be 0.5 CFM/CFA or 21.7 x the Heating Capacity and for systems with cooling, the fan flow must be 400 CFM per ton of cooling capacity.
- 5) Air Handler fan watt draw: if credit is taken for reduced fan power on the air conditioning system, the fan must be run and diagnostically tested by the rater.
- 6) High energy efficiency ratio (EER): If compliance is claimed for increased EER levels in air conditioners or heat pumps, the rater determines that the stated EER model is installed.
- 7) Building Envelope: The rater shall determine and verify the specific leakage area (SLA) of the building.
- 8) High Quality Insulation Installation: the rater shall verify that insulation is installed consistently and appropriately for the location.

The HERS rater records the results of these tests on the final copy of the CF-6R form. The completed rater copy of the CF-6R documents that the house successfully meets the energy efficiency credits claimed on their original CF-6R form.

Note that HERS verifications are not necessarily required in Berkeley. Duct leakage testing for residential applications is only required in Climate Zones 2 and 9-16, and is required in all commercial applications. The air refrigerant charge credit can only be taken in Climate Zones 2 and 8-16. The Berkeley is in Climate Zone 3, so a HERS verification is not necessarily required in residential applications for Package D prescriptive. If the applicant chooses the Performance method and chooses to take credit for duct testing, then a HERS field inspection is required.

Verification Requirements

The HERS rater must conduct a series of tests to determine whether the equipment meets the credits claimed for energy efficiency. Here is a summary of the tests that the rater may or may not conduct to complete the home rating:

- 1) Duct sealing: the HERS rater conducts a duct pressurization test and records the total duct leakage as a percentage. This is typically done with a duct blaster test that would keep HVAC system at 25 pascals. The rater also conducts a smoke test when the building is pressurized to determine leaks in the accessible parts of the duct system. The total duct leakage must not exceed 6% for new homes and 15% for existing homes. The duct leakage to outdoors must not exceed 10% for existing homes. If existing homes fail the total leakage test, there is an option to prove that the new leakage doesn't exceed 60% of the original leakage, and a more stringent visual inspection is needed. Duct testing is required for existing homes when more than 40 feet of ductwork is replaced or if any of the following components are replaced: air handler, outdoor condensing unit, heating or cooling coil, furnace heat exchanger. Duct testing is only required for homes in Climate Zones 2 and 9-16. Duct testing is required for nonresidential spaces in all Climate Zones.
- 2) Duct sizing and location: The HERS rater and the builder shall complete a Supply Duct System Details report with comprehensive design drawings of the duct locations. The

location, size and R value of the ducts will be verified by visual inspection, and for buried ducts, this is done before insulation is put in. Compliance credits may be taken for having less than 12' of ducts in unconditioned space, having all ducts in conditioned space and locating supply ducts in the crawlspace or basement. If the furnace is located inside, the HERS rater shall check that the supply air comes from the outside.

- 3) In 2008, all homes built to a tightness of 3' specific leakage area (SLA) must have a mechanical ventilation system build in accordance of ASHRAE 62.2. The HERS rater shall verify this.
- 4) Improved air conditioner refrigerant charge: The HERS rater must complete this test when the outdoor temperature is 55 degrees or above. The HERS rater will use a digital thermometer, five thermocouples and a refrigerant manifold gauge set to determine pressure and temperature readings of the cooling system and calculate the accurate refrigerant charge. The cooling system must run for at least 15 minutes to accurately conduct the test. The HERS rater runs and tests the fan flow and takes recordings of the return and supply air temperatures, and then compares the actual temperature split with a target temperature split. If the actual and target temperature splits are within 3 degrees of one another, the system passes. Evaporative cooling will be a compliance option in 2008.
- 5) Adequate air flow: The system fan flow must be measured by the HERS rater by several methods. All of these methods involve attaching flow measurement devices at various locations within the system and testing the equipment at operating condition. The watt draw is measured by a watt meter. The air flow must be at least 400 CFM per ton, and operate at 0.0375 cfm/Btu.
- 6) Air handler watt draw: The watt draw is measured by a watt meter when the system is at normal operating conditions.
- 7) Building Envelop/HVAC Sizing: the HERS rater conducts a series of measurements to size an appropriate cooling load for the building and determine the maximum cooling capacity. This includes calculations of U factors for all opaque and fenestration surfaces, SHGC, glass load factors and total infiltration of the building envelope.
- 8) High energy efficiency ratio: The HERS rater shall verify that there is a thermal expansion valve (TXV) on the air conditioning system and that the system has the EER rating listed on system documentation.
- 9) High quality insulation installation: The HERS rater will verify that insulation is air tight, contains an air barrier, fills all signification voids, is only compressed up to 50% in tight areas, and has kraft paper stapled to the inlets.

Sampling

For groups of homes in the same subdivision, raters choosing to sample the group shall test the first model in each subdivision, and then select groups of up to seven for sampling, with every house in the group having the same floor plan and HVAC systems. The rater will test one house out of every seven. If the sample house passes, all the houses pass, and CF-1Rs and CF-4Rs are completed for all houses in the sample⁷². If the sample house fails, the HERS rater will test another house in the group. If the second house passes, the group will pass and the failed house must be corrected. If the second house fails, the builder must correct all houses in the group before arranging for the HERS rater for a third time. The HERS rater will then test all units

⁷² ⁷². While the CF-4R can be completed for houses that are not tested, the builder must still provide CF-6Rs for all the houses in every sample.

within the sample. When all the houses in the group pass, then the group can be considered compliant. All responsibility for arrangement and additional funding of corrective action and tests falls on the builder. The HERS rater provides all documentation to the provider, the builder and the building owner.

Third Party Audits and Conflict of Interest Provisions

The conflict of interest provisions for providers, raters and installers are as follows:

- 1) the provider shall be independent from the rater
- 2) The providers and raters shall be independent of the builder and any contractors installing energy efficiency improvements field tested or diagnosed. This means that the rater shall not have any financial interest in the buildings completion or compliance, and the rater shall not recommend or advocate services or products to the client that would affect the rater's business.
- 3) The HERS rater shall have no financial interest in energy improvements.

Quality Assurance

CEC oversight of HERS Providers:

The HERS training providers are required to administer a 10% random QA sampling of homes field verified and tested or 500 homes annually, whichever is less. The results of the sampling are provided annually to the CEC. The provider also submits to the Commission upon request but no more frequently than annually the total number of homes verified and tested and energy usage data for those homes. The CEC makes this information available to the public by climate zone.

Provider Oversight of HERS Raters:

Each HERS rater provider must have a quality assurance program in place which addresses the following:

- 1) Initial Review: The provider shall mentor the Rater for the first two homes rated. After that, the provider shall conduct a documentation review at least the first five homes that a Rater tests and diagnoses, not including the two homes that the provider supervises as part of the rater's training.
- 2) Field Checks: The provider shall annually review the greater of one home or one percent of the homes tested and verified by the rater. The provider shall independently conduct the field verification and testing of the home to check the rater's accuracy.
- 3) Complaint Response System: Each provider shall maintain a complaint response forum for purchasers of ratings to communicate complaints of raters and the HERS rating protocol. Providers shall ensure that all raters inform their clients of the complaint forums.

Cost

HERS Raters set their own rates, so estimating a cost of a diagnosis is often difficult. The rates will vary according to geographic location and to the extent of the services rendered. CHEERS, a HERS training provider, estimates that basic HERS rating services costs range between \$150.00 and \$300.00.

3) California Building Performance Contractors' Association Home Retrofit Training Program

Purpose

CBPCA's Healthy House Solution program trains contractors to test homes for energy performance and implement home repair solutions through the Green Home Energy Upgrades. The program's goal is to save 5 million Kwh and 100,000 therms of natural gas in California per year. The CBPCA contractors diagnose homes and recommend improvement services through a step-by-step process with clients.

Auditor Credentials

All CBPCA contractors are put through a rigorous six-day training program that involves classroom learning, field tests and energy software modeling training. They must pass a qualifying exam to practice as a home performance contractor through CBPCA. There are no set qualifying prerequisites to become a CBPCA contractor, but most active participants are general contractors, HVAC specialists or solar installers.⁷³ Acceptance into the program is fairly subjective. The CBPCA recognizes two levels of contractors: Professionals and Associates. Professional CBPCA contractors are actively upgrading homes and adhering to CBPCA's QA/QC and verification protocols, while Associates have only taken the training but do not actively seek clients. The CBPCA has also been recognized and endorsed by the U.S. EPA's Home Performance with EnergyStar program. Contractors may obtain a nationally recognized certification by attending an additional three day training and passing an exam offered by CBPCA. The certification is through Building Performance Institute (BPI) is a nationally recognized Home Performance organization.

Data Collection

CBPCA home performance contractors look at the entire building envelope to diagnose sources of energy loss in the home and enhance comfort. Components of the home that receive particular attention are heating and cooling systems, ductwork, windows and doors, attics, crawlspaces, combustion appliances, insulation and framing. The contractor will determine which areas of the home require attention during a preliminary visual inspection with the client. From this visual inspection, the contractor makes recommendations on changes to the system and decide what performance testing methods should be used, and where.

Verification Requirements

In order to diagnose the house comprehensively, contractors use a variety of performance tests and building science expertise to identify leakages, locate temperature and pressure differences and detect moisture problems. The host of performance tests that could be used in a home diagnosis are: a blower door to measure leakage in the building envelope, a diagnostic smoke tool to locate where leakage occurs in the building envelope, a duct blaster test to determine the air leakage percentage in ductwork, an infrared thermometer reading to locate temperature differences and heat loss in the building, a carbon monoxide sensing device, a hygrometer to measure humidity and a moisture sensor to find building moisture problems.

⁷³ Conversation with Harry Ford, Program Manager for the Home Performance Training program for CBPCA Northern CA. March 25, 2008.

After the house has been diagnosed, the contractor will recommend a package of services, which could include air sealing, duct redesign, duct sealing, indoor air quality improvement measures, insulation improvement, building envelope sealing, lighting and appliance upgrades, moisture control and windows upgrades. These recommendations are described in a homeowners' report, which describes technical terms and outlines costs for the upgrades.

If the homeowner decides to go forward with the energy upgrades, they will sign the contract with the CBPCA contractor, who will perform the upgrade services. After all the services have been completed, the contractor will run another set of diagnostic tests to ensure that the home's performance has been improved. The contractor will draft a completion report that illustrates energy savings in 'before' and 'after' numbers. The contractor will submit to CBPCA the original homeowner's report and the final report for review by a CBPCA quality assurance committee. In order to rationalize the improvements and quantify better energy performance, CBPCA plans to adopt and encourage software developed by Advanced Home Energy of Oakland, CA for creation of the homeowners' report and to satisfy documentation requirements of CBPCA's documentation review.⁷⁴

Sampling

CBPCA contractors must test every home in developments seeking Green Home Energy Upgrades; there is no protocol for CBPCA contractors to sample multifamily housing developments for group certification.

Third Party Verification and Conflict of Interest Provisions

The CBPCA Green Home Energy Upgrade program is a contracted service program, not a rating system that is set up to verify compliance with a regulation or standard, such as GreenPoint Rated or HERS, so there is less of a need to establish conflict of interest provisions between the contractor and the homeowner. To ensure that CBPCA home performance contractors are doing an adequate job, the CBPCA mentors newly trained contractors in the field for the first several customers. Currently, the mentorship component of CBPCA is only available in Southern California, but the Northern California office is developing a protocol for field mentorship.⁷⁵

The CBPCA conducts a paper review of every project that contractors perform, and field checks 5% of the of every auditor's projects to ensure that the work is up to CBPCA standards. This field check includes retesting of all home performance tests to ensure that the diagnosis given by the contractor meets that of the program administrator. This review percentage is a requirement for participation in U.S. EPA's "Home Performance with EnergyStar" program.

Quality Assurance

The CBPCA has a process for maintaining quality by ousting contractors who do not do adequate work, but currently this process is subjective. The CBPCA is planning to implement a customer satisfaction element to their program to gain more feedback on contractor performance.

⁷⁴ Email correspondence with Harry Ford, Northern CA Program Manager for CBPCA, April 18th, 2008.

⁷⁵ Conversation with Harry Ford, Program Manager for the Home Performance Training program for CBPCA Northern CA. March 17, 2008.

Cost

CBPCA contractors set their own rates so it can be difficult to estimate a cost range for a diagnosis and upgrade. The Northern California CBPCA program manager estimates that total costs can range anywhere from \$200.00 to \$1,000.00. More experienced contractors typically charge around \$700.00 for a basic audit, and then add charges for more extensive upgrades.⁷⁶

4) CHEERS Certified Existing Homes

Purpose

The California Home Energy Efficiency Rating Services (CHEERS) is a training provider for Title 24 HERS, but it also offers other modules: CHEERS certified existing homes and CHEERS certified new construction. CHEERS for existing homes focuses on improving the building envelope, testing and improving the HVAC system and changing out old appliances to reduce bills, increase comfort and improve indoor air quality in homes. CHEERS contractors ensure that homes comply with Title 24 state regulations at a minimum but also make recommendations for further improvements.

Auditor Credentials

CHEERS raters must individually apply for the CHEERS Core training, stating all applicable licenses (architect, contractor, engineer, local official, GreenPoint Rater, etc). The CHEERS organization admits applicants on a subjective basis. Once the Core Training, or HERS training, has been completed, applicants can sign up for the Existing Home module.

Installer Credentials

In most cases, the installer is separate from the CHEERS rater. The CHEERS organization strongly recommends getting a reputable contractor with a C20 license to do HVAC improvements, but CHEERS has no control over whom the property owner chooses to make improvements.

Data Collection

The CHEERS existing homes program mandates an initial test and inspection of the home, where the CHEERS rater quantifies current energy efficiency with Ratertool software and makes recommendations for improvements. The rater gives the home a score as is, without improvements. After improvements are recommended, the rater provides a cost estimate and a long-term savings estimate calculation to the homeowner, also with CHEERS-approved software. Either the rater or an HVAC or general contractor makes improvements. After improvements are installed, the contractor conducts the same tests and gives the home a new CHEERS Rating Score.⁷⁷

⁷⁶ Email correspondence with Harry Ford, Program Manager for the Home Performance Training program for CBPCA Northern CA. April 2, 2008.

⁷⁷ From conversation with Jana Maddox, Program Manager for CHEERS Certified for existing homes. April 30, 2008.

Sampling

There is no sampling protocol; The CHEERS rater rates 100% of the homes in question.

Third Party Verification and Conflict of Interest Provisions

If the party that installed the upgrades is an HVAC contractor or general contractor who is unrelated to the CHEERS Rater, then the rater's inspection and verification will indeed be third party. However, if the CHEERS Rater tested and conducted the improvements, then the verification will not be third party. In an ideal scenario, an HVAC contractor makes any recommended HVAC improvements, the home owner or other contractor makes improvements to the building envelope and the CHEERS rater tests and verifies results.

Quality Assurance

The quality assurance protocol for this program hinges on whether the CHEERS rater verifies the work of a separate contractor, or whether the CHEERS rater performs the work themselves. If a separate contractor conducts the work, then there is a true third-party verification. If the CHEERS rater conducts the work, there is no third party verification. As mandated by Title 24, the CHEERS organization will shadow new raters for the first two rated projects, and after, will do field checks of the greater of one home or 1% of homes rated in one year. The CHEERS raters must submit basic information about each project into the CHEERS registry, so there is some documentation review of each project.

Cost

Cost is difficult to estimate, as this is a statewide program, and costs will vary with location and with the extent of the work performed. According to the program manager of CHEERS for existing homes, the most basic software recommendation with the minimum amount of testing would cost \$250, but that additional tests will cost more.⁷⁸

5) Residential Energy Conservation Ordinance (RECO) Upgrades

Purpose

RECO strives to ensure that homeowners in Berkeley are taking action to upgrade their home's energy performance and resource consumption in tandem with remodeling projects. All homes or apartment buildings being sold or under resale, or undergoing renovations greater than \$50,000.00 in value must comply with RECO.

Auditor Credentials

For building transfers and resales, the sole auditor for RECO is the Community Energy Services Corporation (CESC), a 501(c)3 nonprofit in Berkeley that is a licensed general contractor. CESC's mission is to help revitalize neighborhoods in the East Bay Area, and the RECO and CECO requirements are one of its projects.

In the case of renovations, RECO inspection and documentation for renovation work is done through the normal building inspection process.

⁷⁸ From conversation with Jana Maddox, Program Manager for CHEERS Certified for existing homes. April 30, 2008.

The Rising Sun Energy Center, a nonprofit devoted to affecting energy efficiency and renewable energy in the Bay Area, offers compliance help with RECO at low-cost.

Data Collection

RECO requires that the following provisions are met. The auditors collect the data through visual inspection.

- **Toilets** -- 1.6 gal/flush, or flow reduction devices;\$25 to \$100 rebate on low-flow toilets available through EBMUD (510-287-1900 for an application); devices save \$3.50/year on water bills.
- **Showerheads** -- 3.0 gal./minute flow rate; saves \$10.00-\$52.00/year per unit installed. Available free from EBMUD.
- **Faucet aerators** -- 2.75 gal./minute flow rate for kitchens and bathrooms; saves ~\$4.00/year per unit installed. Available free from EBMUD.
- **Water heater blankets** -- Insulation wrap of R-12 value; saves \$12.00- \$66.00/year
- **Hot & Cold Water Piping** -- Insulate the first two feet from the heater to R-3 value; saves \$10.00- \$70.00/year
- **Hot Water Piping in Pumped, Re-circulating Heating Systems** -- Insulate all pipes to R-3 value; saves \$10.00 - \$70.00/year
- **Exterior Door Weatherstripping** -- Permanently affix weather stripping, and door sweeps or door shoes; saves \$10.00 - \$70.00/year per door.
- **Furnace duct work** -- Seal duct joints add insulation wrap to R-3 value; saves \$88.00+/year
- **Fireplace chimneys** -- Must have dampers, doors or closures; saves \$165.00+/year
- **Ceiling insulation** -- Insulate to R-30 value or greater; saves \$280.00+ /year
- **Common Area Lighting (multi-unit buildings)** -- Replace incandescent bulbs with compact fluorescent lamps (CFL) of at least 25 lumens; these cost \$10-15 each, but last up to 10,000 hours versus 750 hours for incandescent bulbs. Payback period is 6-10 months at current electricity rates. CFLs will save up to 75% year off the lighting portion of your electricity costs. A 20-watt CFL is equivalent to a 75-watt incandescent bulb in output. Use a CFL that is 1/4 the watts of the bulb you are replacing to keep the light levels the same⁷⁹.

While compliance with the above upgrades is required, there are spending ceilings for sold homes and homes going through upgrades. These spending ceilings are as follows:

- 0.75% of the final property sales price when a single structure of two housing units or less is sold;
- 0.75% of the final property sales price for each structure when a property with more than one structure of two housing units or less is sold;
- \$0.50 per square foot when any one structure with three or more housing units is sold; or
- 1% of renovation costs when a property is undergoing a renovation of \$50,000 or more.

⁷⁹ List taken verbatim from the Residential Energy Conservation Ordinance webpage:
<http://www.ci.berkeley.ca.us/ContentDisplay.aspx?id=15470>

Sampling

There is no known sampling process for multiple housing units or apartment complexes. Every eligible unit must comply with RECO and undergo an inspection.

Third Party Audits and Conflict of Interest Provisions

Since the auditors for this program are either City of Berkeley building inspectors or CESC employees, and there is not a training process open to other building professionals, a conflict of interest provision to prevent auditor association with the homeowner is less necessary.

Quality Assurance

The City of Berkeley has an in-house QA process for their building inspectors and for CESC employees under contract with their programs.

Cost

No cost; free.

6) Commercial Energy Conservation Ordinance (CECO) Upgrades

Purpose

CECO strives to ensure that homeowners in Berkeley are taking action to upgrade their home's energy performance and resource consumption in tandem with remodeling projects. All commercial spaces being sold or under resale, or undergoing renovations where 10% of the conditioned space is being altered or where costs are greater than \$50,000 must comply with CECO.

Auditor Credentials

For building transfers and resales, the sole auditor for CECO is the Community Energy Services Corporation (CESC), a 501(c)3 nonprofit in Berkeley that is a licensed general contractor. CESC's mission is to help revitalize neighborhoods in the East Bay Area, and the RECO and CECO requirements are one of its projects.

In the case of renovations, CECO inspection and documentation for renovation work is done through the normal building inspection process.

The City of Berkeley allows applicants for CECO to conduct self audits, but these must adhere to a set of rigorous guidelines promulgated by the City of Berkeley.

Data Collection

CECO requires that applicants conduct an energy audit, conduct suggested upgrades and arrange for a final energy inspection. Documentation for the initial audit and the final inspection will be filed with the Building and Safety Department at the City of Berkeley.

The following conservation measures are required of all CECO applicants⁸⁰:

- A. Heating, ventilating and air conditioning (HVAC).**

⁸⁰ Taken verbatim from the CECO Ordinance Section 19.72.090.:
http://www.cityofberkeley.info/bmc/Berkeley_Municipal_Code/Title_19/72/090.html

1. Thermostatic control. All thermostats shall be functioning. All non-functioning thermostats shall be repaired or replaced.

2. Timeclock controls. Timeclock controls that can turn systems off and on according to building occupancy requirements shall be present and connected to the following HVAC devices: chillers and other space cooling devices, chilled water pumps, boilers and other space heating devices, hot water pumps, heat exchanger circulation pumps, supply fans, return fans, and exhaust fans. Occupant override may be provided; override must be designed with a timer to automatically revert to timeclock control in no longer than twelve hours. However, for spaces with twenty-four-hour occupancy or containing materials with special atmospheric requirements dependent on twenty-four-hour space conditioning, or where a majority of areas of the building served by the system are under set-back thermostat control, or where manufacturer's specifications stipulate that the system must not be shut off, a timeclock shall not be required.

3. Outside air economizer cycle. Functional outside air economizers shall be present on all cooling systems of more than six and one-fourth tons total cooling capability (roughly seventy-five thousand Btu/hr.) or more than two thousand five hundred cubic feet per minute air flow, provided that there is a manufacturer-approved retrofit method for adding the economizer to the existing system. However, for buildings or special uses requiring one hundred percent outside air for ventilation, or where the existing system has a water-based economizer, or where the existing system does not have an outside air intake, or where special economizer operations (such as carefully controlled humidity) would require more energy use than is conserved, or where there is insufficient space to install necessary equipment, or where installation of an economizer would require major modifications to the building's life-safety system, or where the existing system is a multi-zone system where the same intake air may be used at the same time for either heating or cooling in different parts of the building, an outside air economizer cycle shall not be required.

4. Repair of air duct leaks. Accessible air supply and return ducts shall have no leaks. Any leaks shall be sealed with appropriate sealants. Presence of duct tape does not indicate noncompliance if the duct is not leaking, but duct tape is not acceptable for repair of such a leak. However, if duct repair would require major modification of the building structure in order to access the duct, the accessible air supply and return ducts are not required to be sealed.

5. Repair and adjustment of dampers. Outside air dampers, damper controls and linkages which are controlled by HVAC units shall be in good repair and adjustment.

6. Insulation of air ducts and plenums. All accessible heating and cooling air ducts and plenums, in mechanical rooms, around air handling units, and in other non-conditioned space, meaning space not served by heating or cooling equipment, shall be insulated to the R-value specified for them in Title 24. However, for ducts located within HVAC equipment, or exhaust air ducts, or ducts where asbestos is present, this chapter shall not require the installation of the specified insulation.

7. Piping insulation. All accessible hot water, steam, steam condensate return, and chilled water piping, including that above suspended ceilings, shall be insulated to R-values in accordance with Title 24. However, if piping is within HVAC equipment, or within conditioned space, meaning space served by heating or cooling equipment, and conveys fluids between sixty degrees Fahrenheit and one hundred five degrees Fahrenheit, or the piping is already insulated and the insulation is in good condition, or the insulation cannot be installed without structural alteration, the required insulation may not be installed.

8. Cleaning and tuning of furnaces. Furnace combustion units shall have been cleaned and tuned within one year prior to the inspection. Filters shall be replaced in accordance with the

furnace manufacturer's recommendations. For electric heat, in existing apartment buildings, when central heat is intended to be replaced with individual electric space heaters, the application for the electrical permit shall include documentation which demonstrates, using an approved method, that the new electric heaters will not consume more energy than the existing nonelectric heater(s). An economic analysis for the energy consumption shall be provided. The total calculated annual electricity consumption shall be converted to British thermal units (BTU) at the rate of ten thousand two hundred thirty-nine BTU per kwh. The design shall be such that no more BTU of energy from depletable sources shall be consumed than allowed for a new building in Climatic Zone 3 in accordance with Title 24. However heat pumps are exempt from the economic analysis requirement.

9. Cleaning and tuning of boilers. Boiler systems shall have been cleaned and tuned within one year prior to the inspection.

10. Reset control for boilers. Boilers shall be equipped with at least one of the following two devices:

- a. Outdoor air lock-out thermostat; or
- b. Temperature reset control.

11. Repair of hot water and steam leaks. There shall be no hot water and steam leaks, or defective steam traps or radiator control, relief, and vent valves in any accessible piping.

12. Cleaning and tuning of chiller systems. Chiller systems shall have been cleaned and tuned within one year prior to the inspection.

13. Repair of chilled water leaks. There shall be no leaks in any accessible chilled water lines and equipment.

14. Reset control for chillers. Chillers shall be equipped with an outdoor air lockout thermostat and a chilled water reset control.

B. Service water systems.

1. Hot water temperature. The temperature of the supply of hot water for domestic or commercial purposes other than comfort heating shall be set and maintained to provide water at no higher than one hundred ten degrees Fahrenheit at point of use. However, if water from a water heater must be higher than one hundred ten degrees Fahrenheit for regular use of a dishwasher or for running other justifiable equipment, including instantaneous demand water heaters, the temperature reset shall not be required.

2. Insulation of water heater and storage tank and piping.

a. Water heater and hot water storage tanks shall have a combined total of external and internal insulation of R-6. Internal insulation must have manufacturer's certification.

b. Accessible hot water pipes shall be insulated to R-values as specified in Title 24.

3. Pressure-temperature safety release valve for water heaters. All water heaters of thirty gallons capacity or greater shall have a pressure-temperature safety-release valve.

4. Water heater secured for earthquake safety.

a. Each water heater and water storage tank with a tank capacity of thirty gallons or greater shall be strapped or otherwise secured to a wall, floor, ceiling, or other object that itself is adequately secured to a wall, floor, or ceiling, in order to protect the tank from falling over in an earthquake. Water, gas and overflow pipes connected to water tanks must be similarly secured.

b. Each gas water heater shall have a flexible gas line entering the appliance.

5. Timeclock control of hot water recirculation pumps. The system of circulating pumps for hot water supply for domestic or commercial purposes other than comfort heating shall be under timeclock control. However, for pumps serving spaces where use requires service hot water

available on a twenty-four hour per day basis, such as in hospitals, convalescent homes, motels and hotels, timeclocks shall not be required.

6. Low volume showerhead. Showerheads shall have a maximum flow of not more than two and one-half gallons per minute.

7. Leaks in hot and cold water-pipes. There shall be no leaks in any accessible hot and cold water pipes.

8. Toilets. Tank or flushometer-type toilets shall not use more than one and six tenths gallons per flush, or shall be modified to reduce the amount of water used while insuring correct operation. Any toilet that cannot be modified to reduce water consumption is exempt from this measure. Whenever a toilet is replaced in a renovation, it shall be replaced by an ultra-lo-flow model.

C. Lighting.

1. Reduce interior lighting load. One of the two following methods of compliance must be chosen:

a. All lighting shall comply with Title 24 prescriptive requirements. This includes both allowable watts per square foot controls, and the allowed exemptions under Title 24; or

b. Standard incandescent and halogen lighting shall be replaced with fluorescent lighting or light-bulbs with an efficacy of forty lumens/watt or more. Standard incandescent lighting, or other lighting with efficacy of less than forty lumens per watt, and halogen lighting may be installed only in the following cases:

- (1) Permanently disabled fixtures; or
- (2) Lighting under the control of occupancy sensor or dimmer switches; or
- (3) Emergency lighting (excluding exit signs); or
- (4) Portable or task lighting; or
- (5) Lighting in hotel or motel guest rooms; or
- (6) Ornamental lighting (such as chandeliers) where the presence of compact fluorescents would significantly degrade the appearance of the fixture; or
- (7) Stage, entertainment, or audio-visual system lighting; or
- (8) Lighting inside appliances or display cases; or
- (9) Spotlights and floodlights; or
- (10) Lighting used an average of two hours per day or less; or
- (11) Lighting used an average of six hours per day or less, in fixtures that would have to be replaced to accept compact fluorescents.

2. Reduce exterior lighting load. Outside lights, exit signs, and lights in parking garages that are in use an average of two or more hours per day shall not use incandescent bulbs. Tungsten-halogen bulbs are not considered "incandescent" for the purposes of this requirement. Fixtures with lamps removed or burned out are to be considered as though all the lamps were operational unless the fixture is permanently disabled. Halogen bulbs may be used only in spot lights. However, fixtures that must be replaced to allow more efficient lamps, and that are in use less than six hours per day, may use incandescent bulbs. This requirement does not apply to emergency lighting.

3. Exterior lighting controls. Exterior lighting shall have automatic controls to turn off lighting during daylight hours. However, lighting in exit signs, parking garages, tunnels, and large covered areas that require illumination during daylight hours, and lights that are in use less than two hours per day, shall not be required to have such automatic controls.

D. Commercial refrigeration equipment.

1. Cleaning and tuning of refrigeration equipment. Commercial refrigeration equipment shall have been cleaned and tuned for efficiency, including, but not limited to, cleaning of condenser coils and evaporators, and replacement of defective or worn door gaskets and seals.

2. Thermal doors and curtains.

- a. Doors and strip curtains. Low and medium temperature commercial refrigeration cases shall be equipped with doors, strip curtains, or similar devices. However open-tub systems with cooling capacities of less than twenty-five thousand BTU/hour shall not be required to have such doors or strip curtains.

- b. Compressor systems. The compressor system shall be modified, as appropriate, to compensate for the reduced cooling load resulting from the installation of doors and strip curtains.

E. Motor-driven equipment.

1. Repair of air and water line leaks.

- a. Leaks. There shall be no leaks in compressed air and in-pumped water systems.

- b. Filters. Filters shall be cleaned or replaced.

- c. Belts or other coupling systems shall be in good repair.

F. Swimming pools and spas.

1. Swimming pool and spa covers. Heated swimming pools and spas shall be equipped with a cover for unoccupied hours. However, a cover shall not be required for indoor pools or spas in which water temperature is less than eighty degrees Fahrenheit during time of non-use.

2. Timeclock control of circulation pumps. Pool and spa recirculation pumps shall be under timeclock control.

3. Cleaning and tuning of heaters. Heaters shall be cleaned and tuned for efficiency within one year prior to the inspection.

G. Building envelope.

1. Ceiling insulation. Buildings with three or fewer above ground stories shall have ceiling insulation which is rated R-19 or greater covering any accessible attic space which is directly above an area served by heating or cooling equipment. Accessible attic space shall mean a space between a ceiling joist and roof rafter where the vertical clear height from the top of the bottom chord of the truss or ceiling joist, to the underside of the roof sheathing at the roof ridge, is greater than twenty-four inches. If the R-19 insulation cannot fit in the attic space, then the maximum amount of insulation compatible with available space and existing uses shall be installed. (Ord. 6176-NS § 9, 1993)

Sampling

There is no known sampling process for multiple commercial units. Every eligible unit must comply with CEC and undergo an inspection.

Third Party Audits and Conflict of Interest Provisions

Since the auditors for this program are either City of Berkeley building inspectors or CESC employees, and there is not a training process open to other building professionals, a conflict of interest provision to prevent auditor association with the homeowner is less necessary.

Quality Assurance

The City of Berkeley has an in-house QA process for their building inspectors and for CESC employees under contract with their programs.

Cost

No cost; free.

Glossary

BSI- Berkeley Solar Initiative
CBPCA- California Building Performance Contractors' Association
CEC- California Energy Commission
CESC- Community Energy Services Corporation
CYES- California Youth Energy Services
EE- Energy Efficiency
EBEW- East Bay Energy Watch
FIRST- Financing Initiative for Renewable and Solar Technology
PG&E- Pacific Gas and Electric Company
PV- Photovoltaic
QuEST- Quantum Energy Services and Technology
RAEL- Renewable and Appropriate Energy Laboratory
RSRES- Rising Sun Residential Energy Services
SHW- Solar Hot Water

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