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APPENDIX

CSI-Thermal Program

Energy Division Staff Proprosal for Program Modification

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1. Executive Summary

This Staff Proposal presents recommendations for expanding the CSI-Thermal Program to provide incentives to non-water heating solar thermal technologies and process heat applications. In this document, we describe the technologies that are currently excluded from the program, explain the technical and procedural issues that led to their exclusion, and examine the challenges involved with integrating them into the program.

Finally, we provide a comprehensive proposal for allowing the CSI-Thermal Program to incorporate non-water heating solar thermal and process heat technologies. The proposal makes recommendations on the method of paying incentives, design and installation standards, funding allocation and other issues. Parties are invited to comment on all aspects of this Staff Proposal. A term sheet comparing the existing program to the proposed changes can be found in Appendix A.

A summary of the recommendations made in this Staff Proposal is as follows:

- *Performance-Based Incentives: The CSI-Thermal Program should create a performance-based incentive (PBI) system that pays incentives based on energy delivered from the solar thermal system to the building as measured by a Btu meter with payments made at regular intervals over a defined period of time. Process heat, solar cooling, and combination systems of any size (except single-family), and all systems larger than 250 kW_{th} should be required to take the PBI incentive. Any system not required to take the PBI incentive should be allowed to take PBI as an opt-in. The 70/30 incentive mechanism should be eliminated and replaced with PBI. Staff recommends PBI payments made quarterly for four years but parties may propose alternate structures.*

- *Single-Family Combination Water/Space Heating: The CSI-Thermal Program should offer an incentive to the space heating portion of an OG-300 rated combination system, in addition to the water heating incentive. The additional incentive should be calculated using a standardized method to be developed by the program administrators. The total incentive provided for individual OG-300 combination systems should not exceed the existing incentive limits for single-family systems, and the system must adhere to the OG-300 standard.*

- *Process Heat: The CSI-Thermal Program should provide incentives to process heat applications via a PBI system that pays the incentive based on energy delivered to the facility as measured by a Btu meter over a pre-determined period of time. Funding for process heat should be limited to no more than $15 million in each of the first two steps of the program. No funding limit is proposed for the last two steps.*

- *Solar Cooling: The CSI-Thermal Program should provide incentives to solar assisted absorption chillers as a limited pilot program to test this technology's performance, durability and economics. Incentives should be limited to no more than $5 million across all PA territories, and should be paid on a PBI basis. The incentive should be paid based on actual therms of solar energy delivered to the chiller over the length of the PBI period, and funding should come from the natural gas budget.*

- *Commercial/Multi-family Combination Systems: The CSI-Thermal Program should pay incentives to combination systems through a PBI process that measures energy delivered to the building. Energy Division does not recommend a separate limit on funding for space heating, although the $500,000 per-system cap would apply to the system as a whole. Because Energy Division proposes limits on total funding for process heat and solar cooling, the applicant should estimate the contribution of the system to these processes so that those incentives can be applied toward the limits.*

2. Introduction

When Energy Division first proposed the CSI-Thermal Program via Staff Proposal in July 2009,[1] staff initially recommended including incentives not only for solar water heating (SWH), but also for other solar thermal technologies that displace natural gas or electricity. This recommendation reflects the clear direction in the law[2] that the program should be open to all solar thermal technologies that displace natural gas or electricity.

In comments to the Staff Proposal, however, several parties felt that the program should initially focus only on SWH. The Commission agreed with those comments, and when the CSI-Thermal Program was created in Decision (D.) 10-01-022, the Commission directed Energy Division to host a public workshop to consider the inclusion of non-water heating solar thermal technologies. Since part of the challenge with including those technologies would be the means of calculating energy displacement for the purpose of paying incentives, D.10-01-022 directed Energy Division to consider at the workshop the question of whether performance-based incentives (PBI) might be the appropriate means of paying incentives to non-water heating solar thermal technologies.

Energy Division held a public workshop to consider those issues on February 23, 2011. At the workshop, parties discussed the types of technologies that might seek to participate in the program, explored ways to develop standards for these technologies, and examined potential options for paying incentives to these technologies. Following the workshop, parties were asked to submit written comments on those issues. The recommendations presented in this Staff Proposal build on and incorporate comments from parties at workshop hosted by Energy Division on February 23, 2011. The proposal presented in this document takes into account both the verbal comments made at the workshop and the written comments submitted following the workshop.

A summary of the workshop, the agenda and the written comments can be found at http://www.cpuc.ca.gov/PUC/energy/Solar/workshops.htm.

[1] CSI-Thermal Program Energy Division Staff Proposal, July 2009. http://docs.cpuc.ca.gov/efile/RULINGS/104403.pdf
[2] Public Utilities Code § 2860 (h) and § 2851 (b)

3. Background

3.1. Thermal Incentives in the California Solar Initiative

The Legislature established the California Solar Initiative (CSI) in 2006, [3] providing $2.17 billion in incentives and other support for solar photovoltaic (PV) systems with the goal of installing 1,940 megawatts (MW) in the service territories of California's three large investor-owned electric utilities. The CPUC established the program via a series of decisions,[4] and it launched to the public on January 1, 2007. To incentivize performance, CSI requires large projects to take a performance-based incentive (PBI) that pays the rebate over five years based on actual system output. Smaller systems may take the incentive in an up-front, lump-sum payment based on the system's expected performance.

Although PU Code 2851(b) allows the payment of up to $100.8 million of total CSI incentives "for solar thermal and solar water heating devices," SWH was initially excluded from applying for incentives pending the results of a $2.6 million SWH pilot program (SWHPP) in the service territory of San Diego Gas and Electric Company (SDG&E).[5]

In addition, natural-gas displacing technologies were prevented from receiving incentives,[6] making most solar water heating applications ineligible for CSI. While non-water heating solar thermal technologies that displace electricity were not prohibited from applying for PBI incentives, there have been no applications for electric-displacing solar thermal projects in the CSI General Market program.

3.2. Creation of the CSI-Thermal Program

In October 2007, Governor Schwarzenegger signed Assembly Bill (AB) 1470 (Huffman, 2007) , which authorized $250 million in incentives and other market support for SWH systems that displace natural gas, provided that data from the SWHPP show that such a program would be "cost effective for ratepayers and in the public interest."

In 2009 the CPUC Energy Division analyzed the results of the SWHPP and recommended in a Staff Proposal[7] that the Commission approve a statewide SWH incentive program, finding that such a program could be cost effective and in the public interest. In January 2010, the CPUC adopted D. 10-01-022, which authorized the creation of the CSI-Thermal program based on the staff recommendations. The CSI-Thermal program, as adopted, combines the $250 million authorized for natural-gas displacing SWH (funded by natural gas ratepayers) with the $100.8 million allowed for electric displacing SWH systems (funded by electric ratepayers and already a part of the CSI general market program).

Seeking to promote administrative simplicity, D. 10-01-022 directed incentives for gas-displacing and electric-displacing SWH to be administered with a single application process, database, incentive

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[3] Senate Bill 1 (Murray, 2006).
[4] See primarily D.06-01-024, D.06-08-028 and D. 06-12-033.
[5] See D. 06-01-024, page 13-14.
[6] With the exception of those participating in the SWHPP.
[7] Energy Division Staff Proposal for CSI-Thermal Program, July 15, 2009, http://docs.cpuc.ca.gov/efile/RULINGS/104403.pdf.

calculator and other tools, although the incentive amounts differ depending on the different fuels displaced and the funding comes from different ratepayers. The CSI-Thermal program is administered jointly by four Program Administrators: Southern California Gas (SCG), California Center for Sustainable Energy (CCSE in SDG&E's territory), Pacific Gas and Electric (PG&E), and Southern California Edison (SCE).

3.3. Exclusion of non-SWH Technologies and Process Heat

Non-water heating solar thermal technologies are eligible for incentives under both SB 1 and AB 1470. As mentioned above, SB 1 sets aside a $100.8 million fund for solar thermal technologies that displace the use of electricity. Meanwhile, AB 1470 defines "Solar Water Heating" as "a solar energy device that has the primary purpose of reducing demand for natural gas through water heating, space heating, or other methods of capturing energy from the sun to reduce natural gas consumption in a home, business, or any building receiving natural gas."[8]

In comments to the July 2009 Staff Proposal, however, some parties recommended that the Commission focus its initial program startup efforts on providing incentives to traditional solar water heating technology. The Commission agreed and directed Energy Division to provide incentives initially to water heating technologies that could be paid up-front incentives based on energy displacement that could be estimated using commercially available simulation software.

Non-SWH thermal technologies were initially excluded from the CSI-Thermal program. Rather than include those technologies from the outset of the program, the Decision orders Energy Division to hold a workshop within 180 days of the Decision to determine whether and how to pay incentives for non-water-heating thermal technologies. The Decision states (p. 72):

> *Within 180 days from the effective date of this decision, Energy Division shall hold a workshop on the issue of the eligibility of non-solar water heating solar thermal technologies that displace gas usage and meet all other program requirements. The workshop should address how to estimate these technologies thermal displacement for incentives calculation purposes and whether performance-based incentives might be appropriate for these technologies. Following the workshop, Energy Division should provide a workshop report to the Service List of this proceeding, or its successor proceeding, and the Administrative Law Judge.*

Although process heat applications were not prevented from participating in the program by the Decision, the Program Administrators initially excluded them from participating due to uncertainties in modeling the energy output of those applications for the purpose of paying incentives. Thus, in addition to non-SWH applications, the workshop also addressed process heat.

3.4. CSI-Thermal Rebate Structure for SWH Systems

The CSI-Thermal Program presently accepts applications from single-family and multi-family/commercial customers taking natural gas or electricity service from the large investor-owned utilities in California.[9] To qualify, single-family applicants must install a SWH system with an OG-

[8] Public Utilities Code § 2861 (h)

[9] The portion of the CSI-Thermal Program that funds incentives for electric displacing systems is subject to the overall budget of the CSI general market program. The funding for the commercial portion of the general market program was exhausted in October 2010 in SDG&E territory and in December 2010 in PG&E territory. Once funding is exhausted in the

300 rating from the Solar Rating and Certification Corporation (SRCC), and multi-family/commercial applicants must use install a SWH system with SRCC OG-100 rated collectors. In addition, the program only allows end-uses that directly consume the solar-heated water, rather than using it as a medium to carry heat for other end uses.

Applicants to the program installing systems smaller than 250 kW_{th} (about 3850 square feet of collector space) are paid incentives in an up-front lump-sum payment after the system has been installed and inspected if necessary. Incentives rates are set per therm of natural gas or kWh of electricity, and actual incentives for each individual project are determined by multiplying the system's expected first-year energy displacement by the applicable incentive level.

For single-family OG-300 rated systems, the expected first-year energy displacement is provided by SRCC for each climate zone. The CSI-Thermal incentive calculator simply uses this estimate and adjusts the incentive to account for shading or sub-optimal orientation.

For multi-family/commercial systems with OG-100 collectors, TRNSYS-based software is used to model each system and determine the first-year energy savings. The CSI-Thermal Program has contracted with an independent software developer, TESS, to build and maintain this model. Although many of the most common SWH system configurations are already built into the TRNSYS model, there are many other configurations that are not included and would need to be "custom-modeled" by TESS as the need arises.

One hurdle the program has faced in paying incentives based on modeled energy displacement is the difficulty in verifying the applicant's estimate of building hot water load, which has a large impact on the energy savings and thus can greatly affect the incentive payment. To mitigate this problem, the CSI-Thermal Program requires applicants to meter hot water load for 60 days unless the building type appears on a list of standard hot water load profiles maintained by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).

Due to concerns about "gaming" the incentive calculator with inaccurate hot water loads and to avoid potential inaccuracies in modeling large systems, SWH systems larger than 250 kW_{th} are required to take the incentive in two parts. The first part of the incentive is equal to 70 percent of the expected first-year energy savings as calculated by the TRNSYS model. The second part of the payment is paid after the first year of system operation and is equal to the actual first year energy displacement as measured by a revenue grade meter, less the original payment.

3.5. Summary of Excluded Technologies

There are three main categories of technologies that are excluded from the CSI-Thermal Program that the Commission is considering including into the program.

- **Process Heat:** The CSI-Thermal Program defines process heat applications as those that do not directly consume the solar heated water, but rather use that water as a medium to carry heat for other processes. As mentioned above, process heat was not excluded from the program by the Decision. Rather, the Program Administrators excluded process heat due to the difficulty of modeling the energy production from these systems. Difficulties in modeling process heat applications include variable inlet temperatures and variable loads

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general market program for commercial projects, all new project applications are placed on a waitlist and funding is committed as other projects drop out.

that may be difficult to predict. The program administrators have also expressed concern about how to devise installation standards for these technologies. Finally, because the incentive levels were not designed with this technology in mind, there is a risk that incentive levels may be higher than necessary to deploy these types of systems.

- **Solar Cooling:** A number of technologies currently exist that use the heat of the sun to create cool air, include absorption cooling, desiccant cooling and vapor compression cooling. These technologies can displace electricity by reducing air conditioning load, and thus could qualify CSI-Thermal Electric displacing incentives, provided they use OG-100 rated solar collectors. As with space-heating applications, however, the program's ability to pay these technologies a one-time, up-front incentive will depend on the ability of these systems' energy displacement to be modeled accurately and at reasonable cost. In addition, minimum system design specifications may be required. Finally, similar to process heat, there is a risk that incentive levels may be higher than necessary to incentivize these technologies.

- **Space Heating and Combination Systems:** Space heating systems use SWH collectors to provide radiant or forced air heating. Although it is possible to install stand-alone solar space heating, the most common configuration is combination water heating/space heating, wherein the system provides both hot water and space heating. The Commission must overcome three hurdles to including these systems in the CSI-Thermal Program. First, design and installation standards must be developed to ensure that these systems to not suffer from technical deficiencies such as inadequate overheat protection. Second, it must be determined whether their energy savings can be predicted using TRNSYS-based software with reasonable accuracy and at reasonable expense. Finally, for single-family combination systems, the Commission must determine whether to make an exception to the OG-300 requirement in cases where additional collectors are added to the system, violating the OG-300 certification.

4. Summary of Non-SWH Thermal Workshop

On February 23, 2011, Energy Division held a workshop to discuss the inclusion of process heat and non-water heating solar thermal technologies. Energy Division chaired the workshop, and representatives from SoCalGas, PG&E, SCE and CCSE participated via a panel. The workshop began with a survey of participants to see which technologies were represented at the workshop. Companies present at the workshop included those producing systems for process heat, space heating, combination water and space heating, space cooling (including absorption chillers and adsorportion chillers) and pool heating. The only technology envisioned to be included in the workshop that was not represented was desiccant cooling.

Next, the workshop turned to technical standards development. The Program Administrators (PAs) and the CPUC believe that technical standards are necessary to insure that systems are installed properly and to protect consumers. Suggestions for how to create those standards included: Using standards developed by the International Energy Agency (IEA) or working with IEA to create standards; using funding from the market facilitation budget to set standards in the near-term; using a "request for proposals" process by which projects are selected based on the strength of their design; seeking assistance from the National Renewable Energy Labs (NREL) to develop standards for desiccant cooling systems; creating a separate space heating and cooling pilot program that could provide the

basis for standards development; and paying incentives based on actual thermal output so that risk of under-performance is on the contractor or system owner.

Following the discussion of technical standards development, the workshop tackled the issue of incentive payment options. The PAs and the CPUC are concerned that the current incentive payment structure might not work with process heat and non-water heating technologies. To guide this discussion, the CPUC devised four options for incentive payments and asked parties to comment on them.

The first option presented was using the current incentive payment method, which involves running a standardized TRNSYS model to calculate an upfront incentive to be paid to applicants upon system installation. In order to determine whether the TRNSYS model can work with process heat and non-water heating technologies, Jeff Thornton, president of Thermal Energy Systems Specialists, which created the TRNSYS model, was available via telephone. Mr. Thornton verified that TRNSYS will work for all system types, but load profiles might be difficult to determine for non-water heating systems. In addition, TESS would need to create a number of additional "templates" for different system types at additional cost to the program.

As an alternative to using TRNSYS, some parties suggested that installers have the option of using their own estimation tools and designs, which would could be stamped by a professional engineer and verified by the PAs. One contractor noted that the existence of a CSI-Thermal energy modeling tool reduces the competitive advantage of those companies that have done the work to develop their own energy estimation tools.

The second option presented applies only to combination water heating and space heating for single-family residential systems. Under this option, the TRNSYS model would be used to estimate the energy savings from water heating, and a bonus incentive or "kicker" would be added for the energy savings from space heating. Parties did not object to this method.

The third option considered at the workshop for incentive calculation was to use energy modeling tools that might be more suitable for non-water heating technologies than TRNSYS. However, because TRNSYS appears to work for all system types, this option was not discussed.

The final option discussed at the workshop as a way to pay incentives for process heat and non-water heating technologies was performance-based incentives (PBI) that pay for actual energy output as measured by a Btu meter over some pre-determined period of time. Parties disagreed on whether PBI would be a desirable way to pay incentives. Some parties felt that PBI would be the best way to pay incentives for cooling and process heat applications. Other thought that the solar thermal industry does not have the access to capital necessary to make PBI a viable option. Parties in general preferred opt-in PBI to a mandatory PBI system. Some parties also felt that the current 70/30 true-up method should be used instead of PBI.

5. Energy Division Staff Recommendations

5.1. Inclusion of New Technologies

In comments, several parties urged the Commission to defer opening the CSI-Thermal Program to process heat and non-SWH technologies until the SWH market in California is more developed. Although AB 1470 and SB 1 do not appear to indicate a preference for SWH over other solar thermal

technologies, we note that the installation of small to mid-size, domestic water heating systems are likely to have more job creation and market transformation potential than very large process heat or commercial cooling systems – simply because more workers are need to install many small systems than a few very large ones. It is the experience and knowledge gained by those workers that may reduce future installation costs and lead to an expanded market for small to mid-sized SWH systems.

A second concern with incorporating these technologies is that incentive levels were designed specifically to incentivize small to mid-size residential and commercial systems intended to provide domestic hot water. Space heating, cooling and process heating applications were not considered during the evaluation of the SWHPP or when the Commission set the CSI-Thermal incentive levels. For that reason, the incentive levels currently offered by the program may be higher than necessary to incentivize installation of these technologies.

Finally, some parties commented that some of the technologies under consideration here may not be at a stage of development where they are ready to be commercially deployed. The CSI-Thermal Program is not intended to provide incentives to experimental technologies that might not deliver the promised energy savings.

Nevertheless, the Legislature clearly intended for the CSI-Thermal Program to provide incentives not only to water heating technologies, but also to other technologies that use OG-100 collectors to provide thermal energy which offsets natural gas or electricity use. Providing incentives to these technologies can not only provide significant energy savings, it can also provide much needed data on the performance of these systems, demonstrate the effectiveness of the technology and increase public awareness of the diverse potential benefits of solar thermal technologies.

Thus, Energy Division recommends providing incentives to the non-water heating solar thermal and process heat technologies described below. At the same time we propose limits on these incentives to ensure that sufficient funding is preserved for the solar water heating technologies that currently qualify for the program and which might have greater potential to result in a transformed market.

5.1.1. Single-family Residential Combination Water/Space Heating

Energy Division recommends including into the CSI-Thermal Program OG-300 rated single-family residential systems that provide both domestic hot water and space heating. In some climate zones it likely makes sense to use the solar collectors for both purposes, and the marginal cost of adding an additional collector may well be worth the additional benefits.

Standards: Standards for residential combination system currently present a challenge for the CSI-Thermal Program. Although the program allows incentives for the domestic hot water portion of a residential combination system, it also requires that all systems be OG-300 certified. Since SRCC does not certify combination systems, this means that a system installed with extra collectors to provide space heat will violate the OG-300 certification.

At present, the CSI-Thermal Program has a policy of providing a rebate for the domestic hot water (DHW) portion of the system based on the OG-300 certification. This policy likely disqualifies most residential combination systems, as they would most likely need to be oversized relative to OG-300 in order to provide space heating in addition to DHW. This Staff Proposal does not recommend changing that policy, because we understand that SRCC is currently working on a standard for combination residential space and DHW. Therefore, we recommend maintaining the current certification requirements for residential combination systems with the expectation that SRCC will

develop a new combination system standard to allow increased participation by these systems. In the event that SRCC does not develop this new standard, this Staff Proposal does not recommend allowing exceptions to the OG-300 certification to allow for residential combination systems.

Incentive payments: If SRCC or another CSI-approved listing agency[10] develops a performance rating that estimates annual energy savings for the combined water heating and space heating contributions of single-family residential systems, the CSI-Thermal Program will use that rating as the basis for paying incentives. If SRCC or another CSI-approved listing agency does not develop such a rating but merely allows for the over-sizing of systems to provide for space heating, Energy Division recommends that the program use the bonus incentive method described in Appendix A to this Staff Proposal. The bonus incentive method was developed by CCSE as a cost-effective way to recognize the extra energy savings that may result from the addition of space heating.

Finally, Energy Division recommends maintaining the current caps applying to the single-family program. For instance, for natural gas-displacing systems in Step 1, the cap of $1,875 will apply even if the combined DHW and space heating incentive would be greater than that under the incentive method we devised.

***Recommendation:* The CSI-Thermal Program should offer an additional incentive to the space heating portion of an OG-300 rated combination system if SRCC develops a new combination system standard. The additional incentive should be calculated using a standardized method to be developed by the program administrators. The total incentive provided for OG-300 combination systems should not be allowed to exceed the existing incentive limits for single-family systems, and combination systems should adhere to the OG-300 rating.**

5.1.2. Process Heat

Of the technologies and applications under consideration for inclusion into the program, process heat appears to be the most commercially mature, and it is likely the easiest one to incorporate into the program. Process heat was not prohibited from receiving incentives by D. 10-01-022. Rather, the CSI-Thermal Program administrators decided to defer providing incentives to process heat applications over concern that these applications would not fit into the incentive calculator that was developed for multi-family and commercial DHW applications. Moreover, the program administrators were concerned that the program design and installation standards developed early in the program would not easily apply to process heat applications.

Payment: To overcome earlier concerns about the challenges of modeling the diverse array of process heat systems and characterizing their loads, Energy Division recommends that all process heat applications take a performance-based incentive, which will be described in detail in Section 5.2. By paying process heat applications on actual delivered energy production provided by a Btu meter, the program administrators avoid the need to make costly custom modifications to the CSI-Thermal incentive calculator in order to calculate incentive payments. In addition, paying on a PBI basis alleviates the difficulty inherent in characterizing process heat loads and reduces the risk that incentive payments will be based on inaccurate calculations.

[10] *See* D.11-11-004 where the Commission modified its prior decision regarding certification standards for solar water heating systems and established a process to consider requests for acceptance of SRCC certification performed by entities that are American National Standards Institute accredited listing agencies.

The applicant will submit an estimate of annual energy production using calculations that are backed up by metered energy data and stamped by a professional engineer. The program administrators will then reserve incentives for the applicant of 120% of this estimate, and pay incentives up to the amount reserved using data on energy delivered to the facility using a Btu meter. The incentive cap of $500,000 for multi-family and commercial applications should apply to process heat systems as well.

Standards: Because the risk of underperformance is on the installer and system owner under a PBI system, and because large manufacturers tend to employ engineers capable of detecting poor design and installation, Energy Division does not recommend that the CSI-Thermal Program develop exhaustive design and installation standards for process heat. The requirement to use OG-100 rated collectors should be applied to process heat systems. In addition, there may be general technical standards that should logically apply to all process heat systems, and if so, the PAs should include these in the Program Handbook.

Handbook: A new section should be added to the Handbook for process heat, including any technical standards the program administrators deem necessary; proper metering configurations for PBI payment; and any other rules the Program Administrators may wish to implement.

Incentive limit: Due to concerns expressed by several parties about very large systems and non-water-heating systems consuming a disproportionate share of incentives, the CSI-Thermal Program should limit the total incentive dollars provided to process heat applications in the first two steps of the program. Energy Division proposes this limit in order to ensure that a significant portion of incentive dollars is available to the small to mid-sized systems producing domestic hot water for businesses and multi-family residences. Thus, Energy Division proposes the CSI-Thermal Program should provide no more than $15 million to process heat in each of the first two incentive steps, divided among the PAs by the budget allocation for natural gas. This amount represents roughly half of the incentive budget for multi-family commercial projects in each of the first two steps. Staff recommends that process heat applications have access to the last two steps of the program without limitation.

Table 1: Maximum Process Heat Incentives for Steps 1 & 2 by Program Administrator

Program Administrator	Budget Allocation	Step 1 ($ million)	Step 2 ($ million)
PG&E	39%	$5.85	$5.85
SCG	51%	$7.65	$7.65
CCSE	10%	$1.50	$1.50
Total	100%	$15	$15

Recommendation: ***The CSI-Thermal Program should provide incentives to process heat applications using OG-100 collectors via a PBI system that pays the incentive based on energy delivered to the facility as measured by a Btu meter over a pre-determined period of time. Funding for process heat should be limited to no more than $15 million in each of the first two steps of the program. No funding limit is proposed for steps three and four.***

5.1.3. Solar Cooling

At the February 23 workshop and in post-workshop comments, the most likely application identified by parties was the solar-assisted absorption chiller with natural gas backup replacing part of an existing electric chiller. SRCC notes that these technologies might not be market ready. CalSEIA

recommends that incentives be made available to solar cooling as a pilot program that can test the systems' performance, durability and economics.

Limited pilot program: Because solar cooling might not yet be a mature technology, and because it is prudent to collect more data on the performance, durability and economics of these systems, Energy Division recommends that incentives be offered on a limited pilot basis. In order to focus administrative time on the technology most likely to participate in the program, Energy Division recommends allowing funding only for the technology identified by parties as the most common: solar-assisted absorption chillers that supplement part of an electric cooling system. Energy Division further recommends that incentives for this technology not exceed $5 million across all PA territories.

Table 2: Maximum Incentives for Solar Cooling by Program Administrator

Program Administrator	Budget Allocation	Maximum incentives
PG&E	39%	$1,950,000
SCG	51%	$2,550,000
CCSE	10%	$500,000
Total	100%	$5,000,000

Funding Source: Because electricity is the primary energy source for cooling in California, an argument could be made that funds for solar cooling should come from the CSI budget collected from electric ratepayers. However, since absorption chillers generally run on natural gas, when solar is installed to assist those technologies, the solar array is directly displacing natural gas use – even though the end result is reduced electric demand. Thus, an equally convincing argument could be made that funds for solar cooling should derive from the natural gas budget.

This Staff Proposal recommends drawing the incentives for solar assisted cooling from the natural gas budget for two reasons. First, it creates administrative simplicity, eliminating the need to convert therms delivered to absorption chiller into kWh of electricity reduced. Second, the budget for CSI electric funds is uncertain, given its connection to the CSI General Market program incentives budget, and the possibility that those funds may be depleted before the end of 2017.

Standards: Issues related to technical standards for solar cooling technologies are highly technical, and therefore Energy Division recommends deferring to the technical experts at the Program Administrators to devise appropriate specifications. The PAs may wish to rely on local building inspectors to enforce existing standards, or they may wish to establish some minimum standards to which all solar cooling applicants must adhere. The PAs may also convene a technical panel, including experts from industry, government and academia to develop standards if outside help is deemed necessary. Solar cooling systems should be required to use OG-100 collectors.

Handbook: A new section should be added to the Handbook for solar cooling. This section should outline any technical standards the program administrators wish to require; the metering specifications for making PBI payments; and any other rules or requirements the PAs wish to impose on these types of applications after consulting with technical experts.

Recommendation*: *The CSI-Thermal Program should provide incentives to solar assisted absorption chillers using OG-100 collectors that reduce air conditioning demand as part of a limited pilot program to test this technology's performance, durability and economics. Incentives should be

limited to no more than $5 million across all PA territories and should be paid on a PBI basis. The Program Administrators may develop installation standards if necessary. Funding for the incentives should come from the natural gas budget.

5.1.4. Commercial/Multi-family Combination Systems

Payment: Comments from parties indicate that there may be some technologies capable of producing domestic hot water, cooling and space heat using the same collector array. These systems should be eligible for incentives based on actual metered energy under a PBI system, as will be described in the next section.

Incentive Cap: Energy Division recommends that the incentive cap of $500,000 for commercial systems be kept in place for the combined savings from combination systems.

Incentive limit: Since Energy Division recommends that a total limit of $5 million be placed on the incentives to solar cooling, but not to domestic water heating and space heating, commercial combination systems create a potential accounting problem. Energy Division recommends that the solar cooling (and/or process heat) contribution of a commercial combination system be applied to the total incentive limits of $5 million for solar cooling and $15 million for process heat in each of the first two incentive steps. The applicant should estimate the portion of solar thermal energy that will be dedicated to those functions so that those payments can count against the relevant incentive caps.

Electricity Production: Energy Division does not recommend paying incentives from any part of the CSI-Thermal budget to elements of a combination system that produce electricity (for instance, the PV portion of a combination PV/thermal array). Any electricity production should apply for incentives from the general CSI program.

Standards: Setting of standards should be deferred to the PAs' technical experts. The PAs may wish to rely on local permitting officials to ensure proper design and installation, or they may prefer to set some minimum requirements. If so, those standards should be incorporated into the program Handbook. Multi-family and commercial combination systems should be required to use OG-100 collectors.

Recommendation: The CSI-Thermal Program should pay incentives to multi-family and commercial combination systems using OG-100 collectors through a PBI process that measures energy delivered to the building. Energy Division does not recommend a separate limit on funding for space heating, although the $500,000 per-system cap will apply to the system as a whole. Because Energy Division proposes limits on total funding for process heat and solar cooling, the applicant should estimate the contribution of the system to these processes so that those incentives can be applied toward the limits.

5.2. Performance-Based Incentives (PBI)

5.2.1. Need for PBI

The method by which incentives are paid to program participants is one of the most contentious issues facing the CSI-Thermal Program. Some companies prefer to receive up-front payments based on TRNSYS estimates or their own proprietary models, insisting that up-front funding is necessary to provide the start-up capital needed to get projects started. Other companies prefer the 70/30 method.

Still other companies, the SRCC and DRA favor PBI incentives, insisting that the performance risk to ratepayers and cost to the program are too great under up-front incentive payments.

For the past year, the CSI-Thermal Program has paid incentives to multi-family and commercial projects using a TRNSYS model designed to serve the most common types of solar thermal technologies and applications. It is clear after the first year of the program, however, that the possible number of systems requiring a customized TRNSYS run is greater than originally anticipated, putting a potentially significant cost on the ratepayer. As the solar thermal market in California grows, the likelihood of an increase in the need for customized TRNSYS runs will grow as well. Because the CSI-Thermal Program has limited resources with which to develop these models, the potential for modeling to create a backlog in the application process will grow as well.

In addition, paying projects up front based on the results of TRNSYS modeling transfers to the ratepayers the risk that the project underperforms relative to the incentive amount. As projects become very large, the risk of overpayment becomes very large as well. Because those that install, own and manage the system ultimately have the control over system performance, it makes sense that those entities, rather than ratepayers, should bear the risk of underperformance.

Finally, the accuracy of the modeling used to predict performance for payment of incentives has not yet been verified. Because the accuracy of the model depends on how well the model represents the thermal load of the building where the system is installed, the model will only be as accurate as the load profiles used to run the simulation. Although hot water loads are fairly regular and predictable for many building types, other thermal loads – such as cooling and process heat – may be more difficult to predict and may have a higher variability. For that reason, using TRNSYS to model process heat, solar cooling and combination systems may produce results that are less accurate than for domestic water heating.

5.2.2. Systems required to take PBI

Energy Division recommends that process heat, solar cooling, and combination DWH/space heating be paid exclusively on a PBI basis using actual metered energy production data over a fixed period of time. Once a PBI system is developed, this system should replace the 70/30 true-up mechanism. The CSI-Thermal Program may then consider moving other technologies and end-use applications to PBI if the need permits (for instance if requests for customized TRNSYS modeling become too great).

Thus, Energy Division proposes the following system types and applications would be required to take the rebate as a performance-based incentive:

- Process heat systems of any size
- Solar cooling systems of any size
- Combination water heating and space heating/cooling systems of any size
- All systems larger than 250 kW_{th}
- Any other solar thermal systems that qualify for the program but that the program administrators deem cannot be incorporated into the TRNSYS calculator with reasonable accuracy and at reasonable expense

5.2.3. Opt-in PBI

Energy Division also recommends that systems not required to take PBI may choose be paid PBI on an optional basis. In the course of program development, several companies have commented that their

systems would perform better than the prediction made by the CSI-Thermal incentive calculator. Allowing these systems the option of being paid for actual metered output will allow those systems to receive higher payments than what they might otherwise receive under the incentive calculator.

5.2.4. PBI Structure

Because solar thermal system performance may vary from year to year, PBI payments should be made on a schedule that is long enough to capture that variability and ensure the payment accurately reflects the system's performance under typical conditions. On the other hand, the need for a longer payment schedule should be balanced with the need to provide capital to the projects' investors in a reasonable amount of time. Finally, we must consider the costs the program administrators will incur in administering PBI.

To increase the amount of money received early in the project life, and to reduce administrative cost while capturing yearly performance variability, we recommend the PBI payment be made on a quarterly basis over four years. Under this schedule, the incentive rate per therm or kWh displaced would be one quarter of the otherwise applicable incentive rate (for instance, for step one, the rate would be $3.20/therm [one quarter of $12.82], paid out quarterly over four years).

Energy Division makes this recommendation with the knowledge that the program administrators are in a better position to assess administrative costs, and program participants are in a better position to weigh in on the balance between early recovery of capital and accuracy of performance measurement. Thus we request that those parties include in their comments to this staff proposal feedback on whether a different payment schedule would be preferable to the one proposed here.

Projects taking PBI would also be responsible for the cost of metering, monitoring and data transfer. They would be required to contract with a third-party Performance Data Provider that can transmit data over a reliable and secure electronic system to the PAs. No discount rate would be built into the PBI payments for budgetary reasons. Although these additional costs may be a disadvantage for those projects required to take PBI, it is also true that most projects taking PBI will be larger projects with more favorable financing options than the smaller projects receiving an up-front rebate.

5.2.5. PBI Incentive Reservations

The most challenging element of administering a PBI payment system will be to know how much of the incentive budget to reserve for a particular project. This challenge can be handled by requiring that each project submit an estimate of the system's annual energy projection using historical billing analysis or metered data, stamped by a Professional Engineer. The Program Administrators may perform checks to ensure that the estimate is reasonable. The sum of the PBI payments would not be permitted to exceed 120% of the estimated amount.

Recommendation: ***The CSI-Thermal Program should create a performance-based incentive system that pays incentives based on energy delivered from the solar thermal system to the site as measured by a Btu meter with payments made at regular intervals over a defined period of time. Process heat, solar cooling, and combination systems of any size (except single-family), and all systems larger than 250 kW_{th} should be required to take the PBI incentive. Any system not required to take the PBI incentive should be allowed to take PBI as an opt-in. The 70/30 incentive mechanism set forth in Section 2.7.3 of the CSI Thermal Handbook should be eliminated and replaced with PBI.***

6. Implementation Schedule

Parties will have an opportunity to comment on the recommendations in this Staff Proposal. Following comments, the Assigned Commissioner and ALJ will prepare a proposed decision for consideration of the topics in this Staff Proposal by the full Commission. After the Commission acts on the Proposed Decision, the CSI Thermal program administrators will implement any adopted changes to the CSI Thermal Program based on direction provided in the decision, including database changes and handbook revisions.

When the CSI Thermal Program was initiated in the winter and spring of 2010, the PAs completed the work necessary to get the program up and running in about four months. Energy Division recommends the Commission allow the PAs four months, after issuing its decision on these matters, to file advice letters containing relevant Handbook changes, and it recommends that the Commission order that any such program changes go into effect thirty days after the Commission approves the advice letters filed pursuant to the decision. Parties should comment on this implementation proposal.

Attachment A: Summary of Staff Proposal for CSI Thermal Program Changes

Issue	Current Policy	Proposed Change
Payment of Incentives	Systems > 250 kW_{th}: 70% is paid up-front based on calculator; balance is paid after 1 year of system performance metering to ensure system produces at least 70% of predicted performance.	Systems > 250 kW_{th}: Required to take PBI, paid at regular intervals over a set number of years. Propose quarterly payments over four years but request input from parties on payment schedule that works best for customers and puts lowest cost on PAs.
	Systems < 250 kW_{th}: Up-front based on calculator. Standard system types and load select hot water GPD and load profile from a drop-down menu. Non-standard systems must meter hot water load for 60 days to determine GPD and load profile.	Systems < 250 kW_{th}: Applicants with standard system types and load shapes have the option of taking an up-front incentive or PBI. Applicants with systems whose output cannot be determined by modeling with reasonable expense or accuracy would be required to take PBI.
Process Heat	Currently not eligible for incentives	• Process heat must take PBI. • Total incentives to process heat initially limited to no more than $15 million total in each of first two steps (i.e. roughly half of commercial multi-family budget in steps 1 & 2).
Solar Cooling	Currently not eligible for incentives	• Must take PBI • Incentives only available for solar-assisted absorption chillers and limited to $5 million • Incentives come from natural gas budget and paid per therm delivered
Residential water/space combination systems.	No incentive paid for space heating energy savings. System is disqualified if extra collectors for space heating violate OG-300 or system sizing guidelines.	• Added incentive for space heating based on standard formula in appendix A. • Total incentive cannot exceed existing cap. • Systems must meet OG-300 standards.
Commercial combination systems	Systems are currently eligible, but only for the hot water portion of energy savings	• Additional savings from space heating and cooling would be eligible • Systems must take PBI

Attachment B:

Proposed Method for Determining a Bonus Incentive for Space Heating Component of a Residential Combination System

Step 1: Identify a "typical" house in terms of size and UA value. The UA should be for a new Title 24 home. Suggested size is 1500 or 2000 square feet.

Step 2: Pick a climate zone to model (say San Diego)

Step 3: Use TRNSYS to simulate the annual energy output for heating water (for 3 people) and combined space heating and DHW

Step 4: Simulate with one 4' x 10' collector, then two 4' x 10' collectors. Use the difference to estimate the bonus incentive (probably around 25 -50% of the single-collector amount).

Step 5: Repeat this method for each of the climate zones. Simply determine the extra therms per square foot for one extra collector in each climate zone.

Step 6: Pay additional incentives for space heating as a bonus incentive based on the additional energy savings determined by the modeling simulation above (rather than customized modeling of each system).

(END OF APPENDIX)