Transphase's Comments on the California Energy Commission's

Proposed Load Management Standards

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A. Overview and Summary of Transphase's Comments

For more than the last 20 years, thermal energy storage (TES) systems, which shift electricity for air conditioning and process cooling from on-peak to off-peak time periods, have proven to be one of, if not the, most cost-effective, reliable and feasible means to reducing critical on-peak demand and achieving energy efficiency. As noted in the 1996 California Energy Commission report, "*Source Energy and Environmental Impacts of Thermal Energy Storage*," and as confirmed in a very recent data response provided by Southern California Edison (SCE) in a CPUC proceeding, there is approximately **a 45% reduction in energy consumption** at the power plants and in the transmission and distribution system by shifting a kilowatt-hour (kWh) of consumption from the on-peak to the off-peak time period. Nevertheless, and ***despite the Energy Commission's 1996 call for the cost-effective implementation of 2500 megawatts (MW) of TES in California by 2005, far less than one one-thousandth of this 2500 MW of peak demand reduction has been achieved in this state since then***.

Without major changes in proposed rate designs and incentive programs, the benefits of TES in California will go unrealized. Therefore, Transphase proposes that the Energy Commission's proposed Load Management Standards explicitly encourage rate designs that enhance the benefits of load management and thermal storage. Second, the Energy Commission should support a standard that embraces the ***proposed California Thermal Storage Standard Offer***.

Transphase Company manufactured or installed over 30 MW of cool storage systems based on the use of a 47 degree F eutectic salt phase change material in the 1980s and 1990s. Within the last several months, Transphase has been exceedingly active at the CPUC in both the utilities' Demand Response applications proceeding (CPUC A. 08-06-001 et al.), recently sponsoring and serving testimony from major thermal energy storage manufacturers and engineers in support of a ***California Thermal Storage Standard Offer***[1]. Transphase has also been active in Southern California Edison Company General Rate Case, phase 2 (CPUC A. 08-

[1] "Transphase Sponsored Testimony of Douglas A. Ames, Victor Ott, P.E., Klaus Schiess, P.E., Mark MacCracken, P.E., and Freeman Ford In Support of a California Thermal Storage Standard Offer" separately attached hereto along with the Excel "Spreadsheets in Support of a California Thermal Storage Standard Offer."

03-002), concerning rate design and marginal cost pricing, submitting testimony from Transphase and others in opposition to SCE's proposed rate design, which has substantially "flattened" over the last few years in contrast to established California policy[2].

At pages 48-49 of the Energy Commission's proposed standards, it states:

> "a thermal storage unit allows a building manager or homeowner to store cooling energy over night when electricity is inexpensive, and then use the stored energy to cool during the afternoon when prices are high. At the June 19 workshop, presenters described some of these technologies, and ***Commissioners expressed support for the concept, but indicated that there may be no need for a standard to address their market penetration at this time***. With all customers moving toward at least TOU rates under AMI, the value of such technologies to customers would appear to be increasingly attractive. Properly implemented, this enabling technology could be invisible to the building occupants and provide significant bill savings under a favorable pricing plan, while assisting the system overall by shifting load off−peak. The Committee recommends that utilities provide information about the potential for load shifting technologies to customers as they are moved onto dynamic rates." [emphasis added]

There are some inaccuracies in this statement and in the proposed standards that could do great damage to any rebuild in the thermal storage industry, particularly in how the CPUC views the thermal storage proposals made there given the deference that the CPUC affords Energy Commission policy.

As described in more depth below, and in particular in the filings made at the CPUC, the utilities are in fact increasingly moving away from TOU rates, greatly flattening the rates over the last few years. These rates do not begin to capture the benefit of TES. Second, over and above rates, there is a great need for a ***cost-effective*** **California Thermal Storage Standard Offer**, as Transphase, Calmac, Cryogel and many others in the TES and engineering communities have proposed at the CPUC, using the Total Resource Cost Test and all other cost-effectiveness tests now widely adopted in California.

(i) Utility Rate Designs Have Flattened TOU Rates

SCE's proposed TOU-8 rates in the CPUC proceeding A. 08-03-002 will likely prevent, and at a minimum highly discourage, any new thermal energy storage installations or

[2] "Transphase Testimony of Douglas A. Ames, Victor Ott, P.E., and Klaus Schiess, P.E. in Opposition to SCE's Proposed Rate Design" separately attached hereto along with the Excel "Spreadsheets in Opposition to SCE's Proposed Rate Design".

other peak demand reduction measures within its service territory, directly in violation of a number of Commission and California Public Utilities Code directives. The table below summarizes certain key TOU-8 rates more comprehensively presented in Spreadsheet No. 1 in Support of Transphase Testimony attached to the CPUC filing with all figures in dollars:

	2006	2007	CPP	Option A	Option B
	(Pre-06 GRC)	(Post 06 GRC)	(Proposed by SCE '09)		
On –Peak Demand Charge	30.19	15.62	20.04	0	20.04
URG On-Peak Energy Charge	.164	.102	.089	.359	.089
URG Off-Peak Energy Charge	.015	.037	.041	.041	.041

SCE's proposed 2009 TOU-8 rates take to a whole new level its move away from marginal cost pricing promoting peak demand reduction and energy efficiency. For the first time, SCE has proposed a tripartite TOU-8 rate. The "default" TOU-8 rate, which it misleadingly terms a "Critical Peak Pricing" (CPP) rate, has a $20 per kW on-peak demand charge, a one-third reduction from the on-peak demand charge in effect in 2006. Moreover, this CPP on-peak demand charge will likely be largely offset by a $12.76 per kW "summer non-event on-peak demand credit." When this proposed demand credit is included, ***SCE is proposing over a 75% reduction in the on-peak demand charge from rates in effect in 2006 prior to the implementation of SCE's 2006 GRC***.

Also, SCE's proposed 2009 CPP Utility Related Generation (URG) on-peak energy charge has dropped again, from over 16 cents per kWh pre-2006 GRC, to 10 cents in 2007, and now down to under 9 cents, or ***a 45% reduction in the on-peak URG energy charge from early 2006***. Following its hyper-flattening rate proposals, SCE's URG off-peak energy charge has increased from 1.59 cents in 2006, to 3.73 cents in 2007, to 4.13 cents as proposed now, ***or a 260% increase in the off-peak rate from early 2006 to its proposed 2009 default rate***.

In addition, SCE has now proposed an Option A and Option B to its TOU-8 rate. Option A is no "option" at all- -any customer installing a TES system must go on Option A. ***This Option A includes a prohibitively punitive 35.9 cent URG on- peak energy charge compared to***

SCE's 8.9 cent CPP on-peak energy charge proposal, or about four times the rate under Option A than under the CPP rate. Option B is basically the same as the CPP rate but without the enormous demand charge credits and the rarely and uncertainly applied CPP Event Energy Charge. To further discourage peak demand reduction and energy efficiency, SCE's CPP proposal also includes a Bill Protection Limiter to make sure no participating customer could save money by choosing Option A or Option B, at least in the first year.

As Transphase's spreadsheets attached to its testimony demonstrate, SCE's proposal largely eliminates TES or Permanent Load Shifting (PLS) as a viable option. As an example, for a typical large office building with a 1000 kW peak cooling load, under the pre-2006 GRC rates, the non-TES customer's summer monthly electric bill would be approximately $101,000. Under the same pre-2006 GRC rates, the same customer loads with a one MW TES system would have a monthly bill of $52, 400 – or a monthly savings of approximately $48,600.

However, under SCE's proposed 2009 GRC rates, the same customer's CPP summer monthly electric bill, with no peak demand reduction, would drop to $59,877, or ***more than 40% less than under the 2006 rates***. The same customer under the 2009 GRC Option A rate, with a one MW peak demand reduction from TES, would have a summer monthly bill of $52,444, or a savings of only just over $7000 compared to the CPP rate. No customer would rationally install a TES system with this paltry savings.

SCE's proposed TOU-8 rate directly and unambiguously conflicts with Commission directives and the Public Utilities Code's mandate to enhance energy efficiency and reduce peak demand. Indeed, SCE has built into its ever more-flattening rate structure a perverse disincentive for reducing peak demand; namely, the higher the CPP TOU-8 rate customer's peak demand relative to its 24 hour kWh usage, i.e. the more spiked its peak demand, the greater its percentage electric bill reduction from early 2006.

Transphase has proposed that the CPUC reinstitute a single post-2003/pre-2006 GRC rate design for TOU-8 customers as compatible with Commission directives and the Public Utilities Code, with two modifications.[3]

In general, Transphase supports the Energy Commission's proposed standards with respect to rate design but with the explicit modification that CPP rate designs should not detract from the inherent value of load management measures such as TES. As KS Engineers as suggested in its comments, the Energy Commission should support a standardized rate schedule which supports thermal energy storage.

<u>(ii) The Need for a California Thermal Storage Standard Offer</u>

The utilities' amended Demand Response applications, like their original applications in the consolidated CPUC Demand Response proceeding (A. 06-05-001 et al.), propose to acquire absolutely no resource capacity or demand reduction from new thermal energy storage (TES) and/or permanent load shifting (PLS) programs during the next three years. Instead, the utilities' amended applications have proposed to continue through 2011 with a miniscule program of a token few megawatts ("MW") of TES required by the CPUC in 2006.

Therefore, the thermal storage community has proposed a cost-effective ***California Thermal Storage Standard Offer*** for all three utilities, open to all storage mediums, vendors and customer classes. This Thermal Storage Standard Offer would ramp up to provide up to 30 MW per year of on-peak capacity in SCE territory, 25 MW per year of capacity in PG&E territory, and 10 MW per year in SDG&E territory. The proposed payment structure would be $1400 per kW paid over a multi-year period, or substantially less than the $1950 per kW PG&E currently pays under its 3.9 MW TES program for retrofit TES systems. In addition, the payments would

[3] As shown in Transphase's Spreadsheet number one, from the 2003 GRC rate design through to SCE's proposed 2009 rate design, the delivery service energy charge and the Department of Water Resources (DWR) energy charge has been entirely flat and non-time differentiated. Transphase proposes that these two energy component rates be time-differentiated using the same design as in the GRC 2003 URG energy component. Transphase further proposes that SCE's CPP program be changed from a default rate to a capacity incentive payment, just as the Commission ordered with respect to SCE's Base Interruptible Program (BIP), unless the Commission views the CPP incentive as entirely redundant to the BIP and other SCE capacity incentive payments.

be based on *ex post* metering of each TES system so that the incentives would result from proven, verifiable performance. Significantly, the Standard Offer would be entered into between the utility and the end-use customer, and these payments would be made to the end-use customer, not to any particular vendor.

The proposed California Thermal Storage Standard Offer provides extremely attractive cost effectiveness to all the ratepayers under the Total Resource Cost (TRC) test, the utility under the Utility Cost test, and the participating customer under the Participant test or simple payback period. Attached and incorporated into the CPUC testimony are a collection of excel spreadsheets providing all of these tests for each of the three utilities. Using the avoided cost information for a combustion turbine peaking plant very recently supplied by the utilities in the Demand Response rulemaking proceeding, R. 07-01-041, the TRC benefit/cost ratio for the proposed Standard Offer exceeds 1.5 for each utility. Even though TES typically comprises a significant capital expense, simple payback periods for the participating customer will range from one to three years. In this time of great economic stress and organizations' constrained capital budgets, the California Thermal Storage Standard Offer proposed here will provide a major "green" economic and environmental stimulus and benefits to all that few, if any, other demand side management or energy efficiency measures could match.

In addition, thermal energy storage provides an important, perhaps essential, link to the proliferation of intermittent renewable energy sources, particularly wind energy. A data response from SCE in the CPUC proceeding demonstrates that in 2007, this utility was supplied almost ***four times*** as much wind energy on a daily basis during the summer off-peak time period than during the summer on-peak. TES, also known as cool storage, holds the very real potential to turn this off-peak wind energy into firm, on-peak capacity and energy, in the process providing one of the critical links to achieving the California renewable portfolio standard.

In sum, the Energy Commission should specifically adopt as a load management standard, or at the very least, support the proposed California Thermal Storage Standard Offer, in the process placing the Energy Commission and California in a worldwide energy efficiency and demand response leadership position.

B. The Massive Energy Efficiency and Environmental Benefits of Thermal Storage.

From the 1980s until the mid-1990s, thermal energy storage systems were installed in larger commercial and industrial facilities throughout California to shift air conditioning and process cooling load from the on-peak to the off-peak hours. Many types of such cool storage systems proliferated, including various types of chilled water storage systems, ice storage systems, and eutectic salt storage systems based on the use of 47 degree F phase change materials.[4] A number of field monitoring studies, data analyses, and design guides were published, led by the Electric Power Research Institute (EPRI) [5], the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)[6], the California Energy Commission[7] (CEC or Energy Commission), and various utilities and organizations around the country[8].

The California Energy Commission has long provided leadership and support for thermal energy storage. As early as 1978, the CEC adopted standards for a program of load management that included the development of "end-use storage systems."[9] In August, 2007, the Energy Commission approved Thermal Energy Storage systems for compliance credit under the Title 24 *2005 Building Energy Efficiency Standards* for nonresidential buildings.[10]

In 1996, the California Energy Commission published a landmark study of the energy and environmental benefits of thermal storage systems. The Energy Commission's *Source Energy and Environmental Impacts of Thermal Energy Storage*, February 1996, www.energy.ca.gov/reports/500-95-005_TES-REPORT.PDF, provided a comprehensive

[4] See, for example, PG&E's "*Thermal Energy Storage Strategies for Commercial HVAC Systems*," 1996, www.pge.com/includes/docs/pdfs/about/edusafety/training/pec/inforesource/thrmstor.pdf , which describes and compares various types of cool storage systems.

[5] See, e.g., these four EPRI reports: EPRI, *Commercial Cool Storage*, CU. 3024 (1988); EPRI, *Thermal Energy Storage*, CU.2036 (1992); EPRI, *Commercial Cool Storage Primer*, EM-3371 (1984); *EPRI Cool Storage Monitoring Workshop Presentation Material* (September, 1989.

[6] ASHRAE, *Design Guide for Cool Thermal Storage* (1993)

[7] California Energy Commission, *Source Energy and Environmental Impacts of Thermal Energy Storage* (February, 1996)

[8] For example, the International Thermal Storage Advisory Council (ITSAC) was begun and run by Loren McCannon, an SDG&E engineer. SDG&E had a particularly strong thermal storage program.

[9] The Brattle Group, *California's Next Generation of Load Management Standards,* Prepared for the California Energy Commission, p. 16 (July, 2007)

[10] California Energy Commission, *Thermal Energy Storage Compliance Option* (July, 2007).

analysis. Here are a few of the major conclusions from this detailed study:

- At the source power plant: “In many California TES installations, 40 percent to 80 percent of the annual kWhs of electricity use for air conditioning will be shifted from day to night. In such installations the official Energy Commission methodology, the Incremental Energy Rate method, showed large source energy savings. ***The savings per kWh shifted range from 36 percent to 43 percent for SCE and 20 percent to 30 percent for PG&E***.” p.3 (emphases added)

- At the building site level: “Although early TES systems used more kWhs than conventional systems, monitoring of many recent TES systems shows these systems use 12 percent fewer kWhs than conventional systems. These efficiencies are also attractive compared to the ***20 percent to 50 percent energy penalties from using conventional utility storage technologies such as pumped hydro***.” (p.3-4)

- Source Emissions Analysis: “TES can also greatly reduce air emissions from power plants….Assuming a 20 percent market penetration by 2005, TES could save 260,000 tons of CO_2 annually statewide. Just as importantly it could save about ***1.6 tons of NOx per day in the SCAQMD***. These NOx savings are equivalent to the savings substituting 100,000 electric vehicles for gasoline vehicles.” (p.4)

- Further Air Emission Impacts at the Power Plant Source: “Figure 31 shows that the air emissions savings from shifting a kWh are slightly higher than the source energy savings. For example, Figure 31 shows ***a 47 percent savings in emissions by shifting a kWh of cooling load from on-peak to off-peak***.” (pgs. 41- 42)

This monumental energy conservation impact of thermal storage at power plants occurs because TES avoids deployment of the dirtiest, least efficient peaking plants operating at the margin.

Time-differentiated heat rate data has very recently been verified. In April, 2008, SCE responded to a Transphase data request for time-differentiated heat rates as part of SCE’s 2009 General Rate Case (GRC). SCE’s own 2008 data confirms that shifting a kWh from on–peak to off-peak results in an energy savings of 45% under this Incremental Energy method. PG&E also responded to a Transphase data request in September, 2008 in the CPUC proceeding in which it provided heat rate data based on forward 2009 estimates of electric and gas supply. Below is a table providing this 2008-compiled heat rate data:

SCE[11] and PG&E[12]

Power Plant Heat Rates (Btus/kWh)

	Summer		Winter	
	SCE	PG&E	SCE	PG&E
On-Peak	13,258	11,985	-------	------
Mid-Peak	10,254	10,781	9,413	10,037
Off-Peak	7,263	7,603	6,996	7,742

For SCE, the summer off-peak heat rate is 45% less than the summer on-peak heat rate, which translates directly into a 45% reduction in fossil-fuel consumption at the power plant for every kWh shifted from on-peak to off-peak. For PG&E, the summer off-peak heat rate is 37% less than the summer on-peak heat rate, which translates directly into a 37% reduction in fossil-fuel consumption at the power plant for every kWh shifted from on-peak to off-peak.

In addition, while helping to avoid the capital cost of transformers blowing out on a hot summer afternoon (which should be included in the avoided capacity cost), TES also provides transmission and distribution line energy savings. As the Energy Commission explained:

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[11] SCE's verbatim response to Transphase's data request:

Southern California Edison

2009 GRC Phase 2 A.08-03-002

DATA REQUEST SET TRANSPHASE-SCE-001
To: TRANSPHASE
Prepared by: Paul Nelson
Title: Senior Economist
Dated: 04/17/2008
Question 02:
In SCE's "Marginal Cost and Sales Forecast" Exhibit, I did not see any heat rate information using either the Incremental Energy Rate or Marginal Plant Rate method. (see pages 16 to 23 of this CEC report.) (If you have already included this information somewhere, I apologize in advance.) Would SCE be willing to provide such heat rate information as a means to test SCE's proposal and to better understand what differences might have led to such dramatic rate design changes coming out of the 2003 GRC, on the one hand, and the 2006 and SCE proposed 2009 GRC rate designs, on the other hand?
Response to Question 02:
The incremental energy rate can be calculated from Table I-7 and the average gas price of $7.49 (SCE-2, page 24, line 7):
IER (BTUs/KWH) = Energy Price (cents/KWH) / Gas Price ($/MMbtu) * 10,000
IER (Btus/KWH)

	Summer	Winter
On-Peak	13,258	-
Mid-Peak	10,254	9,413
Off-Peak	7,263	6,996

[12] See PG&E's Answer to Transphase's Question 15 in Transphase's Data Request, Set Two.

> In particular, energy is lost due to resistance in the power lines (line losses). For example, to get 1.00kWh of electricity delivered to the energy user's site, 1.10 kWhs may need to be input into the power lines at the power plant. This amounts to a 10 percent line loss. Moreover, an important factor in this TES analysis is that these line losses vary across the five time periods. In particular, line losses are highest when the ambient temperature is hotter. Both of these factors lead to line losses being higher during the summer on-peak period. Therefore, TES saves energy by shifting electricity use to times of lower line losses…When evaluating DSM programs which have their impacts at the energy user's site, the utilities, CPUC, and California Energy Commission use the distribution level marginal costs that reflect the line losses. [13]

Hence, TES provides very substantial energy savings, as well as avoidance of capital costs.

At least 33% of California's 50,000 MW peak electricity load comes from air conditioning.[14] In addition, on those peak days from the summer of 2007 when California's peak demand rose to over 50,000 MW, the load at night dropped to approximately 28,000 MW.

There is no more effective way to reduce this peak load than from TES. Hospitals, universities, data centers, manufacturing facilities, and office buildings all can be easily retrofitted with TES. As opposed to 'conventional' demand response, ***TES does not affect the comfort or productivity of the participant buildings' inhabitants on the critical peak days***. In many facilities, such as hospitals or data centers, cooling cannot be interrupted or reduced. In such facilities, conventional demand response, wherein cooling is curtailed or completely stopped during critical peak periods, is completely unacceptable.

However, TES is perfectly suited for these cooling- critical facilities. With cool storage, the buildings continue to operate with the same level of cooling.

From the stand-point of the California Independent System Operator and the utility, cool storage eliminates all issues concerning notification periods, triggers, or uncertainty as to whether the participating customer will choose to incur the penalties of any of the capacity

[13] California Energy Commission, *Source Energy and Environmental Impacts of Thermal Energy Storage* at p.19. PG&E states that line losses are included in its heat rate calculations. See Answer 16 to Transphase's data request, set two.

[14] *Source Energy and Environmental Impacts of Thermal Energy Storage*, p. 45 (in 1995, "[a]ir conditioning is currently about 14,000 MW or about a third of the total peak demand in California."

incentive programs, e,g, critical peak period rates, base interruptible program, capacity bidding program, or the demand bidding program, in order to keep the facility cool on a critical peak day. Most significantly, there are no issues of "rolling baselines" with permanent load shifting/TES. From the stand-point of the utility and the Independent System Operator, PLS/TES provides by far the most certainty and predictability of any demand response-type measure.

Various studies have suggested that TES could penetrate at least 33%, or almost 7000 MW, of the 20,000 MW California air conditioning load. In its 1996 report, the Energy Commission used a more conservative 20% penetration rate for TES and, with the then-current California peak demand, concluded that ***2500 MW of TES could be installed in California by 2005***.[15] In that time period, the Energy Commission estimated that "TES could save over a billion dollars of investment in the T&D [transmission and distribution] system and perhaps equal savings in generation capacity investment." Nevertheless, during that period from 1996 through 2005, the amount of TES installed amounted to essentially nothing.

From this perspective, it is easy to see how the proposed California Thermal Storage Standard Offer, ramping up to a maximum of 65 MW of installations in 2011 across the three major California electric utilities, represents an extremely modest and realistic goal for the program.

C. Thermal Storage Transforms Wind Energy from an Intermittent, Heavily Off-Peak Energy Source into a Firm, Cost Effective Peak Capacity and Energy Resource.

(i) The California Thermal Storage Standard Offer Should Play A Major Role in Achieving California's Renewable Portfolio Standard.

The Energy Commission, the CPUC and the California Independent System Operator have all recognized the enormous potential need for combining energy storage with intermittent renewable energy sources. As stated in CPUC Administrative Law Judge Jessica T. Hecht's February 27, 2008 Ruling at p. 21:

> Under California's renewable portfolio standard (RPS), new and creative methods will be required in order to integrate into the electricity supply many of the renewable

[15] *Source Energy and Environmental Impacts of Thermal Energy Storage*, p. 45.

resources that are intermittent. It is possible that intermittent renewable resources can be better integrated to serve load through the use of permanent load shifting techniques such as energy storage; if so, this could assist in meeting the state's RPS standard. Recent studies by the California Energy Commission and the CAISO provide some background on this issue and may be useful in developing proposals. [citations omitted]

PG&E clearly understood the natural fit:

> Most wind generation in California occurs during off-peak hours, particularly during the summer months. Technologies that can shift load from on-peak hours to off-peak hours help maximize the utility's ability to use wind energy during off-peak hours. Although pumped hydro is a good resource to help with this issue, pumped hydro potential is low. Alternative storage technologies include thermal energy storage (water and ice) and several battery technologies.

PG&E Prepared Testimony at p. 2-33. [16]

While PG&E has at least 1200 MWs of pumped storage,[17] its DR Application did not include any new thermal storage resources used in combination with wind energy. It does propose to spend over a million dollars of the ratepayers' money for a study. SCE's Application is equally unresponsive in addressing the massive potential benefits to all Californians from storage/ intermittent renewables. SCE's Application is essentially limited to studying the possibility of using lithium ion batteries in residences.

However, SCE did respond to a Transphase data request for a time-of-use breakdown for 2007 wind supply with the following table:

	Peak Period		2007 daily kWh		
			average	minimum	maximum
Summer	on		1,516,421	50,026	3,925,735
Summer	mid		2,752,099	142,544	6,377,746
Summer	off		4,592,979	47,424	15,122,855
Winter	mid		3,235,441	128,867	9,534,896
Winter	off		2,208,473	20,500	12,290,950

[16] In its brochure in the mid-1990s, PG&E actively promoted thermal energy storage, including a significant section on eutectic salts as the storage medium. Transphase assumes that by PG&E's references to water and ice as storage mediums, it was not intending to exclude eutectic salts or other measurable, verifiable storage mediums.

[17] See, e.g., CAISO Report describing potential use of PG&E's 1200 MW pumped storage facility with wind energy.

During the summer, ***wind energy supplies SCE with over three times as many kWhs during the off-peak period than during the on-peak period.*** On SCE's internet home page, SCE announces that it has recently signed contracts for 900 MW of new wind energy. What will the utilities do with this avalanche of off-peak wind energy pouring into their systems as California's Renewable Portfolio Standard takes hold?

Thermal energy storage provides a critical and cost effective solution to the growing off-peak wind energy supply issue. In fact, TES turns off-peak wind energy into a firm, reliable and committed source of on-peak capacity and energy.

In Transphase's protests to the utilities' original and amended DR applications, Transphase proposed a series of TES/Wind energy pilots. However, none of the three utilities responded to a Transphase data request seeking time-differentiated average wind energy prices.[18] Without this average price information, it is difficult if not impossible to construct the incentive payments or structure for TES/wind energy pilots, at least ones that would differ in a material respect from the proposed Thermal Storage Standard Offer. Hence, at this point Transphase must forego the TES/ wind energy pilots proposed in its protests.

Nevertheless, the ramping-up of California TES installations under the proposed Thermal Storage Standard Offer will inevitably have the beneficial effect of absorbing the off-peak energy (from whatever the source) and turning into it firm, on-peak capacity and energy.

Therefore, a major benefit to the proposed California Thermal Storage Standard Offer is that it provides a realistic, concrete path towards the cost effective attainment of California's Renewable Portfolio Standard.

D. Transphase's Past Utility Power Savings Agreements and Measurement Plans.

Transphase provides here background into Transphase and SCE's past thermal storage programs. In the period from the mid-80s through the mid-90s, Transphase manufactured, installed and/or operated over 80 cool storage systems used to shift electricity consumption for

[18] The lack of the utilities' substantive response to this and other Transphase data requests are the subject of Transphase's pending motion to compel further answers to data requests.

air conditioning and process cooling at large commercial/ industrial buildings from on-peak hours to off-peak hours. Transphase installations reduced peak demand by over 30 MW, most of which occurred in California. This includes a six MW Power Savings Agreement with SCE in 1991 as well as Power Savings Agreements with other utilities. The thermal storage system is based on Transphase's eutectic salt storage medium that melts and freezes at 47 ° F, and can be used with any existing or new chiller. Systems are still in operation and providing superior performance after more than 18 years of service.

The Transphase Cool Storage System is based on the use of inorganic, non-toxic, and inexpensive "eutectic salts" as the storage medium. The primary eutectic salt manufactured by Transphase melts and freezes at 47 °F, although Transphase also developed a 41°F under contract with EPRI. The phase change material ("PCM") is filled into rugged, self-stacking, water-impermeable high density polyethylene containers measuring 24" by 8" by 1.8" deep. The PCM-filled Transphase containers are then placed within a tank, often a below-grade concrete tank underneath a parking lot or landscaped area, at the building facility.

The system is charged using a building's existing or new chillers during off-peak electric hours. At night, 40-42 °F chilled water from the central chiller plant flows into the tank and between the Transphase containers, thereby freezing the 47°F PCM. By the end of the off-peak time period, the tank is filled with solid blocks of "ice", but ice that freezes and melts at 47 degrees, not 32 degrees.

During the daytime on-peak time period, warm return water from the building chilled water piping flows into the tank and in between the eutectic salt-filled containers. The building water is chilled as it passes over the thawing Transphase containers. Upon exiting the tank, the chilled water is circulated through the buildings to provide air conditioning or process cooling in the conventional manner. Various system designs have been employed, including full storage systems designed to handle 100 percent of the building's on-peak cooling load, or partial storage designs where the storage system is sized to handle part of the cooling load. [19]

In addition, Transphase successfully designed and installed systems combining other energy efficiency products such variable frequency drives and automated building control

[19] See, e.g., Ames, "Eutectic cool storage: Current Developments", *ASHRAE Journal* (April, 1990); Kostyun and Ames, "Arizona Utility Adds Eutectic Storage Unit", *ASHRAE Journal* (May, 1987)

systems that greatly increase the system's cost-effectiveness, significantly conserving energy as well as reducing the on-peak electric demand. Most dramatically, in desert or otherwise cool nighttime environments, a "free cooling" heat exchanger can be placed on the cooling tower water lines, allowing the Transphase System to be charged at night without chiller operation. This can result in a further energy reduction of over 50%, as well as on-peak demand reduction.

Because the Transphase System relies upon a phase change at 47°F, the entire universe of buildings with existing or new conventional chillers can be retrofitted with this eutectic salt storage system. The Transphase system's higher temperature phase change point allows the system to be very energy efficient.

By the late 1980s, Transphase had manufactured and/or installed its eutectic salt cool storage system in California, Arizona, Florida, Taiwan, Japan, Korea, Canada, Israel, and Europe. The California utilities led the world by offering TES incentives, typically with a one-time payment to the end user of $200 to $400 per kW. This Commission regularly authorized these incentive payments and budgets of $5 to $7.5 million per year per utility for TES incentives.

However, the utilities began a disturbing pattern of constantly withdrawing the incentive offer from the customer, seriously disrupting the formation of the TES industry. For example, a favorite tactic of SCE during this period was to approach its largest customers and pitch that they need to sign up for these incentives, without any obligation to proceed. With absolutely no reason for these customers not to sign up, very soon SCE would announce that there was no more money in the budget for any customer who actually wanted to install a system. Since a low percentage of the signed-up customers actually proceeded with an installation, given the non-obligatory nature of the reservation, little of the budgeted funds were actually spent as incentives for customers installing TES systems.

In 1990, as a result of a protest filed at this Commission over the utilities' application for shareholder incentives for demand side management, Transphase broke new ground by entering into a so-called "Power Savings Agreements" (PSAs) with various utilities, primarily Southern California Edison and Jersey Central Power & Light Co. Under these PSAs, Transphase developed Measurement Plans applicable to thermal storage systems, agreed to by the utilities. The Measurement Plans comprehensively established measurement and monitoring protocols for the thermal and electrical components of the chiller plant. Transphase's Measurement Plan was later adopted by the National Association of Energy Service Companies ("NAESCO") as the standard for thermal storage systems.

While Transphase successfully manufactured, installed, financed and operated its systems at large prestigious host company installations under these utility Power Savings Agreements, including installations at AT&T's world headquarters, Marriott Desert Springs Resort, City of Hope Medical Center, Ventura County Government Center, and many others, Edison and JCP&L stopped paying for the contracted and well-documented power savings under the 7 to 13 year terms of the Agreements. Several of these systems are still operating more than 18 years after installation, having saved the customers many times the purchase price.

As a result of the debt incurred to finance these installations under utility PSAs, Transphase was eventually forced to cease operations in 1996 (but never declared bankruptcy). In 1999, a California jury awarded Transphase $6.35 million against Edison for breaching its contract with Transphase after a seven week jury trial.[20] As part of this award, the jury also found that Edison had tortiously interfered in Transphase's contracts with its host customers and had maliciously driven Transphase out of business, awarding Transphase punitive damages. While the Edison case ultimately settled for $3.2 million (which Edison evidently charged to the ratepayers), the trial judge and the Court of Appeal issued rulings which upheld all liability verdicts and the punitive damage award. The funds collected in the litigation were then returned to Transphase's creditors and shareholders, including such venture capital investors as the Environmental Venture Fund, Robertson Stephens & Co., First Analysis Corp., and WD Ruckelshaus & Associates.

E. Conclusion.

More than ever before, the time is now for an expanded role for TES. The proposed California Thermal Storage Standard Offer will allow California to regain and expand its world-wide leadership position in energy efficiency and demand side management.

[20] "New Power Source: Former Energy Company Executive Wins Legal Victory Over Edison," *Los Angeles Times*, May 5, 1999, pages C1 and C6.

Respectfully submitted,

/s/ Douglas A. Ames

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December 5, 2008

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Southern California Edison Company (U338-E) for Authority to Establish Marginal Costs, Allocate Revenues, and Design Rates.	)	Application 08-03-002 (Filed March 4, 2008)
In the Matter of the Application of Southern California Edison Company (U338-E) for Authority to Make Various Electric Rate Design Changes.	)	Application 07-12-020

Transphase's Testimony of Douglas A. Ames, Victor J. Ott, P.E., and

Klaus J. Schiess, P.E. In Opposition to

So. Cal. Edison's Proposed Rate Design and Revenue Allocation

And in Support of a Thermal Storage Standard Offer

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As a party to this proceeding, Transphase hereby submits the following witness testimony in opposition to Applicant Southern California Edison's proposed rate design and revenue allocation in its 2009 General Rate Case (GRC), phase two and in support of a Thermal Storage Standard Offer:

This testimony is submitted in accordance with Administrative Law Judge Yip-Kikugawa's Ruling dated September 2, 2008.

Respectfully submitted,

/s/ Douglas A. Ames

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BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

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Transphase's Exhibit A

Testimony of Douglas A. Ames In Opposition to

So. Cal. Edison's Proposed Rate Design and Revenue Allocation

And in Support of a Thermal Storage Standard Offer

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In support of Transphase's opposition to Southern California Edison's proposed TOU-8 rate design and revenue alloeation as part of phase 2 of its 2009 General Rate Case, A. 08-03-002, Douglas A. Ames submits the testimony that follows, including and ineorporating Excel Spreadsheets numbers 1 to 7 attached separately hereto (showing all variables and assumptions in compliance with Commission Rule 10.3 and 10.4).

1. **Overview of Testimony and Recommendations.**

For more than the last 20 years, thermal energy storage (TES) systems, which shift electricity for air conditioning and process cooling from on-peak to off-peak time periods, have proven to be one of, if not the, most cost-effective, reliable and feasible means to reducing critical on-peak demand and achieving energy efficiency. As noted in the 1996 California Energy Commission report, "*Source Energy and Environmental Impacts of Thermal Energy Storage*," and as confirmed in a data response provided by Southern California Edison (SCE) in this proceeding, there is approximately **a 45% reduction in energy consumption** at the power plants and in the transmission and distribution system by shifting a kilowatt-hour (kWh) of consumption from the on-peak to the off-peak time period. Nevertheless, and despite the Energy Commission's 1996 call for the cost-effective implementation of 2500 megawatts (MW) of TES in California by 2005, far less than one one-thousandth of this 2500 MW of peak demand reduction has been achieved in this state since then.

SCE's proposed TOU-8 rates in this proceeding will likely prevent, and at a minimum highly discourage, any new thermal energy storage installations or other peak demand reduction measures within its service territory, directly in violation of a number of Commission and California Public Utilities Code directives. The table below summarizes certain key TOU-8 rates more comprehensively presented in Spreadsheet No. 1 in Support of Transphase Testimony attached hereto with all figures in dollars:

	2006	2007	CPP	Option A	Option B
	(Pre-06 GRC)	(Post 06 GRC)	(Proposed by SCE '09)		
On –Peak Demand Charge	30.19	15.62	20.04	0	20.04
URG On-Peak Energy Charge	.164	.102	.089	.359	.089
URG Off-Peak Energy Charge	.015	.037	.041	.041	.041

SCE's proposed 2009 TOU-8 rates take to a whole new level its move away from marginal cost pricing promoting peak demand reduction and energy efficiency. For the first time, SCE has proposed a tripartite TOU-8 rate. The "default" TOU-8 rate, which it misleadingly terms a "Critical Peak Pricing" (CPP) rate, has a $20 per kW on-peak demand charge, a one-third reduction from the on-peak demand charge in effect in 2006. However, this CPP on-peak demand charge will likely be largely offset by a $12.76 per kW "summer non-event on-peak demand credit." When this proposed demand credit is included, ***SCE is proposing over a 75% reduction in the on-peak demand charge from rates in effect in 2006 prior to the implementation of SCE's 2006 GRC.***

Also, SCE's proposed 2009 CPP Utility Related Generation (URG) on-peak energy charge has dropped again, from over 16 cents per kWh pre-2006 GRC, to 10 cents in 2007, and now down to under 9 cents, or ***a 45% reduction in the on-peak URG energy charge from early 2006***. Following its hyper-flattening rate proposals, SCE's URG off-peak energy charge has increased from 1.59 cents in 2006, to 3.73 cents in 2007, to 4.13 cents as proposed now, ***or a 260% increase in the off-peak rate from early 2006 to its proposed 2009 default rate***.

In addition, SCE has now proposed an Option A and Option B to its TOU-8 rate. Option A is no "option" at all- -any customer installing a TES system must go on Option A. ***This Option A includes a prohibitively punitive 35.9 cent URG on- peak energy charge compared to SCE's 8.9 cent CPP on-peak energy charge proposal, or about four times the rate under Option A than under the CPP rate.*** Option B is basically the same as the CPP rate but without the enormous demand charge credits and the rarely and uncertainly applied CPP Event Energy Charge. To further discourage peak demand reduction and energy efficiency, SCE's CPP proposal also includes a Bill Protection Limiter to make sure no one could save money by choosing Option A or Option B, at least in the first year.

As Transphase's spreadsheets attached to this testimony demonstrate, SCE's proposal largely eliminates TES or Permanent Load Shifting (PLS) as a viable option. As an example, for a typical large office building with a 1000 kW peak cooling load, under the pre-2006 GRC rates, the non-TES customer's summer monthly electric bill would be approximately $101,000. Under the same pre-2006 GRC rates, the same customer loads with a one MW TES system would have a monthly bill of $52, 400 – or a monthly savings of approximately $48,600.

However, under SCE's proposed 2009 GRC rates, the same customer's CPP summer monthly electric bill, with no peak demand reduction, would drop to $59,877, or ***more than 40% less than under the 2006 rates***. The same customer under the 2009 GRC Option A rate, with a one MW peak demand reduction from TES, would have a summer monthly bill of $52,444, or a savings of only just over $7000 compared to the CPP rate. No customer would rationally install a TES system with this paltry savings.

SCE's proposed TOU-8 rate directly and unambiguously conflicts with Commission directives and the Public Utilities Code's mandate to enhance energy efficiency and reduce peak demand. Indeed, SCE has built into its ever more-flattening rate structure a perverse disincentive for reducing peak demand; namely, the higher the CPP TOU-8 rate customer's peak demand relative to its 24 hour kWh usage, i.e. the more spiked its peak demand, the greater its percentage electric bill reduction from early 2006.

Moreover, SCE is attempting ***a massive revenue reallocation*** through its proposed TOU-8 rates. Given the huge electric bill reduction that most large consumers will realize from the pre-2006 GRC rates, the inevitable effect is to shift SCE's increasing revenue requirement from the large commercial/industrial customers onto the smallest, most captive electric customer, be it a residential or small business customer.

Transphase proposes that the Commission reinstitute a single post-2003/pre-2006 GRC rate design for TOU-8 customers as compatible with Commission directives and the Public Utilities Code, with two modifications. As shown in Transphase's Spreadsheet number one, from the 2003 GRC rate design through to SCE's proposed 2009 rate design, the delivery service energy eharge and the Department of Water Resources (DWR) energy charge has been entirely flat and non-time differentiated. Transphase proposes that these two energy eomponent rates be time-differentiated using the same design as in the GRC 2003 URG energy eomponent. Transphase further proposes that SCE's CPP program be changed from a default rate to a capacity incentive payment, just as the Commission ordered with respect to SCE's Base Interruptible Program (BIP), unless the Commission views the CPP incentive as entirely redundant to the BIP and other SCE capacity incentive payments.

Finally. Transphase proposes a Thermal Storage Standard Offer as an alternative to the TOU-BIP, Capacity Bidding Program, Demand Bidding Program and CPP ineentives. Transphase has proposed this four year payment structure based on *ex post* measurement in the utilities' Demand Response proeeeding, A. 08-06-001 et al., just as SCE proposed its various eapaeity incentives such as the BIP, CBP and DBP in that DR proeeeding. A Total Resource Cost (TRC) Test is presented in the attached Transphase spreadsheets which establishes the cost-effectiveness of Transphase's proposal, even though this test result is not final due to the fact that SCE has to date refused to state its avoided costs.

With proper rate design and cost-effective incentives, thermal energy storage will achieve the 2500 MW peak demand reduction in California called for by Energy Commission and provide enormous energy efficiency benefits to all California ratepayers.

2. Commission and Legislative Policies Conflict with SCE's Proposed TOU-8 Rate.

This submittal is testimony, not an opening brief. However, in opposition to SCE's poliey positions in its updated testimony, Transphase summaries the applicable authority:

Cal. Public Utilities Code §454.5(b)(9)(C) provides: "The electrical corporation will first meet its unmet resource needs through all available energy efficiency and demand reduction resources that are cost effective, reliable, and feasible." (emphasis added).

Particularly applicable is Stats. 2002 ch 850:

The Legislature finds and declares all of the following:

(a) Californians can significantly increase the reliability of the electricity system and reduce the level of wholesale electricity prices by reducing electricity usage at peak times through a variety of measures designed to reduce electricity consumption during those periods....

(e) Electricity consumption for air conditioning purposes during peak demand periods significantly contributes to California's electricity shortage vulnerability during summer periods.

(f) It is the intent of the Legislature to promote energy conservation and demand reduction in the State of California.

This legislative intent and mandate has long been in accord with Commission policy. As SCE concedes: "The Commission has placed DR programs in a superior position in the Energy Action Plan 'Loading Order' and set a policy goal of pursuing *all* cost-effective EE and DR before increasing reliance on supply-side resources."[1] (emphasis added) As provided in the Energy Action Plan II, September 2005 at p. 2: "EAP II continues the strong support for the loading order- endorsed by Governor Schwarzenegger- that describes the priority sequence for actions to address increasing energy needs. The loading order identifies energy efficiency and demand response as the State's preferred means of meeting growing energy needs."

Ames hereby references and incorporates the excellent discussion of California legislative intent in section 5 of the testimony of Victor J. Ott, P.E. of Cryogel which follows this testimony at page 31.

In addition, as further described in the next section below, the California Energy Commission has fully recognized and promoted the energy efficiency and environmental benefits of thermal energy storage.

As also demonstrated in section 4 below, all of these California policies are at direct odds with the TOU-8 rate designs proposed by SCE in this 2009 GRC application.

[1] SCE's Appendix C, Demand Response Avoided Capacity Valuation Methodology at p. C-1.

3. The Massive Energy Efficiency and Environmental Potential of Thermal Storage.

From the 1980s until the mid-1990s, thermal energy storage systems were installed in larger commercial and industrial throughout California to shift air conditioning and process cooling load from the on-peak to the off-peak hours. Many types of cool storage systems proliferated, including various types of chilled water storage systems, ice storage systems, and eutectic salt storage systems based on the use of 47 or 41 degree F phase change materials.[2] A number of field monitoring studies, data analyses. and design guides were published, led by the Electrie Power Research Institute (EPRI)[3], the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)[4], the California Energy Commission[5], and various utilities and organizations around the country[6].

The California Energy Commission has long provided leadership and support for thermal energy storage. As early as 1978, the CEC adopted standards for a program of load management that included the development of "end-use storage systems."[7] In August, 2007, the Energy Commission approved Thermal Energy Storage systems for compliance credit under the Title 24 *2005 Building Energy Efficiency Standards* for nonresidential buildings.[8]

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[2] See, for example, PG&E's *"Thermal Energy Storage Strategies for Commercial HVAC Systems,"* 1996, www.pge.com/includes/docs/pdfs/about/edusafety/training/pec/inforesource/thrmstor.pdf , which describes and compares various types of cool storage systems.

[3] See, e.g., these four EPRI reports: *EPRI Cool Storage Monitoring Workshop Presentotion Moterial* (September, 1989); EPRI, *Commercial Cool Storoge*, CU. 3024 (1988); EPRI, *Thermol Energy Storage*, CU.2036 (1992); EPRI, *Commercial Cool Storage Primer*, EM-3371 (1984).

[4] ASHRAE, *Design Guide for Cool Thermol Storage* (1993)

[5] California Energy Commission, *Source Energy and Environmental Impacts of Thermol Energy Storage* (February, 1996)

[6] For example, the International Thermal Storage Advisory Council (ITSAC) was begun and run by Loren McCannon, an SDG&E engineer.

[7] The Brattle Group, *Californio's Next Generotion of Load Monagement Standards,* Prepared for the California Energy Commission, p. 16 (July, 2007)

[8] California Energy Commission, *Thermal Energy Storage Compliance Option* (July, 2007).

In 1996, the California Energy Commission published a landmark study of the impact of thermal storage systems. The study determined that, based on Edison's power plant heat rate data, shifting a kilowatt-hour from on-peak to off-peak reduces natural gas consumption at the generating station by up to 43%.The Energy Commission's *Source Energy and Environmental Impacts of Thermal Energy Storage,* February 1996, www.energy.ca.gov/reports/500-95-005_TES-REPORT.PDF, provided a comprehensive analysis. Here are a few of the major conclusions from this detailed study:

- At the source power plant: "In many California TES installations, 40 percent to 80 percent of the annual kWhs of electricity use for air conditioning will be shifted from day to night. In such installations the official Energy Commission methodology, the Incremental Energy Rate method, showed large source energy savings. ***The savings per kWh shifted range from 36 percent to 43 percent for SCE and 20 percent to 30 percent for PG&E.***" p.3 (emphases added)

- At the building site level: "Although early TES systems used more kWhs than conventional systems, monitoring of many recent TES systems shows these systems use 12 percent fewer kWhs than conventional systems. These efficiencies are also attractive compared to the ***20 percent to 50 percent energy penalties from using conventional utility storage technologies such as pumped hydro.***" (p.3-4)

- Source Emissions Analysis: "TES can also greatly reduce air emissions from power plants....Assuming a 20 percent market penetration by 2005, TES could save 260,000 tons of CO2 annually statewide. Just as importantly it could save about ***1.6 tons of NOx per day in the SCAQMD.*** These NOx savings are equivalent to the savings substituting 100,000 electric vehicles for gasoline vehicles." (p.4)

- Further Air Emissions Impacts at the Power Plant Source: "Figure 31 shows that the air emissions savings from shifting a kWh are slightly higher than the source energy savings. For example, Figure 31 shows ***a 47 percent savings in emissions by shifting a kWh of cooling load from on-peak to off-peak.***" (pgs. 41- 42)

This monumental energy conservation impact of thermal storage at power plants occurs because TES avoids deployment of the dirtiest, least efficient peaking plants operating at the margin.

In April, 2008, SCE responded to a Transphase data request as part of SCE's 2009 General Rate Case (GRC) which shows that shifting a kwh from on–peak to off-peak results in an energy savings of at least 45% under this Incremental Energy Rate method. PG&E also provided heat rate data in response to a Transphase data request. Below is a table providing this heat rate data:

SCE[9] and PG&E

Power Plant Heat Rates (Btus/kwh)

	Summer		Winter	
	SCE	PG&E	SCE	PG&E
On-Peak	13,258	11,985	-------	------
Mid-Peak	10,254	10,781	9,413	10,037
Off-Peak	7,263	7,603	6,996	7,742

For SCE, the summer off-peak heat rate is 45% less than the summer on-peak heat rate, which translates directly into a 45% reduction in fossil-fuel consumption at the power plant for every kwh shifted from on-peak to off-peak.

In addition, while helping to avoid the capital cost of transformers blowing out on a hot summer afternoon (which should be included in the avoided capacity cost), TES also provides transmission and distribution line energy savings. As the Energy Commission explained:

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[9] SCE's verbatim response to Transphase's data request:

Southern California Edison
2009 GRC Phase 2 A.08-03-002

DATA REQUEST SET TRANSPHASE-SCE-001
To: TRANSPHASE
Prepared by: Paul Nelson
Title: Senior Economist
Dated: 04/17/2008
Question 02:
In SCE's "Marginal Cost and Sales Forecast" Exhibit, I did not see any heat rate information using either the Incremental Energy Rate or Marginal Plant Rate method. (see pages 16 to 23 of this CEC report.) (If you have already included this information somewhere, I apologize in advance.) Would SCE be willing to provide such heat rate information as a means to test SCE's proposal and to better understand what differences might have led to such dramatic rate design changes coming out of the 2003 GRC, on the one hand, and the 2006 and SCE proposed 2009 GRC rate designs, on the other hand?
Response to Question 02:
The incremental energy rate can be calculated from Table I-7 and the average gas price of $7.49 (SCE-2, page 24, line 7):
IER (BTUs/KWH) = Energy Price (cents/KWH) / Gas Price ($/MMbtu) * 10,000
IER (Btus/KWH)

	Summer	Winter
On-Peak	13,258	-
Mid-Peak	10,254	9,413
Off-Peak	7,263	6,996

> In particular, energy is lost due to resistanee in the power lines (line losses). For example, to get 1.00kWh of electricity delivered to the energy user's site, 1.10 kWhs may need to be input into the power lines at the power plant. This amounts to a 10 percent line loss. Moreover, an important factor in this TES analysis is that these line losses vary across the five time periods. In particular, line losses are highest when the ambient temperature is hotter. Both of these factors lead to line losses being higher during the summer on-peak period. Therefore, TES saves energy by shifting electricity use to times of lower line losses...When evaluating DSM programs which have their impacts at the energy user's site, the utilities, CPUC, and California Energy Commission use the distribution level marginal costs that reflect the line losses. [10]

Nevertheless, SCE's delivery serviee energy charge and the DWR energy charge components of SCE's TOU-8 rate provide no time differentiation, completely failing to capture the important energy efficiency impacts of line losses and TES.[11]

At least 33% of California's 50,000 MW peak cleetricity load comes from air conditioning. There is no more effeetive way to reduce this peak load than from TES, without affecting the comfort or productivity of the buildings' inhabitants on the critical peak days. Various studies have suggested that TES eould penetrate at least 33%, or almost 7000 MW, of the 20,000 MW California air conditioning load, from large commereial and industrial facilities to residenees.

In its 1996 report, the Energy Commission used a more conservation 20% penetration rate for TES, and, with the then-current California pcak demand, concluded that ***2500 MW of TES could be installed in California by 2005.***[12] Over that past time period, "TES could save over a billion dollars of investment in the T&D [transmission and distribution] system and perhaps equal savings in generation capaeity investment." The report further noted that ***T&D***

[10] California Energy Commission, *Source Energy and Environmental Impacts of Thermal Energy Storage* at p.19.

[11] See Spreadsheet No. 1 in support of Transphase testimony attached hereto; see also pages A-160 to A-172 of SCE-05 (Updated), Proposed Tariff Changes.

[12] *Source Energy and Environmental Impacts of Thermal Energy Storage*, p. 45.

benefits alone would approach $2000 per kW in some constrained areas.[13] However, essentially no thermal storage was installed in California during that time period.

The "*Energy Division's Proposed Demand Response Goals*" attached to the Oetober 1, 2007 Ruling Revising Phase 2 Activities and Schedule in R. 07-01-041 outlined just how significantly the IOU's Demand Response programs have underperformed to date. Based on estimates rather from the summer of 2007, the Energy Division suggested that DR achieved less than two percent of system peak demand, or less than 940 megawatts ("MW"). This is substantially less than half the five percent target from DR established in the California Energy Action Plan II. As the Energy Division states, "a five percent reduction represents a decrease of $240 million per year in electricity costs. Over a 20 year time horizon, the present value of benefits could be as much as $3 billion."[14] Avoiding 3000 MW of peak demand through Demand Response provides the equivalent of 50 combustion turbines.[15]

Relying on a June, 2007 Brattle Group report for the California Energy Commission entitled "*California's Next Generation of Load Management Standards*," the Energy Division notes that the technical potential for demand response is about 25 pcreent of system peak demand, representing maximum deployment of the best available technologies. This CEC report on load management standards further estimated that the cost-effective implementation of demand response would result in a 12 percent reduction in system peak demand.

This CEC report further projected that Edison's DR programs would result in a 373 MW reduction in the peak load, or 1.6 percent of Edison's expected 2007 peak demand. *Thus, Edison's projected performance in 2007 from its DR programs amounted to about one-eighth the 12 percent cost-effective penetration level and less than one-third of the Commission's five percent goal.* In reality, Edison's peak demand exceeded estimates and set a record on Friday, September 4, 2007, at 23,303 MW.

4. **SCE's Proposed TOU-8 Rates Subvert California Policy By Providing A Disineentive for Peak Demand Reduction and Energy Effieiency.**

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[13] Ibid. p.45, n. 65.

[14] "Energy Division's Proposed Demand Response Goals," p. A-1, n.1.

[15] The Brattle Group, *California's Next Generation of Load Management Standards*, Prepared for the California Energy Commission, p. 9 (July, 2007)

In all of SCE's many exhibits attached to its rate design application, there is little if any mention of its tripartite TOU-8 rate proposal involving its default CPP rate, as well as its Option A and Option B alternatives. It appears that the only place its rate alternatives are mentioned is in its proposed tariff changes as an appendix in SCE- 05 (Updated). As SCE states at p. A-159 of its Updated SCE-05: "Option A of this Schedule is only available to customers who participate in Permanent Load Shifting (PLS) or Cold Ironing pollution mitigation programs. PLS is defined as moving electrical energy usage from SCE's on-peak period to another time period on an ongoing (permanent) basis. Examples of PLS technologies include thermal energy storage, solar batteries, and the pumping and storage of water...Behavioral changes that reduce on-peak load with or without the use of hardware [ ]do not qualify as PLS, nor do programs that shift load on a non-permanent basis...In addition, PLS programs or projects that already incorporate load-shifting technologies do not qualify...."

In SCE's many past TOU-8 rates, it has never offered this three-option approach. SCE offers no policy or other explanation as to why it is now proposing three options to its TOU-8 rate structure. Nor does SCE describe what it anticipates the financial impact of these options for a participating or non-participating customer. Further, SCE provides no policy or other explanation as to why there should be such a drastic, draconian shift away from time-of–use differentiated rates towards such a flattened rate structure.

However, the Commission and Legislature's intent to reduce peak demand and promote energy efficiency will be thwarted should SCE's proposals be adopted. Transphase has attached spreadsheets hereto which do describe the impacts of these options. As shown in spreadsheet no. 1, SCE has greatly flattened its rate structure for its TOU-8 rate from its 2003 GRC to its current 2009 GRC proposals.[16] In addition, its Option A includes a heavily punitive on-peak URG energy charge of 35.9 cents per kWh that is over 350% higher than the 8.98 cent CPP on-peak URG energy rate. Further, its delivery service energy charge and DWR energy charge are completely non-time differentiated and fail to capture any line losses due to temperature or congestion, as discussed in the Energy Commission report, *supra.*

[16] In SCE-05 (Updated), compare p. A-166 (proposed CPP rate) with A-167 (Option A) and A-168 (Option B). These rates are directly compared in Transphase's spreadsheet no. 1, along with rates from February, 2006 (pre-2006 GRC) and 2007 (post- 2006 GRC).

SCE's proposed non-time differentiated DWR energy charge appears to conflict directly with the mechanism SCE describes to establish this charge: "The portion of total energy sales provided by DWR, which in turn represents most if not all of SCE's net short position, varies on an hourly basis. Net short is defined here as the difference between SCE total energy requirements less that portion provided by SCE's retained generation assets and SCE's (non-DWR) contracts."[17] Since SCE states that its procurement of DWR energy varies on an hourly basis, it only makes sense that this DWR energy component be priced on a time-differentiated, marginal cost basis. SCE has not offered any policy or legal reason (such as the AB 1X legislation) to explain why this DWR energy component could not be time differentiated to reflect the true marginal cost of the 'net short' time period in which it is purchased.[18]

Transphase spreadsheets nos. 2 through 6 provide an example of the impact of SCE's past and proposed TOU-8 rates on a large office building with a 1000 kW peak cooling load and a 400 kW non-air conditioning load. As summarized in spreadsheet no.6, the impact of SCE's past and proposed rates on this hypothetical typical customer are as follows:

Under SCE's proposed TOU-8 rate in this 2009 GRC proceeding, the CPP customer's monthly summer electric bill, with no peak demand reduction, would be $59, 877. Under SCE's proposed TOU-8 Option A rate in this 2009 GRC proceeding, the TES customer's monthly summer electric bill, with a 1000 kW peak demand reduction, would be $52,444. Given the large initial capital investment in a one MW TES system, this $7,433 monthly savings in the summer would be practically insignificant to the customer. No customer could rationally decide to install a one M W TES system on the basis of this paltry monthly savings.

In sharp contrast, using SCE's actual TOU-8 rate in February. 2006, the hypothetical customer's monthly electric bill in the summer, with no peak demand reduction or TES, would be $101,111. However, using this same early 2006 TOU-8 rate, the same customer with a 1,000 kW peak demand reduction TES system would incur a monthly electric bill of $52,438. Thus, the

[17] SCE-03 (Updated) at p. 8.

[18] Another DWR energy charge issue concerns the unaccountability and vagueness of a customer's calculation of its rate. "For each billing period, SCE determines the portion of total kWhs supplied by SCE's URG and by the DWR. This determination is made by averaging the daily percentages of energy supplied to SCE's Bundled Service Customers by SCE's URG and by the DWR." SCE-05 (Updated) at p. A-188. SCE does not describe any true-up mechanism or reporting to the Commission or the customer to account for and verify this allocation.

pre-2006 GRC monthly summer savings with a one MW PLS system would be $48,673, providing an excellent rate-based savings from TES. Thus, SCE's proposed TOU-8 rate directly and unambiguously conflicts with Commission directives and the Public Utilities Code's mandate to enhance energy efficiency and reduce peak demand by almost eliminating the economic benefits of PLS/TES.

Indeed, SCE has built into its ever more-flattening rate structure a perverse disincentive for reducing peak demand; namely, the higher the TOU-8 rate customer's peak demand relative to its 24 hour kWh usage, i.e. the more spiked its peak demand, the greater its percentage electric bill reduction from the pre-2006 GRC rates. In other words, under SCE's proposed CPP rate, the more the customer has a needle peak load, the greater the bill reduction from early 2006 and the less incentive to install any efficiency measure that reduces peak demand.

It is important to note that SCE is attempting a massive revenue reallocation through its proposed TOU-8 rate. In addition, the same hypothetical customer's summer monthly electric bill declined from $101,111 under the pre-2006 GRC TOU-8 rate to just $52,428 under SCE's proposed CPP rate (in both instances based on the same loads and no peak demand reduction measure). With the example of the office building used in Transphase's spreadsheets, the electric bill for the large TOU-8 customers fell by over 40% from the pre-2006 GRC to SCE's proposed 2009 GRC, despite a substantial increase in the proposed revenue requirement from the 2003 GRC. Not only has SCE proposed rates that act as a disincentive to reducing peak demand, the inevitable effect is to shift the revenue requirement from the large commercial/industrial customers onto the smaller, most captive electric customer.

Transphase proposes that the Commission reinstitute a single post-2003/pre-2006 GRC rate design for TOU-8 rate customers as more compatible with Commission directives and the Public Utilities Code, with two modifications. As shown in Transphase's Spreadsheet number one, from the 2003 GRC rate design to SCE's proposed 2009 rate design, the delivery service energy charge and the DWR energy charge has been entirely flat and non-time differentiated. Transphase proposes that these two energy component rates be time-differentiated using the same design as in the GRC 2003 URG energy component.

Transphase further proposes that the CPP program be changed from a default rate, to a capacity incentive payment, just as the Commission ordered with respect to SCE's Base Interruptible Program (BIP) in D. 05-04-053, unless seen as too redundant to other DR programs.

5. The Commission Should Establish A Vigorous Thermal Storage Standard Offer.

Despite a 25-year history of commercialization of thermal energy storage in California, and the enormous potential energy and environmental benefits this technology sector can provide, California's investor-owned utilities (IOUs) have proposed absolutely no provision for new thermal storage in their DR Applications, only offering a continuation of a *de minimis* program forced on them by this Commission for their favored two or three contractors. In faet, the IOUs actively exelude thermal storage from its on-going programs, such as the Capacity Bidding Program and the IOUs' successor programs because of "rolling average"baseline methodologies that eliminate any permanent measures. In lieu of this continuing intransigence by the utilities, Transphase proposes a Thermal Storage Standard Offer.

Transphase has made the same basic proposal for a Thermal Storage Standard Offer in SCE's DR application for the 2009-2011 time period (A. 08-06-001). In that DR Application, SCE has offered the same DR programs, such as the BIP, CBP, DBP, etc., that it proposes in this phase 2 of its 2009 GRC. It is unclear to Transphase which application forum is the correct one to consider this Thermal Storage Standard Offer. Since SCE has argued that its DR application proceeding should not eonsider Transphase's Thermal Storage Standard Offer, Transphase re-proposes its Thermal Storage Standard Offer here.

The Commission ordered SCE to issue RFPs for permanent load shifting (PLS) in 2006. SCE awarded three sole-source contracts, a chilled water storage contractor, an ice harvester contractor, and an ice storage system directed to smaller installations. Despite having a program of incentives from the early '80s to the mid-'90s leading to many dozens of installations in large commercial/industrial facilities, SCE has no on-going standard offer or other thermal storage program. As SCE puts it, "SCE is not requesting any modifications to the already-authorized program for 2009- 2011. Furthermore, no additional PLS is being requested as part of this

Amended Application. As authorized in Resolution E-4098 [in 2006], SCE expects to achieve approximately 11 MW of PLS by the end of 2011." [19]

In view of the enormous energy and environmental benefits of thermal energy storage and SCE's refusal to propose any on-going incentive program, the Commission should order SCE to institute a Thermal Storage Standard Offer. The basic incentive program should provide $1400 per kW of air conditioning load shifted from on-peak hours spread out over four years. The first of the four annual payments for $800 per kW would be due on system start-up and commissioning, with the next three payments of $200 per kW due on each anniversary thereof.

All customer classes would be eligible- large and small commercial and industrial customers and even residential customers. All technologies would also be eligible: all ice technologies, chilled water storage, eutectic salts, or any other storage medium where the on-peak demand reduction can be measured and verified. Also, the Standard Offer payments would be made to end-use customers where the TES system is installed and not to a third-party DR provider (such as Transphase). Given that the payments would be made over a period of years, it is better to directly incentivize the end-user.

As to measurement and verification, every system would be required to have a thermal meter installed. For the vast majority of system types, this will simply amount to a flow meter and temperature sensors entering and leaving the storage tank (or tank farms). The annual payments would be conditioned upon the verification that the system is providing its rated capacity. A professional engineer or certified energy manager would provide a kW per ton conversion factor as a baseline at the onset. The conversion factor would not be changed over the four year payment period unless a manifest change in conditions occurred.

The Thermal Storage Standard Offer that Transphase proposes here is demonstrably cost-effective. Spreadsheets nos. 7 and 8 provide Transphase's Total Resource Cost (TRC) test. This TRC test result is over 1.3, providing robust benefits to all the ratepayers.[20]

[19] SCE Amended Testimony in A. 08-06-001, p. 53.

[20] While SCE provided in its Appendix C what it terms "Demand Response Avoided Capacity Valuation Methodology," this appendix does not include avoided on-peak or off-peak energy values. SCE has to date refused to respond to Transphase's data requests for avoided cost assumptions. Thus, Transphase has had to make certain assumptions as to avoided costs in its TRC test results until such time as its motion to compel further data responses can be heard, or as otherwise decided by the Commission.

As to size, Transphase proposes that a budget allow for up to 25 MW of additional new projects per year in SCE territory. As the IOUs have proposed for other programs, incentive payments would need to be authorized by the Commission for the full four years of the proposed payments. The total monies spent would obviously depend on the aetual installations, but the budgets ean be estimated as follows, with all figures being in millions of dollars:

		2009	2010	2011
SCE				
	Incentives	10.0	20.0	30.0
	IOU Administrative	1.2	2.4	3.6

In sum, TES provides both enormous load management/ DR benefits, but also provides up to 50% in energy savings, combining the best elements of EE with DR. Transphase's proposed Thermal Storage Standard Offer should be adopted by the Commission.

6. Transphase's Past Utility Power Savings Agreements and Measurement Plans.

Transphase provides here more background into Transphase and SCE's past thermal storage programs. In the period from the mid-80s through the mid-90s, Transphase manufactured, installed and/or operated over 80 cool storage systems used to shift electricity consumption for air eonditioning and process cooling at large commercial/ industrial buildings from on-peak hours to off-peak hours. Transphase installations reduced peak demand by over 30 MW , most of which occurred in California. This includes a six MW Power Savings Agreement with SCE in 1991 as well as Power Savings Agreements with other utilities. The thermal storage system is based on Transphase's euteetic salt storage medium that melts and freezes at 47 ° F, and can be used with any existing or new chiller. Systems are still in operation and providing superior performance after more than 18 years of service.

The Transphase Cool Storage System is based on the use of inorganic, non-toxic, and inexpensive "eutectic salts" as the storage medium. The primary eutectic salt manufactured by Transphase melts and freezes at 47 °F, although Transphase also developed a 41°F under sponsorship from EPRI. The phase change material ("PCM") is filled into rugged, self-stacking, water-impermeable high density polyethylene containers measuring 24" by 8" by 1.8" deep. The PCM -filled Transphase containers are then placed within a tank, often a below-grade concrete tank underneath a parking lot or landscaped area, at the building facility.

The system is charged using a building's existing or new chillers during off-peak electric hours. At night, 40-42 °F chilled water from the central chiller plant flows into the tank and between the Transphase containers, thereby freezing the 47°F PCM. By the end of the off-peak time period, the tank is filled with solid blocks of "ice", but ice that freezes and melts at 47 degrees, not 32 degrees.

During the daytime on-peak time period, warm return water from the building chilled water piping flows into the tank and in between the eutectic salt-filled containers. The building water is chilled as it passes over the thawing Transphase containers. Upon exiting the tank, the chilled water is circulated through the buildings to provide air conditioning or process cooling in the conventional manner. Various system designs have been employed, including full storage systems designed to handle 100 percent of the building's on-peak cooling load, or partial storage designs where the storage system is sized to handle part of the cooling load. [21]

In addition, Transphase successfully designed and installed systems combining other energy efficiency products such variable frequency drives and automated building control systems that greatly increase the system's cost-effectiveness, significantly conserving energy as well as reducing the on-peak electric demand. Most dramatically, in desert or otherwise cool nighttime environments, a "free cooling" heat exchanger can be placed on the cooling tower water lines, allowing the Transphase System to be charged at night without chiller operation. This can result in a further energy reduction of over 50%, as well as on-peak demand reduction.

Because the Transphase System relies upon a phase change at 47°F, the entire universe of buildings with existing or new conventional chillers can be retrofitted with this eutectic salt storage system. In sharp contrast, ice storage systems, which rely upon a phase change at 32°F, cannot be charged with conventional chiller equipment as ice storage requires the installation of new low temperature refrigeration equipment. Because of the Transphase system's higher temperature phase change point, the system can be very energy efficient.[22]

By the late 1980s, Transphase had manufactured and/or installed its eutectic salt cool

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[21] See, e.g., Ames, "Eutectic cool storage: Current Developments", *ASHRAE Journal* (April, 1990); Kostyun and Ames, "Arizona Utility Adds Eutectic Storage Unit", *ASHRAE Journal* (May, 1987)

[22] See, e.g., SAIC, *EPRI Cool Storage Monitoring Workshop Presentation Material* (September, 1989)

storage system in California, Arizona, Florida, Taiwan, Japan, Korea, Canada, Israel, and Europe. The California IOUs led the way by offering TES incentives, typically with a one-time payment to the end user of $200 to $400 per kw. This Commission regularly authorized these incentive payments and budgets of $5 to $7.5 million per year per utility for TES incentives.

However, the utilities began a disturbing pattern of constantly yanking away the incentive offer from the customer, seriously disrupting the formation of the TES industry. For example, a favorite tactic of SCE during this period was to approach its largest customers and pitch that they need to sign up for these incentives, without any obligation to proceed. With absolutely no reason for these customers not to sign up, very soon SCE would proclaim that there was no more money in the budget for any customer who actually wanted to install a system. Since a low percentage of the signed-up customers actually proceeded with an installation, given the non-obligatory nature of the reservation, very little of the budgeted funds were actually spent as incentives for customers installing TES systems. Instead, SCE spent most of the money preparing colorful, meaningless, and self-congratulatory charts and figures.

In 1990, as a result of a protest filed at this Commission over the utilities' application for their shareholder incentives for demand side management, Transphase broke new ground by entering into so-called "Power Savings Agreements" (PSAs) with various utilities, primarily Southern California Edison and Jersey Central Power & Light Co. Under these PSAs, Transphase developed Measurement Plans applicable to thermal storage systems, agreed to by the utilities. The Measurement Plans comprehensively established measurement and monitoring protocols for the thermal and electrical components of the chiller plant. Transphase's Measurement Plan was later adopted by the National Association of Energy Service Companies ("NAESCO") as the standard for thermal storage systems.

While Transphase successfully manufactured, installed, financed and operated its systems at large prestigious host company installations under these utility Power Savings Agreements, including installations at AT&T's world headquarters, Marriott Desert Springs Resort, City of Hope Medical Center, Ventura County Government Center, and many others, Edison and JCP&L stopped paying for the contracted and well-documented power savings under the 7 to 13 year terms of the Agreements. Several of these systems are still operating more than 18 years after installation, having saved the customers many times the purchase price.

As a result of the debt incurred to finance these installations under utility PSAs, Transphase was eventually forced to cease operations in 1996 (but never declared bankruptcy). In 1999, a California jury awarded Transphase $6.35 million against Edison for breaching its PSA with Transphase after a seven week jury trial.[23] As part of this award, the jury also found that Edison had tortiously interfered in Transphase's contracts with its host customers and had maliciously driven Transphase out of business, awarding Transphase punitive damages. While the Edison case ultimately settled for $3.2 million (which Edison evidently charged to the ratepayers), the trial judge and the Court of Appeal issued rulings which upheld all liability verdicts and the punitive damage award. The funds collected in the litigation were then returned to Transphase's creditors and shareholders, including such venture capital investors as the Environmental Venture Fund, Robertson Stephens & Co., First Analysis Corp., and WD Ruckelshaus & Associates.

Now, Transphase is attempting to restart manufacturing operations and return to business. While Transphase Systems, Inc. was dissolved after the distribution of funds, Transphase has been restarted. However, the utilities have cut off incentive payments for TES, other than for a couple of small contracts with select contractors for less than one one-thousandth of the available load. No standard offer is in place and TES is affirmatively excluded from participation in the utilities' Capacity Bidding Program for the irrational reason that TES shifts the load every week day and not just during certain critical peak day time periods.

The lack of incentives and the flattening rate structure have made for long payback periods which most end users simply cannot justify. The avoided generation capacity and energy costs, the 50% reduction in energy consumption due to low nighttime heat rates, as well as the massive reduction in greenhouse gas emissions from TES are simply not seen by the end use customers under SCE's proposed TOU-8 rates.

7. **Conclusion.**

SCE's proposed three-alternative TOU-8 rate should be rejected. Instead, a single TOU-8 rate should be based on the rate design and revenue allocation adopted in the 2003 GRC. Moreover, the TOU-8 rate design from the 2003 GRC should be modified to have time-

[23] "New Power Source: Former Energy Company Executive Wins Legal Victory Over Edison," *Los Angeles Times*, May 5, 1999, pages C1 and C6.

differentiated delivery service and DWR energy charges proportional to the time-differentiated URG energy charge.

SCE's CPP default rate should be rejected. Instead, SCE should adopt a CPP incentive payment similar to the TOU-BIP incentive unless the Commission finds that a CPP incentive is to duplicative to the BIP, CBP, DBP, SLRP and other capacity incentive DR programs.

A Thermal Storage Standard Offer should be adopted as proposed herein in this proceeding and/or in SCE's DR proceeding as a "cost-effective, reliable, and feasible" peak demand reduetion and energy efficiency resource. Cal. Public Utilities Code §454.5(b)(9)(C).

Respectfully submitted,

/s/ Douglas A. Ames

Douglas A. Ames, Esq.

President, Transphase Co.

October 30, 2008

Witness Qualifications of Douglas A. Ames

Current President of Transphase Company

1982-2006, President, Transphase Systems, Inc., manufacturing, constructing, owning and/or operating over 80 large-scale thermal energy storage systems based on the use of eutectic salts as the storage medium

Prepared and/or reviewed hundreds of economic/engineering feasibility studies for TES

Principal Investigator for the Electric Power Research Institute on New Eutectics for Cool Storage

Inventor of Seven Patents in Field of Eutectic Salt TES

Author of Many Articles on Eutectic Salt TES in *ASHRAE Journal* and other Energy Publications

Associate Member, ASHRAE Thermal Storage Technical Committee 6.9

Member of Board of National Association of Energy Service Companies (NAESCO)

Developed Measurement Plan for TES adopted by NAESCO

Court -Approved Expert Witness in Eutectic Salt TES in the Superior Court of California and the U.S. District Court for the District of New Jersey

Educational Background:

> **B.A., Harvard University, Cambridge Massachusetts, *cum laude* concentrating in biology and chemistry (1980).**
>
> **J.D., Western States University College of Law, Fullerton, California, *magna cum laude* and class salutatorian (1998). Admitted to the State Bar of California, U.S. District Court for the Central District of California, U.S. District Court for the Northern District of California, and the Ninth Circuit U.S. Court of Appeals.**

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Southern California Edison Company (U338-E) for Authority to Establish Marginal Costs, Allocate Revenues, and Design Rates.	)	Application 08-03-002 (Filed March 4, 2008)
In the Matter of the Application of Southern California Edison Company (U338-E) for Authority to Make Various Electric Rate Design Changes.	)	Application 07-12-020

Transphase's Exhibit B

Testimony of Victor J. Ott, P.E. In Opposition to

So. Cal. Edison's Proposed Rate Design

And in Support of a Thermal Storage Standard Offer

1. Summary of Testimony:

Cryogel, of San Diego, California is providing this testimony in support of the proposals by Transphase to encourage the widespread adoption of thermal energy storage (TES) in California by implementation of rate designs and incentives that reflect the benefits of thermal storage to the environment, to the reliability of electrical energy supplies and to the economy of the State of California. This testimony is also intended to support the findings of the California Energy Commission with regard to the benefits of TES and to highlight Legislative Intent in support of peak load shifting as an important component of California energy policy. We are not providing testimony in support of any specific thermal storage technology or product, including our own, or to support any technical or competitive distinctions between TES technologies as may be implied in the Transphase Protest or otherwise. We believe that consumers, with the aid of engineers and design professionals, will continue to make rational economic and practical decisions about competitive technologies. We support the position stated by Transphase that incentives, rates and Standard Offers should be available to end users of all thermal storage technology where on-peak demand reductions can be measured and verified. It should be clear that the references to our technology and company history herein are provided only for background, including actual experience in the market, and not as means of elevating our technology or market position.

2. California Energy Commission Report on TES:

Briefly, thermal energy storage (TES) is a proven, energy conserving, environmentally friendly technology that shifts electrical loads from air conditioning and process cooling to off-peak hours. Energy is used during nighttime (off-peak) periods to produce and store cool energy in ice, chilled water or phase change materials. The cool energy in storage is used the next day for air-conditioning or process cooling during periods of peak energy demand.

The benefits of TES have been known for many years. These benefits were quantified years ago through the California Energy Commission Report , "Source Energy and Environmental Impacts of Thermal Energy Storage". The conclusions of that report are more important today than ever. The CEC cover letter introducing that study in 1996 is also quite relevant today and demonstrates CEC foresight, especially when looking back at the tumultuous history of California's energy supplies and failure of utilities and industry to collaborate in an effective manner with regard to the energy supplies and the environment.

In a letter dated February 16, 1996, Charles R Imbrecht, Chairman of the California Energy Commission stated:

> *"The electric power industry is changing. We are now in the process of moving to a more competitive electricity services industry. While competition and cost control are important in the midst of this change, other goals such as clean air remain as critical issues. We believe the cost efficiencies of competition must be balanced with environmental sensitivities.*

The California Energy Commission (Commission) is responding to these changing conditions by commercializing technologies that balance competitive and environmental concerns. One such technology is Thermal Energy Storage (TES). The Commission staff has been facilitating a collaborative of TES stakeholders to identify the benefits and take actions to reduce market barriers facing TES in a re-structured marketplace. The enclosed report, Source Energy and Environmental Impacts of Thermal Energy Storage, was prepared for the TES collaborative. Based on the analyses in the report, implementation of TES could:

- *Lower customer air conditioning costs by 30-50 percent;*
- *Reduce capital investment in the Transmission and Distribution system by a billion dollars in the next decade;*
- *Reduce Nox emission equivalent to 100,000 vehicles in the South Coast Air Quality Management District; and*
- *Save enough source energy to supply all 500,000 electric cars projected for the next decade. "*

The California Energy Commission Report , "Source Energy and Environmental Impacts of Thermal Energy Storage" P500-95-005 (http://www.energy.ca.gov/reports/500-95-005_TES-REPORT.PDF) is well documented in the Ames testimony and full discussion need not be repeated here. However, a couple basic elements of the CEC Report deserve repeating.

The CEC Report highlights the fact that TES technology conserves energy at both the electricity generation source and the point of use. In addition, the CEC report supports the position that TES should be considered a priority in the ranking of Demand Side Management technologies in energy policy decisions.

The CEC Report demonstrates that TES reduces pollution and greenhouse gasses. This results from more efficient electrical generation during off peak periods and reduced transmission line losses. That same conclusion is supported by recent heat rate data and transmission efficiency comparisons included in the Ames testimony. At the time of publication, the CEC Report stated that by 2005, TES could reduce Carbon Dioxide emissions by 260,000 tons and Nitrous Oxide emissions by 600 tons annually.

Contrary to the logical path forward suggested by the CEC Report, the reduction or elimination of incentives and flattening of TOU rates have had the opposite effect with devastating consequences for the TES market in California and the US. Failure to implement TES has resulted in missed opportunities to improve the reliability of the California energy supplies and to delay or avoid the need for and cost of new electrical generation and transmission capacity. Failure to implement TES has resulted in missed opportunities to mitigate air pollution and climate effects associated with fossil fuel used to generate electricity. Finally, this failure has damaged companies that invested in perfecting TES technology and resulted in a loss of associated economic activity in the State and country. These facts are supported by the specific experience of Cryogel as a participant in the thermal storage market.

3. Cryogel Background and Actual Experience in a Shrinking Market:

By way of background and actual experience with the history of thermal storage, Cryogel introduced Ice Ball™ thermal energy storage (TES) equipment in California and the U.S. more than 17 years ago. The product received worldwide market acceptance due to simplicity of concept and flexibility with respect to practical issues of performance, installation, operation and maintenance.

Cryogel Ice Balls are 4" diameter plastic spheres filled with water. Energy is stored in ice using low cost electricity at night to freeze Cryogel Ice Balls. Cool energy is released the next day for air conditioning or process cooling. Cryogel thermal storage systems produce energy cost savings and environmental benefits by using low cost off-peak electrical energy. More than 20 Million Cryogel Ice Balls have been supplied to schools, hospitals, airports, office buildings, churches, senior & retirement facilities, government offices and industrial plants which translates to a shift of approximately 32 MW of peak electrical demand.

The concept and product are simple. Indeed, few engineers or system designers will argue the fact that simplicity in system design is key to holding down costs while insuring ease of operation and improving reliability. Design flexibility allows the Cryogel Ice Ball to be used in nearly any type of storage tank: steel, concrete, fiberglass, atmospheric or pressurized; above grade or buried. The Cryogel Ice Ball is one of the most thoroughly tested thermal storage products on the market today, including independent laboratory testing of performance and durability.

Cryogel began manufacturing ice thermal storage products near Los Angeles, CA in 1991 and enjoyed rapid growth and profitability within the first 3 years of operation. That early success, and economic benefits shared by associated design engineers, installing contractors, ancillary equipment suppliers and building owners, can be traced directly to the incentives and time-of-use (TOU) rates offered for thermal energy storage during the early 1990's.

During the early 90's, more than a dozen companies offered competitive products in a growing TES market. However, by the late '90's, many of the utility incentives had been retracted and many time-of- use (TOU) rates had been "flattened" by reducing the differential between the price of "on-peak" and "off peak" electricity. As the economic incentives and energy cost savings available to end users evaporated, the TES markets began to contract. As a result, only 4 or 5 of the companies from the early 90's remain actively involved in the business today. By 2003, market statistics show that the sales of TES equipment diminished to about 33% of their 1993 levels. Statistics show that sales of TES in California by 1997 were less than 25% of the level achieved in 1993. By 2003, Cryogel revenues fell to less than 30% of the levels posted on average between 1991 and 1995. Current market statistics are not readily available because in this decimated market, TES companies have ceased pooling market statistics which, in our opinion, had become a pointless and frustrating exercise.

Rather than repeat the economic analysis provided in the Transphase spreadsheets incorporated into the testimony, we point to the obvious relationship between contraction of the market for TES and the loss of economic incentives and proper TOU rates. Common sense economics dictates that end users will simply not purchase and install equipment with returns on investment at levels as low as those resulting under current rate structures and TES program offerings. The rates and programs being proposed for the future offer more of the same and promise more of the same dismal results.

4. Economic Benefits Lost:

In the case of Cryogel, the company would have also failed if not for our ability to transfer technology to foreign countries and generate revenue by licensing others to manufacture our product. Since 1996, Cryogel's manufacturing licensee in Malaysia has reported more than a 50% market share in that country and our licensee in China is now manufacturing and installing systems in that expanding market. Foreign licensing fees and royalties have returned to Cryogel in California and have saved the company from insolvency. However, the economic benefits associated with designing systems, installing the hardware, the value of ancillary equipment including tanks, piping, pumps, chillers, controls, etc., have been lost to foreign engineers, contractors and manufacturers.

During my last visit to China, I was invited to address a large group of electric utility managers, electricity rate designers, academics and business leaders regarding the environmental and economic benefits of thermal storage. The basis of my presentation was the California Energy Commission Report mentioned earlier. The Chinese acknowledged the benefits of TES as matters of engineering common sense and proper government policy toward addressing energy shortages and the well-known air pollution problems in that country. However, when they asked about the size and growth of the TES market in the US and in California, I was embarrassed to admit that the same common sense concepts were not being implemented effectively in California or the US and that our market had been shrinking for the past 10 years. The reaction was a predictable scolding about the wasteful energy practices of Americans and suggestions of hypocrisy. Ironically, systems being installed in most foreign countries include US made TES devices or products based on technologies developed in the US and proven in California.

Reduction or elimination of incentives and flattening of TOU rates have had a devastating effect on the market for TES in California and the US. Failure to implement

TES has resulted in missed opportunities to improve the reliability of the California energy supplies and avoid the need and cost of new generation capacity. Failure to implement TES has resulted in missed opportunities to mitigate air pollution and climate effects associated with fossil fuel necessary to generate electricity. This failure has damaged or ruined companies that took substantial risks by investing in the development of TES technology and has resulted in a loss of associated economic activity in the State and country.

5. Legislative Intent:

Members of the thermal storage business community also invested in working with the California Legislature to clarify Legislative Intent and to help stem the negative trends described above. Legislative intent as to shifting peak electrical demands associated with air conditioning loads, and the rate structures needed to encourage peak shifting, is well documented. TES technology is directly responsive to Legislative direction and intent.

Senate Bill 1790 (Senator Debra Bowen, D-Marina del Rey), explains that, *"It is the intent of the Legislature that the state establish cost-effective load control programs for residential and commercial air-conditioning systems" .... "The legislature finds and declares" that, "(a) Air-conditioning load constitutes 28 percent of California's peak electricity demand, the largest single component of electricity demand", and, "(b) Reducing peak load of, and implementing load control for residential and commercial air-conditioning systems by the state's electrical corporations can achieve a significant reduction of California's peak electricity demand in a cost-effective manner."* SB 1790 provides for development of air-conditioning load control programs as part of electrical service offerings as means of *"contributing to the adequacy of the electricity supply and to help customers in reducing their electric bills".*

Senate Bill 1976 (Senator Tom Torlakson, D-Antioch), described by the Legislature as *"an urgency statute"*, addresses electricity rates head-on by directing the Public Utilities Commission to report back to the Governor and Legislature no later than March 31, 2003 regarding real-time pricing and metering. The logic of SB 1976 is clearly in line with the thermal storage industry noting that, *"Califomians can significantly increase the reliability of the electricity system and reduce the level of wholesale electricity prices by reducing electricity usage at peak times."*

In the current economic climate, TES offers a unique opportunity for market forces to accomplish the goals of SB1976. Rather than placing demands on general funds, incentives, peak demand charges and proper TOU rates reflective of energy costs can be a sufficient incentive for architects and engineers to incorporate TES systems and for building owners to realize reasonable returns on investment.

Quoting from SB 1976: *"Electricity consumption for air conditioning purposes during peak demand periods significantly contributes to Califomia's electricity shortage vulnerability during summer periods".*

TES focuses precisely on afternoon air conditioning loads. In fact, air conditioning loads can consume up to thirty percent of a facility's electricity demand on hot summer days. TES uses energy at night during off-peak hours to store cool energy and then provide cooling the next day during periods of peak demand. Shifting loads with TES is a cost competitive altemative to new generating capacity, thereby improving reliability of the electricity system while avoiding expensive construction of new power plants with related environmental impacts.

Senate Bill 1389 (Senator Bowen) states that, *"the govemment has an essential role to ensure that a reliable supply of energy is provided ... ". This law requires the Califomia Energy Commission to report every two years and to, "use assessments and forecasts to develop energy policies that conserve resources, protect the environment, ensure energy reliability, enhance the state's economy and protect public health and safety."*

The legislation calls for an integrated energy policy with public interest strategies including load management and reduction of statewide greenhouse gas emissions.

In addition, in 2002 California voters approved a major school bond including funding and incentives for equipment to improve energy use pattems and to shift peak electrical demand. The school bond was historic for its first-ever inclusion of funding for energy efficiency and energy cost reduction components. A common thread in all the legislation is an emphasis on public benefits for Californians including improved reliability of electrical supplies, reduction in overall energy costs, new job creation and positive environmental impacts. California legislation and bonds demonstrate support for thermal storage and suggest a model for legislation in other states.

Quoting from SB 1976: *"It is the intent of the Legislature to promote conservation and demand reduction in the State of California."*

6. Thermal Storage and Other Energy Solutions:

TES is capable of substantial contributions to demand reduction goals while conserving energy as documented by the California Energy Commission. Solutions for peak electrical demand problems in California and the U.S. include new electrical generation capacity and peak shifting with off-peak thermal energy storage as well as conservation and renewable energy technologies. However, in terms of large and near term reduction of peak electrical demand, thermal storage has definite advantages especially when compared to the construction of new power plants.

- Thermal Energy Storage is Available Now - not 2 or 3 years from now.
- Thermal Storage provides an overall reduction in the use of fossil fuels.
- Thermal Storage provides an overall reduction in air pollution.
- Thermal Storage makes most effective use of existing generation and transmission infrastructure.

Building and operating new generators and transmission lines is expensive both in terms of first costs and long term environmental impact. Spending millions of dollars to enable the continued inefficient use of power plants and the generation of ever greater amounts of air pollution is counter productive. A better option is to use existing capacity and transmission lines more effectively and in a way that reduces overall environmental damage. Using lower cost electricity during off-peak (nighttime) hours is not the complete answer but it is a practical and immediate solution to problems of peak electrical loads. The technology and equipment for storing energy at night to provide low cost air conditioning during the day has been proven over the past 20 years. Air conditioning represents the largest single use of electricity during summer months in most parts of California and the U.S. Shifting electric loads for air conditioning with thermal energy storage is equivalent to building new power plants and new transmission lines with important economic and environmental advantages. Thermal energy storage provides one means to mitigate the uncertainty and speculation as to future energy prices.

7. Conclusion:

This testimony is offered in support of the Transphase Opposition and proposals with regard to rate design, incentives and a Standard Thermal Storage Offering. Without meaningful and positive changes such as those proposed, the opportunities flowing directly from TES to enhance California's energy reliability and security, improve and protect the environment, and generate much needed economic activity will be squandered once again. We hope this testimony and background information is helpful and constructive.

Respectfully Submitted,

/s/ Victor J. Ott

Victor J. Ott, P.E. Cryogel

P.O. Box 910525

San Diego, CA 92191

(858) 457 1837

tes@cryogel.com October 28, 2008

Witness Qualifications of Victor J. Ott, P.E.

President of Cryogel - San Diego, CA

Manufacturer of Ice Ball Thermal Storage Equipment - Since 1990

Mr. Ott has 25 years of experience in the field of thermal energy storage including research and development, system design, installation, testing, marketing, manufacturing and development of industry standards.

Chairman - ARI Thermal Storage Equipment Section 1996 - 1998

Member - ARI Thermal Storage Section Engineering Committee responsible for industry test standards, 1993 - 2004

Professional Engineer - Licensed in California

U.S. Patent Holder - Clathrate Thermal Storage Device - 1988

ASHRAE Technical Committee Member: TC 6.9 - Thermal Storage

Mechanical Engineer - BSME, University of Nevada - 1973

Masters of Business Administration - MBA, University of Santa Clara - 1978

Honorary Society of Business and Commerce - Beta Gamma Sigma

California Governor's Advisory Board for Affordable Housing - California Appropriate Technology Program

Chief Financial Officer, Exec. VP, - Thermal Energy Storage, Inc. 1980 - 1988

Responsible for all aspects of publicly traded company including SEC Reporting.

Design Engineer – Bechtel Corp., San Francisco, CA 1975 - 1977

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Southern California Edison Company (U338-E) for Authority to Establish Marginal Costs, Allocate Revenues, and Design Rates.)	Application 08-03-002 (Filed March 4, 2008)
In the Matter of the Application of Southern California Edison Company (U338-E) for Authority to Make Various Electric Rate Design Changes.)	Application 07-12-020

Transphase's Exhibit C

Testimony of Klaus J. Schiess, P.E. In Opposition to

So. Cal. Edison's Proposed Rate Design

1. Thermal Energy Storage (TES) is the most neglected demand shifting option.

   Southern California Edison's proposed three-option rate design will cause TES to be economically unfeasible within SCE's service territory.

2. Background

   As shown in my attached statement of witness qualifications, I have personally been heavily involved in analyzing the economics and engineering of all types of TES for over 20 years. I am an independent consulting engineer not affiliated with any particular manufacturer or technology.

   TES is not something new. We had heydays with the free studies and the incentives and rates. Rates and incentives have been wildly fluctuating over the past 20 years. Over and above the economics constantly fluctuating for the end-use customer, these changes tend to cause the potential customer to skeptically view the feasibility of TES over the long term. As a result, TES is an industry that is existing but has been totally neglected, particularly for the past 15 years.

3. Necessity today for TES

Brown outs and black outs can be avoided using TES. In addition, proper design and operation allows TES to provide significant energy efficiency. As noted by the California Energy Commission and the Electric Power Researeh Institute, TES provides substantial energy efficiency to the transmission and distribution system as well as at the power stations.

4. What is needed?

A simple, single applicable rate schedule that promotes economie feasibility for new and retrofit projects over a long time period is the most needed ingredient. The cost of energy can fluetuate but the difference between on and off-peak demand and/or energy cost should stay the same. Alternatively, real time pricing (RTP) is a possibility. The present rate structures are ereated by the utilities and seem to satisfy only their objectives. In the past 15 years, the TES interests are not at the table when these rates are created.

5. Who ean act?

The utilities apparently are in charge of rate ereation. Although it appears the CPUC is supposed to guard the hen house and make sure the utilities do not exploit their privileged market position, it is aetually the utilities that guard their interest.
Therefore, it is only Government that can enforee something that is in the interest of the public. Personally, I have talked to the Governor Schwarzenegger and State Senator Kehoe, I have given presentations at AEE and ASHRAE conventions, published papers to no avail. The advice is always given that it is the CPUC that is the body to aet.

According to recent information I have reviewed, it appears that the CPUC is eneouraging TES but the utilities are just paying lip service.

6. Proposed Rate Sehedules by SCE

The new Critical Peak Pricing (CPP) rate schedule appears to be encourage users to shift load by penalizing heavy usage during critical peak periods. However, this proposed rate structure will actually discourage TES installations, perhaps irrevocably. Option A looks as if it is intended to encourage users to shift load permanently during peak periods by implementing measures sueh as TES. If that is the intention then the proposed methodology of zero demand charge is counter -produetive. May be it is the intention to simplify the schedule by loading all the cost to a high energy eost during the peak periods ($0.36/KWH).
However, any potential user or customer of TES will need to compare the operating costs without storage under the CPP rate proposal with the operating costs with TES under Option A. As shown in the Transphase spreadsheets, this appears to be a very unfavorable comparison that will cause potential customers to likely reject TES. Further,

it is in no way conducive to encouraging TES if the whole building (or system load) is subjected to that penalty Option A rate.

7. RTP Schedule

May be the RTP schedule has a chance to give investors a reason to look at TES. I have published a paper in 1996 "The Effect of Real Time Pricing on TES" which should actually be a hot topic still today.

8. Recommendations

A single rate schedule must be created as stated in item 4. above that makes TES an attractive option for end users.

Personally, I think if the rate sehedule is independent of local utilities interests and is consistently applied to California, then the ground is fertile for the development of TES projects and the resultant benefit to all the people of California.
Rebates may be necessary to compensate designers and consultants to do the extra work that is required such as feasibility studies.

Below are some other items that will need attention once we have a rate structure that makes TES feasible.

Just some thoughts which I presented at other attempts to get a TES renaissance going.

An educational program

1. For investors, developers, owners of chilled water plants

2. For consultants, design teams to perform feasibility studies, preliminary design concepts, designs.

3. For operators of systems

4. Provide software tools freely available so that the parties in 1 – 3 can perform their duties.

   The software should be window based and satisfy different requirements in basically three stages: Level 1: For studies

   Level 2: For design

   Level 3: For control sequences

As mentioned COOLAID produced by EPRI in DOS form could be the basis for further development and improvement.

Respectfully submitted,

/s/ Klaus J. Schiess, P.E.

Klaus J. Schiess, P.E.

KS Engineers

KSENGINEERS

Mechanieal Engineering Consultants & Energy Engineers

KSEng
Inc.
dba

RESUME OF KLAUS J. SCHIESS, PRESIDENT

PERSONAL

* US Citizen. Languagcs: English, German, Afrikaans, Swiss, some French.

EDUCATION

* B.Sc Eng. (ME), 1961, University of the Witwatersrand, Johannesburg, South Africa.

REGISTRATION, CERTIFICATION & AWARDS

* Registered Professional Engineer, California, 1983; Maryland, 1979; South Afriea, 1969.
* Certified Energy Manager (CEM), Association of Energy Engineers.
* Value Engineering Analyst.
* AEE Energy Professional Development Award for San Diego 1994

PROFESSIONAL ACTIVITIES & AFFILIATIONS

* Member of ASHRAE; Member of AEE, Who's Who in Engineering.
* Technical Speaker at "Conserving Energy - Using Evaporative Cooling Systems" conference at Virginia Polytechnic Institute and State University.
* Presentation of "Three-out-of-the Ordinary TES Systems" at the 1987 H.V.A.C. Systems and Building Congress for the West Coast, Anaheim, California. Text published in ENERGY ENGINEERING Aug/Sep 1987.
* Member of Expert Panel for TES Seminars organized by Southern California Edison Company, 1986 and 1987.

* Speaker at Energy Seminar for the Navy on "Low Cost/No Cost Energy Conservation Opportunities" in San Diego 1987.

* Presentation of TES Case Study: "McDonnell-Douglas Production Facility" at World Energy Engineering Congress 1989, Atlanta, Georgia.

* Presentation of "Commissioning HVAC Systems; from Design to Reality" at HVAC Solutions Seminar given by San Diego Gas & Electrics, San Diego, Oct. 1990.

* Speaker at Thermal Energy Storage, Commissioning Procedures Workshop presented by San Diego State University Energy Engineering Institute, San Diego, February 1991.

* Presentation of "An Overview on Thermal Energy Storage (TES) in the USA" at THERMASTOCK '91, 5th International Conference on TES, Scheveningen, The Netherlands, 13 - 16 May 1991.

* Presentation of Mount Carmel High School TES project: "Case Study of a Combined Thermal Energy Storage and Gas Engine Driven Chiller System to Replaee 500 Ton Chiller" at 15th World Energy Engincering Congress 1992, Atlanta, Georgia.

* Presentation of "Thermal Energy Storage - The Natural Way" at 16th World Energy Engincering Congress 1993, Atlanta, Georgia.

* Presentation of "Commissioning" at 17th World Energy Engineering Congress 1994, Atlanta, Georgia. Text published in "Strategie Planning for Energy and the Environment" Fall 1995.

* Presentation of "The Effect of Real Time Pricing (RTP) on TES Systems" at the 11th Annual Cooling Conference of International District Energy Association (IDEA), October 1996, Chicago.

* Presentation of "The Effect of Real Time Pricing (RTP) on TES Systems" at the 19th World Energy Engineering Congress 1996, Atlanta, Georgia.

* Presentations "TES at the Crossroads" at Annual AEE Seminars, Southern California Chapter in Long Beach in 1998 & 1999.

* Presentation of "Two TES Technologies in Onc Central Plant....You must be kidding" ASHRAE 2004 Winter Meeting, Anaheim, CA

PUBLISHED PAPERS

Three Out-of-the-Ordinary Thermal Energy Systems	Energy Engineering
	Vol.84, No.5 * 1987
Case Study: McDonnell Douglas Production Facility	Energy Engineering
	Vol.87, No.6 * 1990

Commissioning of HVAC Systems	Strategie Planning for Energy and the Environment Vol.15, No.2 * 1995
Commissioning: Britain vs. US	Engineered Systems, May 1998
The Effect of Real Time Pricing (RTP) on TES Systems	Strategic Planning for Energy and the Environment * Fall 1996
RTP + TES = ?	Engineered Systems, October 1998
Demand Shifting Will Boost Thermal Energy Storage (TES)	Strategic Planning for Energy and the Environment Vol.18, No.4 * 1999

ENERGY ENGINEERING

* Energy Survey for the new Navy Hospital in San Diego. CA with special emphasis on lighting, HVAC, Central Plant and EMCS improvements and operation.
* Steam Trap Survey (1320 traps) for Marine Corps Reeruit Center, San Diego, CA.
* Pre-concept Study for Installation of Energy Monitoring and Control Systems at the Carlisle Barracks, Carlisle, Pennsylvania.
* Electric Peak Shaving Report for Naval Public Works Center, San Diego.
* Engineering Report to determine Heat Losses of Main Steam Distribution Line for Naval Station, San Diego, CA.
* Naval Air Depot, North Island, San Diego, California: Energy Study for Building 472, Cleaning and Stripping Shop.
* Energy Study for Single Building Controllers at Fleet Anti-Submarine Warfare Training Center, (Pacific) San Diego, CA.
* Air conditioning Tune-up Study for Dental Clinic and Dispensary at Marine Corps Recruit Depot, San Diego, CA.
* HVAC Energy Study for Bldg. 698 at Naval Air Station, North Island, San Diego, CA.
* Evaluation of Feasibility to replace HVAC System at Home Economics Buildings at Cal State University, Long Beach, CA.
* Eighty (80) Energy Conservation Reviews for New Construction Design Program for San Diego Gas & Electric Company. Develop and quantify energy conservation opportunities.
* Central plant master plan study for University of San Diego.

* Selected by California Energy Commission for the Energy Partnership Program (EEP) in the following categories:
  1. Energy Audits
  2. New Construction Design Assistance.

  Work Orders:

  Energy Audit for City of West Covina (after implementation the City received Energy Award from the CEC)

  Energy Audit/TES Assistance for Civic Center, Pasadena

  Energy Audit for Kern County

  Energy Audit for City of San Bernardino

  Energy Audit/TES and centralizing 5 systems study for Contra Costa County

  Design for Visalia Court House TES retrofit, County of Tulare

Facility Energy Plan: Developing energy conservation projects ETAP & ECIP

Balboa Naval Hospital, San Diego, California.

Naval Medical Clinic, Naval Station, San Diego, California.

Naval Construction Battalion Center, Port Hueneme, California.

Naval Ship Weapon System, Port Hueneme, California.

Naval Air Station, El Centro, California.

Naval Station, Long Beach, California.

Naval Shipyard, Long Beach, California.

Naval Amphibious Base, Coronado, San Diego, California.

Marine Corps Air Station, Yuma, Arizona.

Naval Electronics System Engineering Center, San Diego, CA.

Naval Air Rework Facility, North Island, San Diego,California.

Naval and Marine Corps Reserve Center, Los Angeles, CA.

Peak Load Reduction Plan and Energy Management and Control Systems Training

(California Energy Commission in collaboration with California Department of Corrections)

* Assist with preparing all 33 California State Prisons for demand shifting techniques before the expected black out alerts.

* Visit all 33 California State prisons and train operating personnel in energy conservation and energy management techniques to achieve electrical demand reduction and conserve energy.

* Feasibility Study and air conditioning and evaporative cooling eomparison for typical "270" Housing Units for California State Prisons.

Present Workload

* 2003 to present: HVAC & Energy consultant for REM (Resource Efficiency Manager) and BTU (Building Tune Up) program for Navy Southwest Division. Winning awards for achieved Data Center Energy Conservation results.

* 2003 to present: HVAC and Energy Peer Consultant for 8 year bond program for Poway Unified School District.

H.V.A.C. DESIGN, ENGINEERING AND SPECIFICATION

* University of San Diego, expansion of TES system and HVAC design for Chancery.

* Study to centralize 7 chiller systems and implement variable flow for Beckman Instruments Inc., Fullerton, California. (Won 1990 ASHRAE Industrial Energy Award).

* General Atomics, La Jolla, California: HVAC for standards laboratory with Thermal Energy Storage (TES) system.

* Hotel Del Coronado, Options to improve existing TES and chiller system.

* Abraham & Strauss Department Store, Short Hills, New Jersey: 400 ton AC system.

* Naval Academy, Annapolis, Maryland: Solar heating for indoor Olympie size pool.

* Economizer improvements to Court House and Library, Orange County, California.

* Various mechanical systems for Quality Evaluation Laboratories for Naval Weapons System, Fallbrook, California.

* Engineering Report for Air Conditioning Modifications in the 3/14 Computer Complex, Goddard Space Flight Center, Greenbelt, Maryland.

* Nestle Headquarters in Randburg, South Africa: 500 ton VAV system for high-rise office building.

* National Institute of Metallurgy, Randburg, South Africa: 600 ton fan coil unit system with 70 laboratory fume hoods inclusive radioactive exhaust system.

* J.G.Strijdom Hospital, Johannesburg, South Africa: Doubling an existing 600 bed hospital to become a teaching hospital for Rand University. Addition of 13 operating rooms to existing, keeping hospital fully operational.

* Standard Bank Computer Center, Johannesburg, South Africa: Complete redesign of air conditioning system keeping computer center fully operational.

* Farmfare Chicken Hatchers and Proeessing Plant, Esakheni, Kwazulu, South Africa: Complete mechanical support systcm to hatchery and processing plant.

* Springbok Clothing Factory, Babelegi, Boputhatswana, South Africa: Evaporative cooling system for clothing factory.

THERMAL ENERGY STORAGE (TES)

Design and Specification for the following TES systems:

(** Indicates KSE study resulted in TES implementation)

* Peer Review of TES study and TES Design for California Institute of Technology, Pasadena, CA.

* Reviewing Engineer for ESCO project for California Department of Correction Calipatria Prison chilled water TES system.

** College of the Desert, Palm Desert, CA: 2,500 ton-hour ice storage TES system, integrated with 2,500 ton-hour cutectic salt storage TES system.

** Sonoma State University, Rohnert Park, CA: 7,000 ton-hour chilled water storage TES system.

* University of San Diego, Expansion of existing TES system with cross connection to existing campus cogen - absorption chiller system.

** Court House, Visalia, Tulare County. Design of retrofit ice TES system (1,300 T-H).

** Pasadena Center, Pasadena, Study and Design of 2,500 T-H ice storage TES system with chiller system optimization.

** Mount Carmel High School, Poway Unified School District, TES (1,400 Ton-Hours) combined with gas fired chiller and heat recovery for swimming pool.

** Martin Luther King Jr. Hospital, Los Angelcs, CA. 6,000 ton-hours eutectic salt.

** TES PLUS Project for Saddleback Community College, Mission Viejo, California. 4,800 ton hours eutectic salt system in conjunction with existing rejuvenated ice storage system.

** GA Technologies, Inc., La Jolla, California: 90 ton-hour Calmac System.

** TES Consultant to Transphase, Inc. (Engineer of Record) for 500,000 gals. fire reservoir to use as chilled watcr storage tank at MeDonnell Douglas, Culver City, CA.

* TES Consultant to Transphase, Inc. (Engineer of Record) for 6,000 Ton-Hour Eutectic Salt TES system for Marriott Desert Springs, CA.

* TES Consultant to Transphase, Inc. (Engineer of Record) for 4,200 Ton-Hour Eutectic Salt TES system for Hughes Radar Systems Group, Los Angeles, CA.

** Sierra Mira Mesa Office Building, San Diego, CA. 1400 ton-hours Transphase Eutectic Salt system.

** Grossmont Hospital, La Mesa, California: 2600 ton-hours, Calmac Iec system.

** Joe Mueller Office Building, Laguna Niguel, CA. 100 ton-hours Calmac Ice System.

10/12/05

KSEngineers

8763 Caminito Sueno

La Jolla, CA 92037

Tel.& Fax (858) 535-9819 Cell (858) 472-3331

KSEngineers

347 Melrose Avenue

Mill Valley, CA 94941

T&F(415) 381-5544

Certificate of Service

I hereby certify that on October 30, 2008, I served by email in accordance with Rule 1.10 a true and correct copy of the foregoing document, "Transphase's Testimony of Douglas A. Ames, Victor J. Ott, P.E., and Klaus J. Schiess, P.E. In Opposition to So. Cal. Edison's Proposed Rate Design and Revenue Allocation," including as an attachment "Transphase's Spreadsheets in Support of Testimony," on the interested parties on the CPUC Service List for Application 08-03-002. I further certify that on October 30, 2008, I overnight mailed a hard-copy of this filing to assigned Administrative Law Judge Amy Yip-Kikugawa, as well as Assigned Commissioner Michael R. Peevey. I further overnight mailed an original and three copies to the CPUC Docket Office. All hard-copies included a print-out of the aforementioned spreadsheets.

Executed on October 30, 2008 in Huntington Beach, California.

/s/ Douglas A. Ames

Douglas A. Ames

CPUC A. 08-03-002

2009 SCE GRC Phase 2- Application of SCE to Establish Marginal Costs, Allocate Revenues, and Rate Design

Spreadsheet No. 1 In Support of Transphase Testimony

Comparison of SCE's Proposed 2009 Rate Alternatives for Time-of-Use General Service Large (TOU-8 rate)
With Pre-and Post- SCE 2006 GRC TOU-8 Rates

Service Metered and Delivered at Voltages of 2KV to 50KV

			2006	2007	SCE- Proposed 2009 GRC Alternatives			Notes
			Pre 06 GRC	Post 06 GRC	CPP	Option A	Option B	
Delivery Service- Energy Charge $/kwh/meter/month								
	Summer	On-Peak	0.01587	0.01351	0.01413	0.01413	0.01413	No Account for
		Mid-Peak	0.01587	0.01351	0.01413	0.01413	0.01413	Time Differentiated
		Off-Peak	0.01587	0.01351	0.01413	0.01413	0.01413	Line Losses
	Winter	Mid-Peak	0.01587	0.01351	0.01413	0.01413	0.01413	
		Off-Peak	0.01587	0.01351	0.01413	0.01413	0.01413	GHG Emissions?
Utility-Related Generation (URG)Energy Charge $/kwh/meter/month								
	Summer	On-Peak	0.16434	0.10175	0.0898	**0.35927**	0.0898	
		Mid-Peak	0.06987	0.07391	0.0715	0.12811	0.0715	**Heavily Punitive for Option A;**
		Off-Peak	0.01469	0.03737	0.0413	0.0413	0.0413	Unspecified rates where SCE determines
	Winter	Mid-Peak	0.10222	0.07674	0.06945	0.06945	0.06945	% from URG and % from DWR;
		Off-Peak	0.01775	0.04122	0.03846	0.03846	0.03846	DWR Non-time Differentiated
Dept. Water Resources (DWR) Energy Charge $/kwh/meter/month								
	Summer	On-Peak	0.10369	0.0949	0.08614	0.08614	0.08614	
		Mid-Peak	0.10369	0.0949	0.08614	0.08614	0.08614	
		Off-Peak	0.10369	0.0949	0.08614	0.08614	0.08614	
	Winter	Mid-Peak	0.10369	0.0949	0.08614	0.08614	0.08614	
		Off-Peak	0.10369	0.0949	0.08614	0.08614	0.08614	
Demand Charge- $/kw/meter/month								
	Facilities- Non-time differentiated		8.52	9.2	9.39	9.39	9.39	
	Summer	On-Peak	30.19	15.62	20.04	0	20.04	
		Mid-Peak	4.93	5.29	5.62	0	5.62	
		Off-Peak	0	0	0	0	0	
	Winter	Mid-Peak	0	0	0	0	0	
		Off-Peak	0	0	0	0	0	
	CPP Event Energy Charge $/kWh				1.39495	0	0	
	Summer Non-Event On-Peak Demand *Credit* -$/kW				-12.76	0	0	

		Spreadsheet No. 2 In Support of Transphase Testimony								
		Simplified Building Model (Summer Only)								
			TOU-8 Rate Large General Service							
			Load Impact for Large Office Building							
					Conventional Weekday			Thermal Storage Weekday		
					A/C Load	Non-A/c Load	Total	a/c load	non-a/c load	Total
Peak Demand, kW										
Summer		On-Peak			1000	400	1400	0	400	400
		Mid-Peak			600	300	900	600	300	900
		Off-Peak			0	200	200	675	200	875
Energy Consumption, kWh										
Summer		On-Peak			5400	2400	7800	0	2400	2400
		Mid-Peak			3600	2160	5760	3600	2160	5760
		Off-Peak			0	1800	1800	5400	1800	7200
				Total Kwh	9000	6360	15360	9000	6360	15360

Spreadsheet No. 3 In Support of Transphase Testimony

Conventional (Non-Storage) Building Electricity Costs Under Various TOU-8 Rate Designs

Service Metered and Delivered at Voltages of 2KV to 50KV

			2006	2007	SCE- Proposed 2009 GRC Alternatives		
			Pre 06 GRC	Post 06 GRC	CPP	Option A	Option B
Delivery Service- Energy Charge $/kwh/meter/month							
	Summer	On-Peak	2723	2318	2425	2425	2425
		Mid-Peak	2011	1712	1791	1791	1791
		Off-Peak	628	535	560	560	560
	Total Per Summer Month		5363	4565	4775	4775	4775
Utility-Related Generation (URG)Energy Charge $/month- Assumes 80% of kwh from URG							
	Summer	On-Peak	22561	13968	12328	**49321**	12328
		Mid-Peak	7083	7493	7248	**12987**	7248
		Off-Peak	465	1184	1308	**1308**	1308
	Total Per Summer Month		30109	22645	20885	**63616**	20885
Dept. Water Resources (DWR) Energy Charge $/month- Assumes 20% from DWR							
	Summer	On-Peak	3559	3257	2956	2956	2956
		Mid-Peak	2628	2405	2183	2183	2183
		Off-Peak	821	752	682	682	682
	Total Per Summer Month		7008	6414	5822	5822	5822
Demand Charge- $/kw/meter/month							
	Facilities- Non-time differentiated		11928	12880	13146	13146	13146
	Summer	On-Peak	42266	21868	28056	0	28056
		Mid-Peak	4437	4761	5058	0	5058
		Off-Peak	0	0	0	0	0
CPP-only Summer Non-Event On-Peak Demand ***Credit*** -$12.76/kW					-17864		
	Total Demand Charge		58631	39509	28396	13146	46260
	CPP Event Energy Charge $/kWh				1.39495	0	0
						0	0
Total Electricity Charge Per Month			101111	73133	59877	87359	77741

Note: Option A is exclusively for customers with PLS/TES. Therefore, non-TES customer shown above would not be able to go on the Option A rate.
It is shown only for illustrative purposes.

Spreadsheet No. 4 In Support of Transphase Testimony

Building Electricity Costs Under Various TOU-8 Rate Designs and Thermal Energy Storage

Service Metered and Delivered at Voltages of 2KV to 50KV

			2006	2007	SCE- Proposed 2009 GRC Alternatives		
			Pre 06 GRC	Post 06 GRC	CPP	Option A	Option B
Delivery Service- Energy Charge $/kwh/meter/month							
	Summer	On-Peak	838	713	746	**746**	746
		Mid-Peak	2011	1712	1791	1791	1791
		Off-Peak	2514	2140	2238	2238	2238
	Total Per Summer Month		5363	4565	4775	4775	4775
Utility-Related Generation (URG)Energy Charge $/kwh/meter/month							
	Summer	On-Peak	6942	4298	3793	**15176**	3793
		Mid-Peak	7083	7493	7248	**12987**	7248
		Off-Peak	1862	4736	5234	**5234**	5234
	Total Per Summer Month		15886	16526	16275	**33396**	16275
Dept. Water Resources (DWR) Energy Charge $/kwh/meter/month							
	Summer	On-Peak	1095	1002	910	910	910
		Mid-Peak	2628	2405	2183	2183	2183
		Off-Peak	3285	3006	2729	2729	2729
	Total Per Summer Month		7008	6414	5822	5822	5822
Demand Charge- $/kw/meter/month							
	Facilities- Non-time differentiated		7668	8280	8451	8451	8451
	Summer	On-Peak	12076	6248	8016	0	8016
		Mid-Peak	4437	4761	5058	0	5058
		Off-Peak	0	0	0	0	0
	Total Demand Charge		24181	19289	21525	8451	21525
Total Electricity Charge Per Month (Assumes 80% from URG and 20% from DWR)							
			52438	46794	48397	52444	48397

Note: Option A is exclusively for customers with PLS/TES. Therefore, the TES customer shown above would not be able to go on the CPP or Option B rate.
It is shown only for illustrative purposes.

Spreadsheet No. 5 In Support of Transphase Testimony	
Summary Electric Bill Impacts	
Under SCE's proposed rates in this 2009 GRC proceeding, the sample CPP customer's monthly electric bill, with no peak demand reduction, would be	$ 59,877
Under SCE's proposed rates in this 2009 GRC proceeding, the sample TES customer's monthly electric bill, with a 1000 kW peak demand reduction, would be	
	$ 52,444
Monthly Savings with One MW Permanent Load Shifting	
	$ 7,433
Under SCE's actual rates in effect in February 2006 (pre-2006 GRC proceeding), the sample non-TES customer's monthly electric bill, with no peak demand reduction, would be	
	$ 101,111
Under SCE's actual rates in effect in Feb. 2006 (pre-2006 GRC proceeding), the sampleTES customer's monthly electric bill, with 1MW peak demand reduction, would be	
	$ 52,438
Monthly Savings with One MW Permanent Load Shifting	
	$ 48,673

Spreadsheet No. 6 In Support of Transphase Testimony

Total Resource Cost Test for Transphase's Proposed Thermal Storage Standard Offer

Avoided Costs For One kW

Year	Avoided CT Capital Cost	NPV	Avoided T&D Capital Cost	NPV	Avoided Energy On-Peak Per kWh ($/kWh)	Total Avoided For Summer ($/kWh)	Added Energy Off-Peak ($/kWh)	Net Avoided Energy Cost	Net Avoided Energy Cost NPV	Avoided GHG Emissions	NPV
1	131.0	$1,561.4	30.0	$357.6	0.1148	54.55	30.00	24.55	$292.6	13.1	$156.1
2	134.9		30.9		0.1182	56.19	30.90	25.29		13.5	
3	139.0		31.8		0.1218	57.88	31.83	26.04		13.9	
4	143.1		32.8		0.1254	59.61	32.79	26.83		14.3	
5	147.4		33.8		0.1292	61.40	33.77	27.63		14.7	
6	151.9		34.8		0.1331	63.24	34.78	28.46		15.2	
7	156.4		35.8		0.1371	65.14	35.83	29.31		15.6	
8	161.1		36.9		0.1412	67.09	36.90	30.19		16.1	
9	165.9		38.0		0.1454	69.11	38.01	31.10		16.6	
10	170.9		39.1		0.1498	71.18	39.15	32.03		17.1	
11	176.1		40.3		0.1543	73.31	40.32	32.99		17.6	
12	181.3		41.5		0.1589	75.51	41.53	33.98		18.1	
13	186.8		42.8		0.1637	77.78	42.78	35.00		18.7	
14	192.4		44.1		0.1686	80.11	44.06	36.05		19.2	
15	198.1		45.4		0.1736	82.52	45.38	37.13		19.8	
16	204.1		46.7		0.1789	84.99	46.75	38.25		20.4	
17	210.2		48.1		0.1842	87.54	48.15	39.39		21.0	

		Spreadsheet No. 7 In Support of Transphase Testimony							
		Total Resource Cost Test for Transphase's Proposed Thermal Storage Standard Offer							
			Net Present Value of Payments For One kW						
			Utility		Customer Added		Utility Program		
			Incentive	NPV	Costs		Costs	NPV	
			($/kW)						
			800	$1,238.19	300		96	$148.58	
			200				24		
			200				24		
			200				24		
			Total NPV of Payments Proposed					$1,686.77	
Total Resource Cost Test= Avoided Capacity and Energy Costs divided by Utility Payments, Added Customer Costs and Utility Program Costs									
TRC=	1.31		(Assumes No GHG emissions avoidance credit)						
TRC=	1.40		(With GHG emissions adder per PG&E calcs. In A. 08-06-003)						
All of the above apreadsheets were prepared by Doug Ames of Transphase on or about Oct. 28, 2008									

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Southern California Edison Company for Approval of Demand Response Programs, Goals, and Budgets for 2009-2011	)	Application 08-06-001 (Filed June 2, 2008)
Application of San Diego Gas & Electric Company for Approval of Demand Response Programs and Budgets for 2009-2011	)	Application 08-06-002 (Filed June 2, 2008)
Application of Pacific Gas & Electric Company For Approval of Demand Response Programs and Budgets for 2009-2011	)	Application 08-06-003 (Filed June 2, 2008)

Transphase Sponsored Testimony of Douglas A. Ames, Victor J. Ott, P.E.,

Klaus J. Schiess, P.E., Mark M. MacCracken, P.E. and Freeman Ford

in Support of a California Thermal Storage Standard Offer

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As a party to this consolidated proceeding, Transphase hereby sponsors and submits the following witness testimony in support of a California Thermal Storage Standard Offer:

Each of these witnesses has had a leadership position in the thermal energy storage industry and more than 20 years of experience. Separately and collectively, these witnesses provide compelling and passionate testimony as to the history of the thermal storage industry and the yet-unrealized potential value of thermal energy storage to California, the country, and the world.

Respectfully submitted,

/s/ Douglas A. Ames

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November 24, 2008

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Southern California Edison Company for Approval of Demand Response Programs, Goals, and Budgets for 2009-2011	))))	 Application 08-06-001 (Filed June 2, 2008)
Application of San Diego Gas & Electric Company for Approval of Demand Response Programs and Budgets for 2009-2011	))))	 Application 08-06-002 (Filed June 2, 2008)
Application of Pacific Gas & Electric Company For Approval of Demand Response Programs and Budgets for 2009-2011	))))	 Application 08-06-003 (Filed June 2, 2008)

Transphase's Exhibit A

Testimony of Douglas A. Ames

in Support of a California Thermal Storage Standard Offer

Ames Testimony

Table of Contents Page

In support of a proposed California Thermal Storage Standard Offer, Douglas A. Ames submits the testimony that follows, including and incorporating excel spreadsheets attached separately hereto (showing all variables, assumptions and data sources in compliance with Commission Rules 10.3 and 10.4).

1. **Overview of Testimony.**

For more than the last 20 years, thermal energy storage (TES) systems, which shift electricity for air conditioning and process cooling from on-peak to off-peak time periods, have proven to be one of, if not the, most cost-effective, reliable and feasible means to reducing critical on-peak demand and achieving energy efficiency. As noted in the 1996 California Energy Commission report, "*Source Energy and Environmental Impacts of Thermal Energy Storage*," and as recently confirmed in data responses provided by Southern California Edison (SCE) and Pacific Gas & Electric Company (PG&E), there is approximately **a 37%- 45% reduction in energy consumption and greenhouse gas (GHG) emissions** at the power plants by shifting a kilowatt-hour (kWh) of usage from the on-peak to the off-peak time period.

The utilities' amended applications, like their original applications in this consolidated proceeding, propose to acquire absolutely no resource capacity or demand reduction from new thermal energy storage (TES) and/or permanent load shifting (PLS) programs during the next three years. Instead, the utilities' amended applications have proposed to continue through 2011 with a miniscule program of a token few megawatts ("MW") of TES required by this Commission in 2006.

In 1996, the Energy Commission, in the *Source Energy and Environmental Impacts of Thermal Energy Storage* report, identified 2500 MW of TES that could be cost effectively achieved in California ***by 2005***. Instead, essentially no TES was installed during that time period, and the utilities' amended applications propose that about one-half of one percent of this conservative 2500 MW TES potential in California should be achieved in the six year period from 2006 through 2011. Further, the TES contracts signed by the utilities restrict the program to a few select technologies and companies.

Therefore, Transphase has proposed a cost-effective ***California Thermal Storage Standard Offer*** for all three utilities, open to all storage mediums, vendors and customer classes. This Thermal Storage Standard Offer would ramp up to provide up to 30 MW per year of on-peak capacity in SCE territory, 25 MW per year of capacity in PG&E territory, and 10 MW per year in SDG&E territory. The proposed payment structure would be $1400 per kW paid over a multi-year period, or substantially less than the $1950 per kW PG&E currently pays under its 3.9 MW PLS program for retrofits. In addition, the payments would be based on *ex post* metering of each TES system so that the incentives would result from proven, verifiable performance. Significantly, the Standard Offer would be entered into between the utility and the end-use customer, and these payments would be made to the end-use customer, not to any particular vendor.

The proposed CaliforniaThermal Storage Standard Offer provides extremely attractive cost effectiveness to all the ratepayers under the Total Resource Cost (TRC) test, the utility under the Utility Cost test, and the participating customer under the Participant test or simple payback period. Attached and incorporated into this testimony are a collection of excel spreadsheets providing all of these tests for each of the three utilities. Using the avoided cost information for a combustion turbine peaking plant very recently supplied by the utilities in the Demand Response rulemaking proceeding, R. 07-01-041, the TRC benefit/cost ratio for the proposed Standard Offer exceeds 1.5 for each utility. Even though TES typically comprises a significant capital expense, simple payback periods for the participating customer will range from one to three years. In this time of great economic stress and organizations' constrained capital budgets, the California Thermal Storage Standard Offer proposed here will provide a major "green" economic and environmental stimulus and benefits to all that few, if any, other demand side management or energy efficiency measures could match.

In addition, thermal energy storage provides an important, perhaps essential, link to the proliferation of intermittent renewable energy sources, particularly wind energy. A data response from SCE in this proceeding demonstrates that in 2007, this utility was supplied almost ***four times*** as much wind energy on a daily basis during the summer off-peak time period than during the summer on-peak. TES, also known as cool storage, holds the very real potential to turn this off-peak wind energy into firm, on-peak capacity and energy, in the process providing one of the critical links to achieving the California renewable portfolio standard.

In sum, the Commission should approve the proposed California Thermal Storage Standard Offer, in the process placing the Commission and California in a worldwide energy efficiency and demand response leadership position.

2. The Proposed CaliforniaThermal Storage Standard Offer.

The proposed incentive payment pricing for the proposed Standard Offer is shown below, compared to the established pricing under PG&E's existing Switch & Save Program for retrofits[1]:

Program Year	Potential $/kW Under Proposed Standard Offer	Potential $/kW Under PG&E's Switch & Save
Installation/ Commissioning Payment	$800	$850
Performance Payment At Year Two	$200	$195
Performance Payment At Year Three	$200	$195
Performance Payment At Year Three	$200	$195
Performance Payment At Year Four	---	$515
Total Potential Payment/kW shifted	$1,400	$1950

The Installation Payment would be made during installation and commissioning of the system, with the next payments due on each anniversary of successful system start-up.

All thermal storage sectors would be eligible-- large and small commercial and industrial customers and even residential customers. All technologies would also be eligible: all ice technologies, chilled water storage, eutectic salts, or any other storage medium where the on-peak demand reduction can be measured and verified. Also, the Standard Offer payments would be made to end-use customers where the TES system is installed . Given that the payments

[1] Per PG&E's Application, PG&E's TES/PLS program totals 3.9 MW of load shifting from 2006 until 2012 and is closed to most TES technologies and manufacturers.

would be made over a period of years, it is felt that it is better to directly incentivize the end-user.

As to measurement and verification, every system would be required to have a thermal meter installed. For the vast majority of system types, this will simply amount to a flow meter and temperature sensors entering and leaving the storage tank (or tank farms). The annual payments would be conditioned upon the verification that the system is providing its rated capacity and with an operational automated control system to insure successful continuing TES operation. While the kW per ton conversion typically runs from 0.7 to 1.3 kW per ton shifted, which includes the cooling tower fans and pumps, this plan is based on thermal measurements to avoid the complexity of dozens of measurement points covering the central chiller plant. A professional engineer or certified energy manager would provide a kW per ton conversion factor as a baseline at the onset. The conversion factor would not be changed over the four year payment period unless a manifest change in conditions occurred.

The proposed California Thermal Storage Standard Offer allows for up to 30 MW of additional new projects per year in SCE territory, 25 MW of new projects per year in PG&E territory, and 10 MW per year in SDG&E territory. As the utilities have proposed for other programs, incentive payments would need to be authorized by the Commission for the full term of the proposed payments. In light of the fact that the proposed Standard Offer would not be approved in a final Commission decision until late spring, it is estimated that the installations would be relatively small in 2009, with a ramp-up in activity in 2010 and the full estimated 65MW of peak demand reduction from the Standard Offer in 2011[2]. The total monies spent would obviously depend on the actual installations, but budgets can be estimated as follows, with all incentives and administrative cost figures being in millions of dollars:

[2] However, it may be that the part-year 2009 performance will be larger than that estimated below, as companies such as Cryogel and Calmac are positioned to possibly expand rapidly.

	2009	2010	2011
SCE			
MWs installed/yr.	3	20	30
Incentives	2.4	16.6	28.6
Utility Program Costs	0.6[3]	2.0	3.4
PG&E			
MWs installed/yr.	2	15	25
Incentives	1.6	12.4	23.4
Utility Program Costs	0.4[4]	1.5	2.8
SDG&E			
MWs installed/yr.	1	5	10
Incentives	0.8	4.2	9.2
Utility Program Costs	0.1[5]	0.5	1.1
Totals			
MWs installed/yr.	6.0	40.0	65
Incentives	4.8	33.2	61.2
Utility Program Costs	1.1	4.0	7.3

Significant advantages will accrue from having a consistent, understandable Thermal Storage Standard Offer in place statewide. This consistency will facilitate and encourage commercial customers to participate with multiple facilities across the state. There are many opportunities for such multiple-facility penetration. For instance, Transphase installed major retrofit installations at three Hughes Aircraft facilities, two McDonnell Douglas facilities, and three major medical centers, St. Francis Medical Center, St. Bernadines Medical Center, and St. Mary Medical Centers, all owned by the Sisters of Charity.

[3] Assumes approximately $300,000 in additional utility program “start-up” expenses.

[4] Assumes approximately $200,000 in additional program “start-up” expenses.

[5] Assumes approximately $100,000 in additional program “start-up” expenses.

3. **<u>As Demonstrated in the Attached Excel Spreadsheets, the Proposed California Thermal Storage Standard Offer Provides Extremely Robust Cost Effectiveness to All Californians.</u>**

In complete compliance with Commission Rule 10.3 and Public Utilities Code section 1822, Transphase has attached a comprehensive set of spreadsheets demonstrating that the proposed Thermal Storage Standard Offer provides extremely positive cost effectiveness test results for each of the three utilities.

The attached spreadsheet contains a separate page for each utility. Page 1 (tab 1at the lower left of the spreadsheet) is for SCE; Page 2 is for PG&E; Page 3 is for SDG&E. Each page contains a total of six tables.

Table 1 on each page calculates the avoided costs based on the total fixed Combustion Turbine (CT) capital cost which each utility supplied in the DR rulemaking (R. 07-01-041) on or about November 3, 2008. In its response, SCE filled in the blank on Table A2 for "Total Fixed" capital cost of the proxy CT at $156.4 $/kW-yr. SDG&E filled in this same blank on Table A2 at $152/ kW-yr. PG&E filled in the Table A2 blank at $151.88/kW-yr. This CT capital cost proxy used in Table 1is termed the "higher" CT avoided cost scenario. Notes below this table provide a complete list of assumptions and sources.

On each of the three spreadsheet pages, Table 2 provides the Thermal Storage Standard Offer incentives, customer costs, and program costs, as proposed. From this information, and the net present value calculations in Table 1, the standard cost effectiveness tests are presented, including the Total Resource Cost Test, the Participant Cost test, the Rate Impact test, and the Utility Cost test.

Table 3 on each page provides the same information as Table 1, except that a "lower" CT capital cost figure is used. In the case of SCE, this "lower" CT capital cost of $112/kW-yr. is taken from its Appendix C, "Demand Response Avoided Capacity Valuation Methodology," p. C-5. For PG&E and SDG&E, these lower CT capital cost assumptions are taken from Table A1 in Administrative Law Judge Jessica Hecht's October 16, 2008 Ruling in R. 07-01-041 representing the values of $126 and $135 per kW-yr. for PG&E and SDG&E, respectively.

Table 4calculates the same cost effectiveness test information as Table 2, but using the lower CT capital cost assumptions from Table 3.

Beginning at column 'S' of each spreadsheet page, Table 5 shows the load impact for a typical large office building with a 1000 kW peak cooling load before and after TES is installed. Based on each utility's currently-effective large customer electric rate schedule, Table 6 on that page establishes the electric bill savings for that customer. These electric bill savings, on a per kW basis, are then used in Tables 1 to 4 to calculate the participant cost test, the rate impact test, and the utility cost tests.

While the detailed results are shown on the spreadsheets, all TRC test results proved extremely positive, indicating that the benefits of the proposed Thermal Storage Standard Offer at the proposed incentive level far outweighs the costs, including the utility administrative costs. Below is a summary of these TRC test results:

	SCE	PG&E	SDG&E
"High" CT fixed cost $151- $156/kW-yr.	1.56	1.53	1.55
"Low" CT fixed cost $112- $135/kW-yr.	1.24	1.35	1.42

Over and above the CT capital cost, the California Energy Commission report, *Source Energy and Environmental Impacts of Thermal Energy Storage*, discussed at length below, noted that ***Transmission& Distribution (T&D) benefits alone would approach $2000 per kW*** in some constrained areas.[6] However, the spreadsheets attached and incorporated into this testimony only use as the T&D avoided cost ***a mere $29.72 per kW*** for all three utilities based on the only hard figure available, that in SCE's "Demand Response Avoided Capacity Valuation Methodology," Appendix C at p. C-12. This once again demonstrates the conservative estimates of avoided costs provided in the TRC test results for the proposed CaliforniaThermal Storage Standard Offer.

Given that TES systems involve a large initial capital expense, probably the largest capital expense of any type of demand side management measure, the TRC results demonstrate a tremendously positive benefit/cost ratio that would accrue to all California ratepayers from the proposed Thermal Storage Standard Offer.

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[6] Ibid. p.45, n. 65.

In these extremely difficult economic times, the facility owners' capital and 'green' improvement budgets are very constrained. To be successful, the Thermal Storage Standard Offer must provide the building owner with an exceptional return on this major capital investment. As structured and proposed here, it does. Based on the current rates for the large power customer for each of the three utilities, TES electric bill savings for the participating customer is estimated at $177 per kW-yr. in SCE territory, $162 per kW-yr. in PG&E territory, but only $93 per kW-yr. in SDG&E territory. The bill savings are so much lower in SDG&E territory because of SDG&E's newly adopted Critical Peak Pricing (CPP) default rate[7].

As structured, the participating customer would retain 100% of the bill savings. Further, the customer would pay $300 per kW during the installation, over and above the utility incentive. The customer's simple payback period would thus range from about one year to three years, depending on what arrangement was made between the thermal storage vendor and the participant as to the utility incentive payments. For instance, the participating customer and the vendor might want to split the on-going incentive payments, providing both with a strong monetary incentive to keep the system running at its rated performance level.

These cost effectiveness tests demonstrate the tremendous economic benefits of TES. From the customer, to the utility and to all the utility's ratepayers, even with its major capital expense, the proposed Thermal Storage Standard Offer still results in some of, if not the, highest TRC test results for any major energy efficiency or demand side management measure, as well as even higher Utility Cost test results, and fast paybacks to the participating customer.

The California Thermal Storage Standard Offer provides compelling benefits for all.

4. <u>Commission and Legislative Policies Fully Support Thermal Energy Storage.</u>

California Public Utilities Code §454.5(b)(9)(C) provides: "The electrical corporation will first meet its unmet resource needs through <u>all</u> available energy efficiency and demand reduction resources that are cost effective, reliable, and feasible." (emphasis added).

[7] It may be more advantageous for the SDG&E TES customer to opt out of the CPP default rate and stay on the traditional alternative.

Particularly applicable is Stats. 2002 ch 850:

> The Legislature finds and declares all of the following:
>
> (a) Californians can significantly increase the reliability of the electricity system and reduce the level of wholesale electricity prices by reducing electricity usage at peak times through a variety of measures designed to reduce electricity consumption during those periods….
>
> (e) Electricity consumption for air conditioning purposes during peak demand periods significantly contributes to California's electricity shortage vulnerability during summer periods.
>
> (f) It is the intent of the Legislature to promote energy conservation and demand reduction in the State of California.

This legislative intent has long been in accord with Commission policy. As SCE acknowledges: "The Commission has placed DR programs in a superior position in the Energy Action Plan 'Loading Order' and set a policy goal of pursuing ***all*** cost-effective EE and DR before increasing reliance on supply-side resources."[8] (emphasis added) As provided in the Energy Action Plan II, September 2005 at p. 2: "EAP II continues the strong support for the loading order- endorsed by Governor Schwarzenegger- that describes the priority sequence for actions to address increasing energy needs. The loading order identifies energy efficiency and demand response as the State's preferred means of meeting growing energy needs."

Ames hereby references and incorporates the excellent discussion of California legislative intent in the testimony of Victor J. Ott, P.E. of Cryogel which follows this testimony.

In addition, as further described in the next section below, the California Energy Commission has fully recognized and promoted the energy efficiency and environmental benefits of thermal energy storage.

5. The Massive Energy Efficiency and Environmental Benefits of Thermal Storage.

From the 1980s until the mid-1990s, thermal energy storage systems were installed in larger commercial and industrial facilities throughout California to shift air conditioning and process cooling load from the on-peak to the off-peak hours. Many types of such cool storage systems proliferated, including various types of chilled water storage systems, ice storage

[8] SCE's Appendix C, Demand Response Avoided Capacity Valuation Methodology at p. C-1.

systems, and eutectic salt storage systems based on the use of 47 degree F phase change materials.[9] A number of field monitoring studies, data analyses, and design guides were published, led by the Electric Power Research Institute (EPRI) [10], the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)[11], the California Energy Commission[12] (CEC or Energy Commission), and various utilities and organizations around the country[13].

The California Energy Commission has long provided leadership and support for thermal energy storage. As early as 1978, the CEC adopted standards for a program of load management that included the development of "end-use storage systems."[14] In August, 2007, the Energy Commission approved Thermal Energy Storage systems for compliance credit under the Title 24 *2005 Building Energy Efficiency Standards* for nonresidential buildings.[15]

In 1996, the California Energy Commission published a landmark study of the energy and environmental benefits of thermal storage systems. The Energy Commission's *Source Energy and Environmental Impacts of Thermal Energy Storage,* February 1996, www.energy.ca.gov/reports/500-95-005_TES-REPORT.PDF, provided a comprehensive analysis. Here are a few of the major conclusions from this detailed study:

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[9] See, for example, PG&E's "*Thermal Energy Storage Strategies for Commercial HVAC Systems*," 1996, www.pge.com/includes/docs/pdfs/about/edusafety/training/pec/inforesource/thrmstor.pdf , which describes and compares various types of cool storage systems.

[10] See, e.g., these four EPRI reports: EPRI, *Commercial Cool Storage*, CU. 3024 (1988); EPRI, *Thermal Energy Storage*, CU.2036 (1992); EPRI, *Commercial Cool Storage Primer*, EM-3371 (1984); *EPRI Cool Storage Monitoring Workshop Presentation Material* (September, 1989.

[11] ASHRAE, *Design Guide for Cool Thermal Storage* (1993)

[12] California Energy Commission, *Source Energy and Environmental Impacts of Thermal Energy Storage* (February, 1996)

[13] For example, the International Thermal Storage Advisory Council (ITSAC) was begun and run by Loren McCannon, an SDG&E engineer. SDG&E had a particularly strong thermal storage program.

[14] The Brattle Group, *California's Next Generation of Load Management Standards,* Prepared for the California Energy Commission, p. 16 (July, 2007)

[15] California Energy Commission, *Thermal Energy Storage Compliance Option* (July, 2007).

- At the source power plant: "In many California TES installations, 40 percent to 80 percent of the annual kWhs of electricity use for air conditioning will be shifted from day to night. In such installations the official Energy Commission methodology, the Incremental Energy Rate method, showed large source energy savings. ***The savings per kWh shifted range from 36 percent to 43 percent for SCE and 20 percent to 30 percent for PG&E***." p.3 (emphases added)

- At the building site level: "Although early TES systems used more kWhs than conventional systems, monitoring of many recent TES systems shows these systems use 12 percent fewer kWhs than conventional systems. These efficiencies are also attractive compared to the ***20 percent to 50 percent energy penalties from using conventional utility storage technologies such as pumped hydro***." (p.3-4)

- Source Emissions Analysis: "TES can also greatly reduce air emissions from power plants….Assuming a 20 percent market penetration by 2005, TES could save 260,000 tons of CO2 annually statewide. Just as importantly it could save about ***1.6 tons of NOx per day in the SCAQMD***. These NOx savings are equivalent to the savings substituting 100,000 electric vehicles for gasoline vehicles." (p.4)

- Further Air Emission Impacts at the Power Plant Source: "Figure 31 shows that the air emissions savings from shifting a kWh are slightly higher than the source energy savings. For example, Figure 31 shows ***a 47 percent savings in emissions by shifting a kWh of cooling load from on-peak to off-peak***." (pgs. 41- 42)

This monumental energy conservation impact of thermal storage at power plants occurs because TES avoids deployment of the dirtiest, least efficient peaking plants operating at the margin.

Time-differentiated heat rate data has very recently been verified. In April, 2008, SCE responded to a Transphase data request for time-differentiated heat rates as part of SCE's 2009 General Rate Case (GRC). SCE's own 2008 data confirms that shifting a kWh from on–peak to off-peak results in an energy savings of 45% under this Incremental Energy method. PG&E also responded to a Transphase data request in September, 2008 in this proceeding in which it provided heat rate data based on forward 2009 estimates of electric and gas supply. Below is a table providing this 2008-compiled heat rate data:

SCE[16] and PG&E[17]

Power Plant Heat Rates (Btus/kWh)

	Summer		Winter	
	SCE	PG&E	SCE	PG&E
On-Peak	13,258	11,985	-------	------
Mid-Peak	10,254	10,781	9,413	10,037
Off-Peak	7,263	7,603	6,996	7,742

For SCE, the summer off-peak heat rate is 45% less than the summer on-peak heat rate, which translates directly into a 45% reduction in fossil-fuel consumption at the power plant for every kWh shifted from on-peak to off-peak. For PG&E, the summer off-peak heat rate is 37% less than the summer on-peak heat rate, which translates directly into a 37% reduction in fossil-fuel consumption at the power plant for every kWh shifted from on-peak to off-peak.

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[16] SCE's verbatim response to Transphase's data request:

Southern California Edison

2009 GRC Phase 2 A.08-03-002

DATA REQUEST SET TRANSPHASE-SCE-001
To: TRANSPHASE
Prepared by: Paul Nelson
Title: Senior Economist
Dated: 04/17/2008
Question 02:
In SCE's "Marginal Cost and Sales Forecast" Exhibit, I did not see any heat rate information using either the Incremental Energy Rate or Marginal Plant Rate method. (see pages 16 to 23 of this CEC report.) (If you have already included this information somewhere, I apologize in advance.) Would SCE be willing to provide such heat rate information as a means to test SCE's proposal and to better understand what differences might have led to such dramatic rate design changes coming out of the 2003 GRC, on the one hand, and the 2006 and SCE proposed 2009 GRC rate designs, on the other hand?
Response to Question 02:
The incremental energy rate can be calculated from Table I-7 and the average gas price of $7.49 (SCE-2, page 24, line 7):
IER (BTUs/KWH) = Energy Price (cents/KWH) / Gas Price ($/MMbtu) * 10,000
IER (Btus/KWH)

	Summer	Winter
On-Peak	13,258	-
Mid-Peak	10,254	9,413
Off-Peak	7,263	6,996

[17] See PG&E's Answer to Transphase's Question 15 in Transphase's Data Request, Set Two.

In addition, while helping to avoid the capital cost of transformers blowing out on a hot summer afternoon (which should be included in the avoided capacity cost), TES also provides transmission and distribution line energy savings. As the Energy Commission explained:

> In particular, energy is lost due to resistance in the power lines (line losses). For example, to get 1.00kWh of electricity delivered to the energy user's site, 1.10 kWhs may need to be input into the power lines at the power plant. This amounts to a 10 percent line loss. Moreover, an important factor in this TES analysis is that these line losses vary across the five time periods. In particular, line losses are highest when the ambient temperature is hotter. Both of these factors lead to line losses being higher during the summer on-peak period. Therefore, TES saves energy by shifting electricity use to times of lower line losses…When evaluating DSM programs which have their impacts at the energy user's site, the utilities, CPUC, and California Energy Commission use the distribution level marginal costs that reflect the line losses. [18]

Hence, TES provides very substantial energy savings, as well as avoidance of capital costs.

At least 33% of California's 50,000 MW peak electricity load comes from air conditioning.[19] In addition, on those peak days from the summer of 2007 when California's peak demand rose to over 50,000 MW, the load at night dropped to approximately 28,000 MW.

There is no more effective way to reduce this peak load than from TES. Hospitals, universities, data centers, manufacturing facilities, and office buildings all can be easily retrofitted with TES. As opposed to 'conventional' demand response, ***TES does not affect the comfort or productivity of the participant buildings' inhabitants on the critical peak days***. In many facilities, such as hospitals or data centers, cooling cannot be interrupted or reduced. In such facilities, conventional demand response, wherein cooling is curtailed or completely stopped during critical peak periods, is completely unacceptable.

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[18] California Energy Commission, *Source Energy and Environmental Impacts of Thermal Energy Storage* at p.19. PG&E states that line losses are included in its heat rate calculations. See Answer 16 to Transphase's data request, set two.

[19] *Source Energy and Environmental Impacts of Thermal Energy Storage*, p. 45 (in 1995, "[a]ir conditioning is currently about 14,000 MW or about a third of the total peak demand in California."

However, TES is perfectly suited for these cooling- critical facilities. With cool storage, the buildings continue to operate with the same level of cooling.

From the stand-point of the California Independent System Operator and the utility, cool storage eliminates all issues concerning notification periods, triggers, or uncertainty as to whether the participating customer will choose to incur the penalties of any of the capacity incentive programs, e,g, critical peak period rates, base interruptible program, capacity bidding program, or the demand bidding program, in order to keep the facility cool on a critical peak day. Most significantly, there are no issues of "rolling baselines" with permanent load shifting/TES. From the stand-point of the utility and the Independent System Operator, PLS/TES provides by far the most certainty and predictability of any demand response-type measure.

Various studies have suggested that TES could penetrate at least 33%, or almost 7000 MW, of the 20,000 MW California air conditioning load. In its 1996 report, the Energy Commission used a more conservative 20% penetration rate for TES and, with the then-current California peak demand, concluded that ***2500 MW of TES could be installed in California by 2005***.[20] In that time period, the Energy Commission estimated that "TES could save over a billion dollars of investment in the T&D [transmission and distribution] system and perhaps equal savings in generation capacity investment." Nevertheless, during that period from 1996 through 2005, the amount of TES installed amounted to essentially nothing.

From this perspective, it is easy to see how the proposed California Thermal Storage Standard Offer, ramping up to a maximum of 65 MW of installations in 2011 across the three major California electric utilities, represents an extremely modest and realistic goal for the program.

6. Thermal Storage Transforms Wind Energy from an Intermittent, Heavily Off-Peak Energy Source into a Firm, Cost Effective Peak Capacity and Energy Resource; the California Thermal Storage Standard Offer Should Play A Major Role in Achieving California's Renewable Portfolio Standard.

This Commission, the Energy Commission and the California Independent System Operator have all recognized the enormous potential need for combining energy storage with

[20] *Source Energy and Environmental Impacts of Thermal Energy Storage*, p. 45.

intermittent renewable energy sources. As stated in Administrative Law Judge Jessica T. Hecht's February 27, 2008 Ruling at p. 21:

> Under California's renewable portfolio standard (RPS), new and creative methods will be required in order to integrate into the electricity supply many of the renewable resources that are intermittent. It is possible that intermittent renewable resources can be better integrated to serve load through the use of permanent load shifting techniques such as energy storage; if so, this could assist in meeting the state's RPS standard. Recent studies by the California Energy Commission and the CAISO provide some background on this issue and may be useful in developing proposals. [citations omitted]

PG&E clearly understood the natural fit:

> Most wind generation in California occurs during off-peak hours, particularly during the summer months. Technologies that can shift load from on-peak hours to off-peak hours help maximize the utility's ability to use wind energy during off-peak hours. Although pumped hydro is a good resource to help with this issue, pumped hydro potential is low. Alternative storage technologies include thermal energy storage (water and ice) and several battery technologies.

PG&E Prepared Testimony at p. 2-33. [21]

While PG&E has at least 1200 MWs of pumped storage,[22] its DR Application did not include any new thermal storage resources used in combination with wind energy. It does propose to spend over a million dollars of the ratepayers' money for a study. SCE's Application is equally unresponsive in addressing the massive potential benefits to all Californians from storage/ intermittent renewables. SCE's Application is essentially limited to studying the possibility of using lithium ion batteries in residences.

However, SCE did respond to a Transphase data request for a time-of-use breakdown for 2007 wind supply with the following table:

[21] In its brochure in the mid-1990s, PG&E actively promoted thermal energy storage, including a significant section on eutectic salts as the storage medium. Transphase assumes that by PG&E's references to water and ice as storage mediums, it was not intending to exclude eutectic salts or other measurable, verifiable storage mediums.

[22] See, e.g., CAISO Report describing potential use of PG&E's 1200 MW pumped storage facility with wind energy.

	Peak Period		2007 daily kWh		
			average	minimum	maximum
Summer	on		1,516,421	50,026	3,925,735
Summer	mid		2,752,099	142,544	6,377,746
Summer	off		4,592,979	47,424	15,122,855
Winter	mid		3,235,441	128,867	9,534,896
Winter	off		2,208,473	20,500	12,290,950

During the summer, ***wind energy supplies SCE with over three times as many kWhs during the off-peak period than during the on-peak period.*** On SCE's internet home page, SCE announces that it has recently signed contracts for 900 MW of new wind energy. What will the utilities do with this avalanche of off-peak wind energy pouring into their systems as California's Renewable Portfolio Standard takes hold?

Thermal energy storage provides a critical and cost effective solution to the growing off-peak wind energy supply issue. In fact, TES turns off-peak wind energy into a firm, reliable and committed source of on-peak capacity and energy.

In Transphase's protests to the utilities' original and amended DR applications, Transphase proposed a series of TES/Wind energy pilots. However, none of the three utilities responded to a Transphase data request seeking time-differentiated average wind energy prices.[23] Without this average price information, it is difficult if not impossible to construct the incentive payments or structure for TES/wind energy pilots, at least ones that would differ in a material respect from the proposed Thermal Storage Standard Offer. Hence, at this point Transphase must forego the TES/ wind energy pilots proposed in its protests.

Nevertheless, the ramping-up of California TES installations under the proposed Thermal Storage Standard Offer will inevitably have the beneficial effect of absorbing the off-peak energy (from whatever the source) and turning into it firm, on-peak capacity and energy.

Therefore, a major benefit to the proposed California Thermal Storage Standard Offer is that it provides a realistic, concrete path towards the cost effective attainment of California's Renewable Portfolio Standard.

[23] The lack of the utilities' substantive response to this and other Transphase data requests are the subject of Transphase's pending motion to compel further answers to data requests.

7. Transphase's Past Utility Power Savings Agreements and Measurement Plans.

Transphase provides here background into Transphase and SCE's past thermal storage programs. In the period from the mid-80s through the mid-90s, Transphase manufactured, installed and/or operated over 80 cool storage systems used to shift electricity consumption for air conditioning and process cooling at large commercial/ industrial buildings from on-peak hours to off-peak hours. Transphase installations reduced peak demand by over 30 MW, most of which occurred in California. This includes a six MW Power Savings Agreement with SCE in 1991 as well as Power Savings Agreements with other utilities. The thermal storage system is based on Transphase's eutectic salt storage medium that melts and freezes at 47 ° F, and can be used with any existing or new chiller. Systems are still in operation and providing superior performance after more than 18 years of service.

The Transphase Cool Storage System is based on the use of inorganic, non-toxic, and inexpensive "eutectic salts" as the storage medium. The primary eutectic salt manufactured by Transphase melts and freezes at 47 °F, although Transphase also developed a 41°F under contract with EPRI. The phase change material ("PCM") is filled into rugged, self-stacking, water-impermeable high density polyethylene containers measuring 24" by 8" by 1.8" deep. The PCM-filled Transphase containers are then placed within a tank, often a below-grade concrete tank underneath a parking lot or landscaped area, at the building facility.

The system is charged using a building's existing or new chillers during off-peak electric hours. At night, 40-42 °F chilled water from the central chiller plant flows into the tank and between the Transphase containers, thereby freezing the 47°F PCM. By the end of the off-peak time period, the tank is filled with solid blocks of "ice", but ice that freezes and melts at 47 degrees, not 32 degrees.

During the daytime on-peak time period, warm return water from the building chilled water piping flows into the tank and in between the eutectic salt-filled containers. The building water is chilled as it passes over the thawing Transphase containers. Upon exiting the tank, the chilled water is circulated through the buildings to provide air conditioning or process cooling in the conventional manner. Various system designs have been employed, including full storage systems designed to handle 100 percent of the building's on-peak cooling load, or partial storage designs where the storage system is sized to handle part of the cooling load. [24]

In addition, Transphase successfully designed and installed systems combining other energy efficiency products such variable frequency drives and automated building control systems that greatly increase the system's cost-effectiveness, significantly conserving energy as well as reducing the on-peak electric demand. Most dramatically, in desert or otherwise cool nighttime environments, a "free cooling" heat exchanger can be placed on the cooling tower water lines, allowing the Transphase System to be charged at night without chiller operation. This can result in a further energy reduction of over 50%, as well as on-peak demand reduction.

Because the Transphase System relies upon a phase change at 47°F, the entire universe of buildings with existing or new conventional chillers can be retrofitted with this eutectic salt storage system. The Transphase system's higher temperature phase change point allows the system to be very energy efficient.

By the late 1980s, Transphase had manufactured and/or installed its eutectic salt cool storage system in California, Arizona, Florida, Taiwan, Japan, Korea, Canada, Israel, and Europe. The California utilities led the world by offering TES incentives, typically with a one-time payment to the end user of $200 to $400 per kW. This Commission regularly authorized these incentive payments and budgets of $5 to $7.5 million per year per utility for TES incentives.

However, the utilities began a disturbing pattern of constantly withdrawing the incentive offer from the customer, seriously disrupting the formation of the TES industry. For example, a favorite tactic of SCE during this period was to approach its largest customers and pitch that they need to sign up for these incentives, without any obligation to proceed. With absolutely no reason for these customers not to sign up, very soon SCE would announce that there was no more money in the budget for any customer who actually wanted to install a system. Since a low percentage of the signed-up customers actually proceeded with an installation, given the non-obligatory nature of the reservation, little of the budgeted funds were actually spent as incentives for customers installing TES systems.

In 1990, as a result of a protest filed at this Commission over the utilities' application for

[24] See, e.g., Ames, "Eutectic cool storage: Current Developments", *ASHRAE Journal* (April, 1990); Kostyun and Ames, "Arizona Utility Adds Eutectic Storage Unit", *ASHRAE Journal* (May, 1987)

shareholder incentives for demand side management, Transphase broke new ground by entering into a so-called “Power Savings Agreements” (PSAs) with various utilities, primarily Southern California Edison and Jersey Central Power & Light Co. Under these PSAs, Transphase developed Measurement Plans applicable to thermal storage systems, agreed to by the utilities. The Measurement Plans comprehensively established measurement and monitoring protocols for the thermal and electrical components of the chiller plant. Transphase’s Measurement Plan was later adopted by the National Association of Energy Service Companies (“NAESCO”) as the standard for thermal storage systems.

While Transphase successfully manufactured, installed, financed and operated its systems at large prestigious host company installations under these utility Power Savings Agreements, including installations at AT&T’s world headquarters, Marriott Desert Springs Resort, City of Hope Medical Center, Ventura County Government Center, and many others, Edison and JCP&L stopped paying for the contracted and well-documented power savings under the 7 to 13 year terms of the Agreements. Several of these systems are still operating more than 18 years after installation, having saved the customers many times the purchase price.

As a result of the debt incurred to finance these installations under utility PSAs, Transphase was eventually forced to cease operations in 1996 (but never declared bankruptcy). In 1999, a California jury awarded Transphase $6.35 million against Edison for breaching its contract with Transphase after a seven week jury trial.[25] As part of this award, the jury also found that Edison had tortiously interfered in Transphase’s contracts with its host customers and had maliciously driven Transphase out of business, awarding Transphase punitive damages. While the Edison case ultimately settled for $3.2 million (which Edison evidently charged to the ratepayers), the trial judge and the Court of Appeal issued rulings which upheld all liability verdicts and the punitive damage award. The funds collected in the litigation were then returned to Transphase’s creditors and shareholders, including such venture capital investors as the Environmental Venture Fund, Robertson Stephens & Co., First Analysis Corp., and WD Ruckelshaus & Associates.

[25] “New Power Source: Former Energy Company Executive Wins Legal Victory Over Edison,” *Los Angeles Times*, May 5, 1999, pages C1 and C6.

8. Conclusion.

More than ever before, the time is now for an expanded role for TES. The proposed California Thermal Storage Standard Offer will allow California to regain and expand its world-wide leadership position in energy efficiency and demand side management.

Respectfully submitted,

/s/ Douglas A. Ames

Douglas A. Ames
President, Transphase Co.

November 24, 2008

Witness Qualifications of Douglas A. Ames

Current President of Transphase Company

1982-2006, President, Transphase Systems, Inc., manufacturing, constructing, engineering, owning and/or operating over 80 large-scale thermal energy storage systems based on the use of eutectic salts as the storage medium

Prepared and/or reviewed hundreds of economic/engineering feasibility studies for TES

Principal Investigator for the Electric Power Research Institute on New Eutectics for Cool Storage

Inventor of Seven Patents in Field of Eutectic Salt TES

Author of Many Articles on Eutectic Salt TES in *ASHRAE Journal* and other Energy Publications

Associate Member, ASHRAE Thermal Storage Technical Committee 6.9

Member of Board of National Association of Energy Service Companies (NAESCO)

Developed Measurement Plan for TES adopted by NAESCO

Court -Approved Expert Witness in Thermal Energy Storage for the Superior Court of California and the U.S. District Court for the District of New Jersey

Educational Background:

> **B.A., Harvard University, Cambridge Massachusetts, *cum laude* concentrating in biology and chemistry (1980).**
>
> **J.D., Western States University College of Law, Fullerton, California, *magna cum laude* and class salutatorian (1998). Admitted to the State Bar of California, U.S. District Court for the Central District of California, U.S. District Court for the Northern District of California, and the Ninth Circuit U.S. Court of Appeals.**

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Southern California Edison Company for Approval of Demand Response Programs, Goals, and Budgets for 2009-2011	))))	Application 08-06-001 (Filed June 2, 2008)
Application of San Diego Gas & Electric Company for Approval of Demand Response Programs and Budgets for 2009-2011	))))	Application 08-06-002 (Filed June 2, 2008)
Application of Pacific Gas & Electric Company For Approval of Demand Response Programs and Budgets for 2009-2011	))))	Application 08-06-003 (Filed June 2, 2008)

Transphase's Exhibit B

Cryogel's Written Testimony in Connection With Transphase's Consolidated Protest to Amended Applications and Alternative Demand Response/Energy Efficiency Proposals for 2009 –2011 – 9/27/08

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Cryogel

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Submitted November 20, 2008

1. Summary of Testimony:

Cryogel, of San Diego, California is providing this testimony in support of the proposals by Transphase to encourage the widespread adoption of thermal energy storage (TES) in California by implementation of rate designs and incentives that reflect the benefits of thermal storage to the environment, to the reliability of electrical energy supplies and to the economy of the State of California. This testimony is also intended to support the findings of the California Energy Commission with regard to the benefits of TES and to highlight Legislative Intent in support of peak load shifting as an important component of California energy policy. We are not providing testimony in support of any specific thermal storage technology or product, including our own, or to support any technical or competitive distinctions between TES technologies as may be implied in the Transphase Protest or otherwise. We believe that consumers, with the aid of engineers and design professionals, will continue to make rational economic and practical decisions about competitive technologies. We support the position stated by Transphase that incentives, rates and Standard Offers should be available to end users of all thermal storage technology where on-peak demand reductions can be measured and verified. It should be clear that the references to our technology and company history herein are provided only for background, including actual experience in the market, and not as means of elevating our technology or market position.

2. Thermal Storage is Simple, Proven Technology – A Few Examples

Briefly, thermal energy storage (TES) is a proven, energy conserving, environmentally friendly technology that shifts electrical loads from air conditioning and process cooling to off-peak hours. Energy is used during nighttime (off-peak) periods to produce and store cool energy in ice, chilled water or phase change materials. The cool energy in storage is used the next day for air-conditioning or process cooling during periods of peak energy demand.

From a practical point of view, properly sized and automated TES systems can be nearly transparent to building owners and operators. Analogous to battery backup for electrical equipment, TES simply discharges cool energy to provide air conditioning as needed when electric chillers are shut down or their output is limited to reduce demand. With TES, the flow or cool air to occupied spaces or processes is not interrupted or diminished during on peak periods or power supply alerts.

In this way, TES is superior to air conditioning cycling or interruptible rate strategies now being offered because there is no deterioration of comfort levels in buildings served by TES. TES replaces the function of chillers during on-peak periods or critical peak periods as programmed in controls or as may be dictated by dispatch signals from the utility. Because comfort levels are maintained even when chillers or air conditioning compressors are shut down, there is no need for owners or operators to consider bypassing or overriding controls thereby undermining demand reductions. TES systems are charged each night and are ready during the day as a flexible source of cooling without the electrical demand imposed by chillers or air conditioning equipment.

TES has been proven with successful systems operating for years with hundreds of examples by a number of thermal storage equipment manufacturers employing a competitive range of technologies. As just one case in point, a Cryogel ice thermal storage system was installed in a 24 story office building at the corner of 8th and Figueroa in downtown Los Angeles in 1992. Today, that system continues to cool the building for 10 hours each day with no assistance from electric chillers. The system is currently shifting a peak load of approximately 750 kW off the grid during the day, every day, without any emergency signals or calls to curtail power. There is no need for operators to rush around the building shutting down chillers in response to a call from the electric utility to curtail loads because the chiller are always off during peak hours. Tenants of the building are not aware that chillers are never operating during the day because comfort levels are normal. This thermal ice battery simply cools the building each day and is essentially invisible to everyone except the corporation paying lower monthly electric bills.

This building recently won and energy efficiency award from the local utility and building engineers report energy bills of less than half that seen in similar buildings that they have also maintained in downtown Los Angeles. The system is controlled and monitored by a single computer room and operators are not required on site during nights or weekends. The system was originally designed to shift the full air conditioning load for 8 hours. The capacity of the system exceeds design requirements such that it currently shifts the full load for 10 hours in response to a change of rate structures by the local utility. The success of this system is in its flexibility to satisfy changing electrical rate structures, simplicity of concept and operation, low maintenance requirements, permanent reduction in peak demand and lower energy costs year after year.

In addition to typical air conditioning installations in office buildings, schools and hospitals, where TES systems cycle once each day, Cryogel systems have also been proven in some of the most critical and difficult applications of TES. For example, since 1996 Cryogel has installed thermal storage systems at airports in San Francisco, Los Angeles, Atlanta, Dallas - Ft. Worth, Ft. Lauderdale, Chicago, Phoenix and Miami to cool aircraft on the tarmac and airport terminals. These systems cool aircraft with low temperature air and cycle more than once per day because loads are constantly peaking and falling as aircraft arrive and depart. The reported failure rate on these systems is zero even under demanding service conditions. The Atlanta airport has installed two such systems and the Miami airport has installed six Cryogel systems since 1996. The fact that such facilities with critical air conditioning loads install the same equipment on a repeat basis should be clear evidence of the viability and reliability of the equipment.

TES technology is available now, it is fully developed, it is proven over the past two decades and it is as simple to understand as any battery. Following blackouts several years ago in the Northeastern US, a newspaper article appeared lamenting the fact that battery technology did not yet exist in a form that would satisfy on-site electrical demands during peak periods. The article reasoned that if electrical batteries were installed in buildings to provide power during peak periods, the distribution grid would not have been overloaded and the cascading power failures could have been avoided. It is extremely frustrating to read such articles knowing that batteries do exist in the form of TES and that these thermal batteries are designed to supplant the largest peak electrical loads in many buildings; the air conditioning load. A journalist might be excused for not understanding that energy can be stored by means other than electrical batteries and achieve the same result of shifting peak loads and reducing strain on the transmission grid. However, it is difficult to understand why this concept has not gained widespread support from the technical community responsible for the reliability of the electrical grid.

3. California Energy Commission Report on TES:

The benefits of TES on a macro scale were quantified years ago through the California Energy Commission Report , "Source Energy and Environmental Impacts of Thermal Energy Storage". The conclusions of that report are more important today than ever. The CEC cover letter introducing that study in 1996 is also quite relevant today and demonstrates CEC foresight, especially when looking back at the tumultuous history of California's energy supplies and failure of utilities and industry to collaborate in an effective manner with regard to the energy supplies and the environment.

In a letter dated February 16, 1996, Charles R Imbrecht, Chairman of the California Energy Commission stated:

> *"The electric power industry is changing. We are now in the process of moving to a more competitive electricity services industry. While competition and cost control are important in the midst of this change, other goals such as clean air remain as critical issues. We believe the cost efficiencies of competition must be balanced with environmental sensitivities.*
>
> *The California Energy Commission (Commission) is responding to these changing conditions by commercializing technologies that balance competitive and environmental concerns. One such technology is Thermal Energy Storage*

(TES). The Commission staff has been facilitating a collaborative of TES stakeholders to identify the benefits and take actions to reduce market barriers facing TES in a re-structured marketplace. The enclosed report, Source Energy and Environmental Impacts of Thermal Energy Storage, was prepared for the TES collaborative. Based on the analyses in the report, implementation of TES could:

- *Lower customer air conditioning costs by 30-50 percent;*
- *Reduce capital investment in the Transmission and Distribution system by a billion dollars in the next decade;*
- *Reduce Nox emission equivalent to 100,000 vehicles in the South Coast Air Quality Management District; and*
- *Save enough source energy to supply all 500,000 electric cars projected for the next decade; "*

The California Energy Commission Report , "Source Energy and Environmental Impacts of Thermal Energy Storage" P500-95-005 (http://www.energy.ca.gov/reports/500-95-005_TES-REPORT.PDF) is well documented in the Transphase Protest and full discussion need not be repeated here. However, a couple basic elements of the CEC Report deserve repeating.

The CEC Report highlights the fact that TES technology conserves energy at both the electricity generation source and the point of use. In addition, the CEC report supports the position that TES should be considered a priority in the ranking of Demand Side Management technologies in energy policy decisions.

The CEC Report demonstrates that TES reduces pollution and greenhouse gasses. This results from more efficient electrical generation mix during off peak periods and reduced transmission line losses. That same conclusion is supported by recent heat rate data and transmission efficiency comparisons included in the Transphase Protest. At the time of publication, the CEC Report stated that by 2005, TES could reduce Carbon Dioxide emissions by 260,000 tons and Nitrous Oxide emissions by 600 tons annually. That report is even more relevant today than when it was published in view of concerns about climate change, greenhouse gas emissions and general environmental protection. While the economics of possible "cap and trade" systems or “carbon taxes” were not factored into the CEC report, it should be clear today that the real costs of emissions should be a factor in generation cost analysis and allocation. We do not know if such costs or contingencies are currently included in marginal cost models and we have submitted a formal data request for that information. In our opinion, however, failure to include apparently inevitable cost adders associated with emissions would represent an extremely short-sighted approach when evaluating and implementing strategies including the significant peak demand and source emissions reductions attributable to TES.

Contrary to the logical path forward suggested by the CEC Report, the reduction or elimination of incentives and flattening of TOU rates have had the opposite effect with devastating consequences for the TES market in California and the US. Failure to implement TES has resulted in missed opportunities to improve the reliability of the California energy supplies and to delay or avoid the need for and cost of new electrical generation and transmission capacity. Failure to implement TES has resulted in missed opportunities to mitigate air pollution and climate effects associated with fossil fuel used to generate electricity. Finally, this failure has damaged companies that invested in perfecting TES technology and resulted in a loss of associated economic activity in the State and country.

These facts are supported by the specific experience of Cryogel as a participant in the thermal storage market.

4. Background and Actual Experience in a Shrinking Market:

By way of background and actual experience with the history of thermal storage, Cryogel introduced Ice Ball™ thermal energy storage (TES) equipment in California and the U.S. more than 17 years ago. The product received worldwide market acceptance due to simplicity of concept and flexibility with respect to practical issues of performance, installation, operation and maintenance.

Cryogel Ice Balls are 4” diameter plastic spheres filled with water. Energy is stored in ice using low cost electricity at night to freeze Cryogel Ice Balls. Cool energy is released the next day for air conditioning or process cooling. Cryogel thermal storage systems produce energy cost savings and environmental benefits by using low cost off-peak electrical energy. More than 20 Million Cryogel Ice Balls have been supplied to schools, hospitals, airports, office buildings, churches, senior & retirement facilities, government offices and industrial plants which translates to a shift of approximately 32 mW of peak electrical demand.

The concept and product are simple. Indeed, few engineers or system designers will argue the fact that simplicity in system design is key to holding down costs while insuring ease of operation and improving reliability. Design flexibility allows the Cryogel Ice Ball to be used in nearly any type of storage tank: steel, concrete, fiberglass, atmospheric or pressurized; above grade or buried. The Cryogel Ice Ball is one of the most thoroughly tested thermal storage products on the market today, including independent laboratory testing of performance and durability.

Cryogel began manufacturing ice thermal storage products near Los Angeles, CA in 1991 and enjoyed rapid growth and profitability within the first 3 years of operation. That early success, and economic benefits shared by associated design engineers, installing contractors, ancillary equipment suppliers and building owners, can be traced directly to the incentives and time-of-use (TOU) rates offered for thermal energy storage during the early 1990's.

During the early 90's, more than a dozen companies offered competitive products in a growing TES market. However, by the late '90's, many of the utility incentives had been retracted and many time-of- use (TOU) rates had been "flattened" by reducing the differential between the price of "on-peak" and "off peak" electricity. As the economic incentives and energy cost savings available to end users evaporated, the TES markets began to contract. As a result, only 4 or 5 of the companies from the early 90's remain actively involved in the business today. By 2003, market statistics show that the sales of TES equipment diminished to about 33% of their 1993 levels. Statistics show that sales of TES in California by 1997 were less than 25% of the level achieved in 1993. By 2003, Cryogel revenues fell to less than 30% of the levels posted on average between 1991 and 1995. Current market statistics are not readily available because in this decimated market, TES companies have ceased pooling market statistics which, in our opinion, had become a pointless and frustrating exercise.

Rather than repeat the economic analysis provided in the Transphase Protest and spreadsheets, we point to the obvious relationship between contraction of the market for TES and the loss of economic incentives and proper TOU rates. Common sense economics dictates that end users will simply not purchase and install equipment with returns on investment at levels as low as those resulting under current rate structures and TES program offerings. The rates and programs being proposed for the future offer more of the same and promise more of the same dismal results.

5. Economic Benefits Lost:

In the case of Cryogel, the company would have also failed if not for our ability to transfer technology to foreign countries and generate revenue by licensing others to manufacture our product. Since 1996, Cryogel's manufacturing licensee in Malaysia has reported more than a 50% market share in that country and our licensee in China is now manufacturing and installing systems in that expanding market. Foreign licensing fees and royalties have returned to Cryogel in California and have saved the company from insolvency. However, the economic benefits associated with designing systems, installing the hardware, the value of ancillary equipment including tanks, piping, pumps, chillers, controls, etc., have been lost to foreign engineers, contractors and manufacturers.

During my last visit to China, I was invited to address a large group of electric utility managers, electricity rate designers, academics and business leaders regarding the environmental and economic benefits of thermal storage. The basis of my presentation was the California Energy Commission Report mentioned earlier. The Chinese acknowledged the benefits of TES as matters of engineering common sense and proper government policy toward addressing energy shortages and the well-known air pollution problems in that country. However, when they asked about the size and growth of the TES market in the US and in California, I was embarrassed to admit that the same common sense concepts were not being implemented effectively in California or the US and that our market had been shrinking for the past 10 years. The reaction was a predictable scolding about the wasteful energy practices of Americans and suggestions of hypocrisy. Ironically, systems being installed in most foreign countries include US made TES devices or products based on technologies developed in the US and proven in California.

Reduction or elimination of incentives and flattening of TOU rates have had a devastating effect on the market for TES in California and the US. Failure to implement TES has resulted in missed opportunities to improve the reliability of the California energy supplies and avoid the need and cost of new generation capacity. Failure to implement TES has resulted in missed opportunities to mitigate air pollution and climate effects associated with fossil fuel necessary to generate electricity. This failure has damaged or ruined companies that took substantial risks by investing in the development of TES technology and has resulted in a loss of associated economic activity in the State and country.

6. Legislative Intent:

Members of the thermal storage business community also invested in working with the California Legislature to clarify Legislative Intent and to help stem the negative trends described above. Legislative intent as to shifting peak electrical demands associated with air conditioning loads, and the rate structures needed to encourage peak shifting, is well documented. TES technology is directly responsive to Legislative direction and intent.

Senate Bill 1790 (Senator Debra Bowen, D-Marina del Rey), explains that, *"It is the intent of the Legislature that the state establish cost-effective load control programs for residential and commercial air-conditioning systems" …. "The legislature finds and declares" that, "(a) Air-conditioning load constitutes 28 percent of California's peak electricity demand, the largest single component of electricity demand", and, "(b) Reducing peak load of, and implementing load control for residential and commercial air-conditioning systems by the state's electrical corporations can achieve a significant reduction of California's peak electricity demand in a cost-effective manner."* SB 1790 provides for development of air-conditioning load control programs as part of electrical service offerings as means *of "contributing to the adequacy of the electricity supply and to help customers in reducing their electric bills".*

Senate Bill 1976 (Senator Tom Torlakson, D-Antioch), described by the Legislature as *"an urgency statute",* addresses electricity rates head-on by directing the Public Utilities Commission to report back to the Governor and Legislature no later than March 31, 2003 regarding real-time pricing and metering. The logic of SB 1976 is clearly in line with the thermal storage industry noting that*, "Californians can significantly increase the reliability of the electricity system and reduce the level of wholesale electricity prices by reducing electricity usage at peak times."*

In the current economic climate, TES offers a unique opportunity for market forces to accomplish the goals of SB1976. Rather than placing demands on general funds, incentives, peak demand charges and proper TOU rates reflective of energy costs can be a sufficient incentive for architects and engineers to incorporate TES systems and for building owners to realize reasonable returns on investment.

Quoting from SB 1976*: "Electricity consumption for air conditioning purposes during peak demand periods significantly contributes to California's electricity shortage vulnerability during summer periods".*

TES focuses precisely on afternoon air conditioning loads. In fact, air conditioning loads can consume up to thirty percent of a facility's electricity demand on hot summer days. TES uses energy at night during off-peak hours to store cool energy and then provide cooling the next day during periods of peak demand. Shifting loads with TES is a cost competitive alternative to new generating capacity, thereby improving reliability of the electricity system while avoiding expensive construction of new power plants with related environmental impacts.

Senate Bill 1389 (Senator Bowen) states that*, "the government has an essential role to ensure that a reliable supply of energy is provided ... ". This law requires the California Energy Commission to report every two years and to, "use assessments and forecasts to develop energy policies that conserve resources, protect the environment, ensure energy reliability, enhance the state's economy and protect public health and safety."*

The legislation calls for an integrated energy policy with public interest strategies including load management and reduction of statewide greenhouse gas emissions.

In addition, in 2002 California voters approved a major school bond including funding and incentives for equipment to improve energy use patterns and to shift peak electrical demand. The school bond was historic for its first-ever inclusion of funding for energy efficiency and energy cost reduction components. A common thread in all the legislation is an emphasis on public benefits for Californians including improved reliability of electrical supplies, reduction in overall energy costs, new job creation and positive environmental impacts. California legislation and bonds demonstrate support for thermal storage and suggest a model for legislation in other states.

Quoting from SB 1976: *"It is the intent of the Legislature to promote conservation and demand reduction in the State of California."*

7. Thermal Storage and Other Energy Solutions:

TES is capable of substantial contributions to demand reduction goals while conserving energy as documented by the California Energy Commission. Solutions for peak electrical demand problems in California and the U.S. include new electrical generation capacity and peak shifting with off-peak thermal energy storage as well as conservation and renewable energy technologies. However, in terms of large and near term reduction of peak electrical demand, thermal storage has definite advantages especially when compared to the construction of new power plants.

- Thermal Energy Storage is Available Now - not 2 or 3 years from now.
- Thermal Storage provides an overall reduction in the use of fossil fuels.
- Thermal Storage provides an overall reduction in air pollution.
- Thermal Storage makes most effective use of existing generation and transmission infrastructure.

Building and operating new generators and transmission lines is expensive both in terms of first costs and long term environmental impact. Spending millions of dollars to enable the continued inefficient use of power plants and the generation of ever greater amounts of air pollution is counter productive. A better option is to use existing capacity and transmission lines more effectively and in a way that reduces overall environmental damage. Using lower cost electricity during off-peak (nighttime) hours is not the complete answer but it is a practical and immediate solution to problems of peak electrical loads. The technology and equipment for storing energy at night to provide low cost air conditioning during the day has been proven over the past 20 years. Air conditioning represents the largest single use of electricity during summer months in most parts of California and the U.S. Shifting electric loads for air conditioning with thermal energy storage is equivalent to building new power plants and new transmission lines with important economic and environmental advantages. Thermal energy storage provides one means to mitigate the uncertainty and speculation as to future energy prices.

8. Conclusion:

This testimony is offered in support of the Transphase Protest and proposals with regard to rate design, incentives and a Standard Thermal Storage Offering. Without meaningful and positive changes such as those proposed, the opportunities flowing directly from TES to enhance California's energy reliability and security, improve and protect the environment, and generate much needed economic activity will be squandered once again. We hope this testimony and background information is helpful and constructive.

Respectfully Submitted,

/s/ Victor J. Ott

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Cryogel

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November 20, 2008

Witness Qualifications of Victor J. Ott, P.E.

President of Cryogel - San Diego, CA

Manufacturer of Ice Ball Thermal Storage Equipment - Since 1990

Mr. Ott has 25 years of experience in the field of thermal energy storage including research and development, system design, installation, testing, marketing, manufacturing and development of industry standards.

Chairman - ARI Thermal Storage Equipment Section 1996 - 1998

Member - ARI Thermal Storage Section Engineering Committee responsible for industry test standards, 1993 - 2004

Professional Engineer - Licensed in California

U.S. Patent Holder - Clathrate Thermal Storage Device - 1988

ASHRAE Technical Committee Member: TC 6.9 - Thermal Storage

Mechanical Engineer - BSME, University of Nevada - 1973

Masters of Business Administration - MBA, University of Santa Clara - 1978

Honorary Society of Business and Commerce - Beta Gamma Sigma

California Governor's Advisory Board for Affordable Housing - California Appropriate Technology Program

Chief Financial Officer, Exec. VP, - Thermal Energy Storage, Inc. 1980 - 1988

Responsible for all aspects of publicly traded company including SEC Reporting.

Design Engineer – Bechtel Corp., San Francisco, CA 1975 - 1977

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Southern California Edison Company for Approval of Demand Response Programs, Goals, and Budgets for 2009-2011	)	Application 08-06-001 (Filed June 2, 2008)
Application of San Diego Gas & Electric Company for Approval of Demand Response Programs and Budgets for 2009-2011	)	Application 08-06-002 (Filed June 2, 2008)
Application of Pacific Gas & Electric Company For Approval of Demand Response Programs and Budgets for 2009-2011	)	Application 08-06-003 (Filed June 2, 2008)

Transphase's Exhibit C

Testimony of Klaus J. Schiess, P.E. In Support of a

Thermal Storage Standard Offer

SUMMARY

My name is Klaus Schiess and I am president of KSEngineers, a one man engineering firm which I started in 1987. I am a totally independent engineer with decades of energy and energy cost savings experience. I have no affiliation with any manufacturer and have always guarded my independence. I have also worked on two other continents and have always thought that America is at the forefront of everything. I took like fish to water when TES started to make inroads in the early eighties. Yes, this is the answer to electricity storage. Then something happened that is still a mystery to me.

From my white hair, one can see that I cannot have any selfish long term plans by trying to improve the conditions for or promote Thermal Energy Storage. It is purely that I am frustrated that this technology is not at the forefront of our energy policy. If I can make a slight difference even at this late stage, it would give me personal satisfaction that I may have contributed my little share to something that benefits society and helps the environment.

1. HISTORY

Personal History

My whole professional career seemed to evolve around the recurring theme of demand shifting applications.

My first job after graduating was in Switzerland working for Escher Wyss in the early sixties, a leading hydraulic turbine manufacturer who just started developing pump turbines for the then upcoming potential market for pump storage systems. Switzerland is known for its pump storage systems that pump water up the Alps during the night to let it come down during the day when the grid peaks. Overall efficiencies can reach 80%.

Then later in South Africa, which has no oil or natural gas resources and in addition was boycotted during that time, was forced to solely rely on coal fired electrical power plants. Therefore, even heating was electric resistance heating. I designed the largest hot water storage system in the country for a metallurgical laboratory complex in 1976, which required a lot of outside air. Thus on a cold winter morning the demand rose to such levels that the electrical design engineer had a fit and we resolved the issue by spreading the load over 24 hours to bring down the peak demand utilizing a hot water storage tank.

When I came to the USA in 1978 I was enthused to see that thermal energy storage for cooling started to make its entry. Electrical load shifting was right up my alley and I soon got involved with energy conservation and Thermal Energy Storage (TES) for cooling. I was convinced that within two decades there would hardly be a chiller-based air conditioning system built in the USA without applying this relatively simple technology.

Millions are spent on finding a battery that can store large amounts of electrical energy. Until such time as somebody invents such a battery it is obvious that America with the high air conditioning loads is the ideal place for TES, produce the “coolth” at night when it is cheap and the grid load is low and cool the buildings with the stored cooling energy during the day. It is a nearly 100% efficient process and the energy is stored right at the site where it is produced and used up, relieving the electrical distribution system at the same time.

In the eighties the utilities fully supported this new approach with rebate programs and promotional material. I was soon involved in feasibility studies that looked at TES for new projects and retrofit projects. As each project is usually unique, it was necessary that consulting engineers should become involved and familiar with all TES technologies, which are basically split into three categories.

2. TYPES OF TES

<u>Chilled water storage</u>

The idea is to store chilled water, which requires large but relatively cheap tanks. Various ways were developed to ensure that a constant temperature difference could be maintained. In the end a vertical tank utilizing the stratification effect became the most economical method. As there is no phase change of the cooling media is involved it is called sensible heat only.

<u>Ice Storage</u>

An alternative way is to utilize the latent heat effect of a phase change of liquid to solid. As water is abundantly available and in addition has the highest phase change energy requirements of any liquid it is a good opportunity to make ice at night and then melt it during the day to cool the building. Ice storage however introduces new aspects such as an ice machine is required involving temperatures about 10 degrees below freezing.

Various methods of ice making developed such as ice harvesting, encapsulated ice or ice freezing on coils or tubes or even on plastic panels that originated from the solar heating industry.

<u>Eutectic Salt</u>

A mixture of substances were developed to try to get the benefit of the two above described systems into one, meaning that ice making chillers and the lower temperatures could be avoided yet the benefit of the latent heat principle could be reaped. Transphase developed the eutectic salt system with a melting/freezing temperature of 47 degrees. Therefore, normal chilled water chillers could be used and the storage tanks became considerably smaller than for chilled water due to the latent heat storage of the eutectic salt.

4. THE HAYDAYS OF TES

In 1983 I moved to San Diego and took like a fish to water. SDG&E and other California utilities heavily promoted TES with sharing in costs for feasibility studies

Late 1980s were the "heydays" of TES for the following reasons:

Rate schedules were favorable for TES by differentiating between day time and night time energy costs

On peak demand charges reached $25/KW

Even a special Super-TOU rate was created by SCE to promote TES which introduced a 4 hour on-peak window to keep storage capacities lower and with it initial project costs.

Utilities provided Rebates up to $300/KW shifted
Utilities offered free or 50% assistance for TES studies
Utilities offered special TES Seminars
EPRI developed "COOLAID" software for Utilities to explore and to assist in the evaluation and design. I was personally involved with assisting with the development of that DOS based computer software.

KSEngineers had a high ratio of feasibility studies actually developing into projects, some of them under my design.

5. THE DECLINE OF TES

After a few years the interest and assistance of the utilities started to wane. There were unfortunately some teething problems and especially one particular manufacturer caused a lot of damage to the industry when those systems did not perform and large lawsuits were filed that could have dampened any enthusiasm for the utilities to stay involved with TES.

There was also the impression given that the trend of the electric rates was going towards Real Time Pricing (RTP). Metering technology would facilitate this methodology of charging customers rates that were a true reflection of the real cost to produce the power.

KSEngineers was actually commissioned to do a study on the effect of RTP on TES. PG&E had a test site where this experimental rate was applied. As a result I published a paper, which was also presented at one of the annual World Energy Congresses. **"The Effect or Real Time Pricing on TES"** published in 1995 is actually today still totally up to date. The conclusions reached were that RTP would greatly promote the feasibility of TES perhaps even more so than the normal time-of-use (TOU) rate structures.

With the onset of deregulation or the split into electricity providers and transporters a definite trend became evident in the fact that rate schedules started to eliminate the difference between on peak and off peak charges per KWH as well as lower the demand charges. The rebates disappeared and it seemed everybody started to lose interest in demand shifting.

Representing the building owners, engineering consultants and designers are on the receiving end of rate structures, and we have to provide tools to calculate and predict the costs of any changes that a project would yield. This is no easy task because there are so many different utilities with each one having their own numerous rate schedules that as an outsider are difficult to explain. The impression is gained that rate design is a special breed of calculators that cannot see the forest for the trees, or I would even go further, they cannot see the beach for the grains of sand.

Again, as an outsider to the thinking process of utilities I could not decide if the rate and incentive designers knew what the changes they made did to TES, whether they actually cared or may be if it was intentional.

Reasons for the decline and why TES could not sustain itself.

No investor will risk capital if there is not a potential to get rewarded for the effort. One of the major problems is that TES does not save energy at the site or very little but it saves at the source. The source and the distribution are in the hands of the utilities. Electricity is a monopoly that is regulated by a public commission.

The market is too small or too small to afford an effective lobby. Chiller manufacturers associated themselves with certain manufacturers of TES equipment but the real reason was not to boost TES, it was more to not miss out in marketing and selling of chillers.

But the fact was that it got difficult to develop projects that had an acceptable pay back period. By 1994 a collaborate of concerned professionals in the energy conservation industry was formed to try to stem this trend. We all could not understand why this proven effective demand shifting opportunity started to become a wall flower and was not invited to dance anymore.

6. CALIFORNIA ENERGY COMMISSION

The collaborative worked out a white paper that the CEC published as their report that clearly defined all the benefits of TES to the State and to the Nation. Some of the main statements are repeated here:

In 1995 the CEC stated and confirmed that:
"TES is an energy technology offering compelling energy, environmental, diversity, and economical development benefits to California." (CEC TES Systems Report P500-95-005 Page 51)

"TES is the best tool a commercial facility manager has for managing power costs under Real-Time Pricing, which the California Public Utilities Commission has proposed as the dominant type of pricing in a deregulated competitive electricity industry." (CEC TES Systems Report P500-95-005 Page 6)

The report estimates all the potential savings in reducing California's peak demand and the associated pollution reduction. Clearly it was concluded that TES benefits the State and the Nation. Certain legislation was past that required utilities to encourage demand shifting opportunities.

That was 1995. We are now going into 2009. What has happened? Why have we wasted 15 years of valuable time to utilize the "best battery money can buy"?

7. RELIABILITY OF TES SYSTEMS

7.1 Technical Reliability

Like with any energy conservation measure it takes some input to achieve savings. Unfortunately with mechanical things it is not quite as easy as changing a light bulb. Chillers have to run now at night but with our vastly improved control technology with remote warnings etc. things have become a lot more user friendly than just ten or twenty years ago.

I have personally designed TES projects of all three types chilled water, ice storage and eutectic salt systems that are still in use today after nearly 20 years of operation. Many of them are still in operation today. I try to stay in touch with "my children" but owners change or operators change and they then deal with their own advisers if any.

There have been some problems with some installations but they really had nothing to do with the technology. It was sometimes bad quality control, bad designs, and neglected maintenance or control sequences being changed. But that happens to any machinery. TES is a technology that works and if maintained and controlled properly delivers what it is planned to do.

Over the years I have had many trouble shooting consultations, they were mainly due to human lack of interest or misconceptions. But again this happens in any technical field. Right now I am in the process to provide consulting advice on what to do for two ice systems that are still operating but may need to be replaced with new, abandon them and replace with new chillers or try to hang on until the TES renaissance is happening.

3.2 Economical Reliability

Like with any energy conservation and energy cost savings measure there is no free lunch. It takes upfront cost to achieve savings. It is always a compromise.

The past history of the utilities in guaranteeing the economical long term feasibility to invest in TES has been badly shaken by the mere fact that the rates have smothered the economical reliability of TES. The disappearance of incentives also contributed to the fact that the TES market slowed down considerably. The savings potential was just too little for investing in new TES projects or even retrofits.

Owners are discouraged when they find out that rate structures have changed in such a manner that the savings are progressively reduced. As an example, about two years ago SDG&E switched the on-peak demand charge from approximately $12 down to $5, but at the same time increase the NTR demand from $5 to $12. Nobody realized this except a TES expert. I had to inform the owners that as a result the monthly summer savings potential has been reduced by $2,000 for a TES system of about 1,500 ton-hours. Why? The new highest demand now that gets hit with the $12 demand charge is the 15 minute interval just before the on-peak period. The shift that was originally worth $12 has now been de-rated to $5.

In an attempt to reduce this damage and salvage some of the savings potential, completely new control methodology has to be introduced. In stead of on-peak shaving, which shuts down chillers at a certain time, a control strategy has now to be implemented which makes use of load leveling techniques. This is a much more complicated process as the building electrical load profile comes into play with the TES sharing cooling with the chillers at the same time.

8. FEASIBILITY

TES projects are totally dependent on a favorable rate structure or incentives in the form of rebates or tax credits. Hospitals, schools, universities, office buildings, manufacturing facilities all use chilled water systems that make a TES system feasible if and only if: SHOW ME THE MONEY. That applies for new projects but even the retrofit market could contribute tremendously to a State wide reduction in peak demand loads.

I have been named the "Moses of TES" as at one ASHREA conference I gave a presentation where I introduced "The Ten Commandments of TES". Here the first two.

<u>First Commandment of TES</u>:

There shall be a Rate Schedule that makes the extra effort and

cost to implement a TES project economically feasible.

<u>Second Commandment of TES</u>:

There shall be some financial incentive in form of rebates or tax credits

to make TES economically feasible.

Basically, it has to be realized that TES is intricately linked to rates and incentives that can make it feasible or not. Or alternatively it is the rates that can kill a good thing. The same thing is being realized in the electrical solar industry where it is found that photo voltaic projects do not realize sufficient savings because the high non-time related demand charge is hitting the bill in the morning before the sun can produce sufficient power.

9 PAST PROBLEMS WITH THE UTILITIES

9.1 <u>The infatuation of the utilities with demand response programs</u>

In recent years it has become more than apparent that the utilities are very much interested in shifting demand during peak periods. Energy conservation measures obviously contribute to it but it is not enough. Unnecessary loads need to be turned off. And of course attempt to try to shift load from on-peak to off-peak. Well, as it is, the giant economical rechargeable battery does not exist yet. In the mean time there is the storage of potential energy (pump storage systems) and thermal energy storage systems that do a good job all over the world.

The utilities are offering programs that reward demand shifting but only during the time that it suits the utilities. That means only during the time that the grid is in trouble.

The public is now offered programs via aggregators that reward the user if they reduce load in any fashion during the peak period but only if the grid is in trouble . If, however, the user has found a successful demand shifting measure and thinks that is a good idea to do it permanently, then hey wait a minute! The utilities will punish you for doing something good all the time. No, we want you to shift only when it suits utility. So the program only rewards the shift is achieved against the load profile of the five previous workdays.

This is a contradiction in itself unless there are other motives involved that are generally not known. Until I know what they are I maintain that:

Demand response programs are like taking a pill when you get a headache. Do PLS like TES and you won't get a headache.

It got so far that account representatives of a utility went around their customers who still had functional TES systems and advised them to use them only as a demand response program.

9.2 Experience with Demand Response Marketing

KSEngineers has been employed by an aggregator to assist in finding demand response opportunities with potential clients that show interest in signing up. A visit to the facility usually ended up in finding relatively little to do without some heavy investment. The result usually was that it is not worth the trouble. My experience so far is that it is going to be very difficult to sign up enough reliable load shift.

However, what I found is that there is plenty of opportunity to do some real load shifting on a permanent basis if some improvements are made however they needed some experienced engineering to develop. The moment we talked about them, there was interest but who is going to pay for the project development and the feasibility thereof?

Funds for Technical Assistance (TA) reports were not available anymore. The latest development is that the client cannot choose their own engineer or consultant to do any TA work, it has to be done by a utility selected consultant. Therefore, I as an independent consultant cannot provide the same services for free, on the contrary I am now forced to compete against free services. I have lost many potential jobs because of that.

9.3 The sad cases of this Engineer having to nix TES Projects

9.3.1 Prison

A prison located in desert climate proposed to add a chilled water storage tank of considerable size to shift of close to 1000 KW from on-peak to off-peak. KS Engineers was appointed to evaluate the proposal from an ESCO company.

KS Engineers soon discovered that this was a typical proposal to get a project going with very flimsy cost savings calculations. The rates at the time did not even have any difference between on-peak and off-peak. The utility promised to adjust the rate structure once the project was implemented and offered a 2 cents/KWh difference with no demand charges. The incentives were not really worth talking about.

Now if you are well versed in this business, you are going to laugh loudly.

9.3.2 Large University

A large technical university had already done the design for a large chilled water storage tank under their baseball field. It was a $7million project. KSEngineers was required to do a peer review. I soon discovered that the rates onto which the feasibility study was based had changed considerably and that the 6 year proposed simple pay-back period had now changed to about 25 years. The University decided to shelf that project. The main reason was that a NTD charge had been silently added as well as a ratchet clause of a year that alone nixed the first years' savings.

When I called up the utility and asked them if they were in the business of providing $800,000 rebate for a 25 year payback TES system they said no way of course. When I told them that with their rate change they had done that and just killed the project, the account rep told me that she would have to talk to her supervisor.

T appears that those rate designers could not see the Relationship between NTD and On-peak demand. It appears that rate designers have no clue what they are doing to the outside world. They just see their own world and bottom line rules. They can't see the forest for the trees, no a tree is a good thing, they are worse, they cannot see the beach for sand grains**.**

9.3.3 Gas cooling SCE nixes hybrid project (City of West Covina)

KSEngineers developed a unique project for a police station in a City in SCE territory that involved utilizing a gas engine driven chiller that would produce cooling during on-peak periods. But at the same time we could also use it as a generator in case of a power failure. As this was going to be an experimental project the manufacturer guaranteed that after one year of close monitoring, the City could either buy the unit that was to be installed for free or give it back.

Now it is a known fact that it is a lot easier to implement a hybrid system in a utility territory that is served by a "Gas & Electric". I did not know that I would land up in a hot political battle between two sides consisting of the mayor and some council members and some councilors under the leadership of an employee of SCE who managed to squash the project. I was verbally attacked at the City Council meeting by that account representative of SCE when I suggested that as an employee of SCE he should recuse himself from voting.

10. WHAT DOES IT TAKE TO ESTABLISH TES AS A PERMANENT LOAD SHIFTING APPLICATION

<u>Rate Design Research</u>:

Provide a rate schedule that guarantees the demand charges and the on-peak off-peak difference for at least 10 years but guarantees the utilities the necessary income that other rate schedules provide. May be California needs a "Green Rate Schedule" that promotes TES, Solar

Power and Wind Power.

The rates can go up and down with the market conditions but **the differences** must stay constant. This needs cooperation with the major utilities and probably government input to achieve cooperation.

Incentives, Rebates and Tax Breaks

If the rate schedule is made attractive enough, no further financial incentives like rebates etc. are needed after a few years of kick starting the process again with rebates or tax breaks.

Education

Some State sponsored institution must offer educational programs to educate the potential investors and the engineers necessary to produce feasibility studies and eventually design and implement the project.

11. A DECADE OF PERSONAL FRUSTRATION BY PERHAPS AN IDEALIST

Ten years ago I gave a presentation at the Western Conference of the Association of Energy Engineers at Long Beach and called it: "TES at the Crossroads". I then followed it up with an article that got published in the AEE's "Strategic Planning for Energy and the Environment" (Vol 18, No. 4 – 1999). It gives my thoughts at what should be done to follow what the California Energy Commission report reported and with its publication attempts to contribute to the welfare of the State of California.

Personally, I do not understand what the reasons are that we as progressive Americans have let things slide so badly that this needed demand management opportunity has been neglected if perhaps not kept on the backburner on purpose. We have a public utility commission that has to keep a watchful eye on the monopoly of the electrical supply to the State.

After witnessing the trend in rate design and the flipping of on-peak demand with non-time related (NTD) demand charges one cannot help to come to the conclusion that the rate design is so grossly self indulgent that they have no idea what they are doing to any of the industries like TES or the photovoltaic and wind power industries even perhaps gas cooling. These demand management opportunities need a rate schedule to make them economically feasible.

Here are my perhaps naïve thoughts on what is needed:

A simple rate structure, preferably state-wide to ensure that these industries can overcome the initial capital investment and allow economically feasible projects. The rates must reflect the difference in cost between on-peak and off-peak Of course the rates may vary up and down according to the market, but the difference must be guaranteed for at least a 10 year period.

If Real Time Pricing reflects the real cost of electricity to be produced then let it be RTP and as far as I can gather from my past experience, TES will have a chance to flourish and make the contribution to society it should have done already for decades.

12. CONCLUSION

Dear CPUC:

Google talks of developing a smart electrical grid. Everybody is starting to realize that something has to be done. TES uses electricity on a site when it suits the grid. It relieves the grid during peak time. What more do you want, the storage is happening right there at the site. It does not only even out the load profile, it also helps to improve the efficiency of the grid. Just like, I am sure you agree, it is a lot easier to drive at night when there is no traffic.

Now is the time to act and make up the time lost. It is in your power. Rate design is not rocket science, it just needs the will from all parties for it to be done.

13. APPENDIX

Copy of the article "TES at the Crossroads" on following page:

Respectfully submitted,

/s/ Klaus J. Schiess

Klaus J. Schiess, P.E.

November 21, 2008

THERMAL ENERGY STORAGE (TES) AT THE CROSSROADS[26]

November, 1999

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INTRODUCTION

Thermal Energy Storage (TES) or off-peak cooling as the technology is also called is at a crossroads. Deregulation will bring dramatic changes to electrical rate structures that will impact TES more than any other load management technology. Predictions from crystal ball gazers vary from one extreme to the other. Some say that the industry is going to die, others expect a rapid take off. Generally, most experts predict that deregulation will bring higher on-peak costs and lower off-peak costs. If this is true then TES is not only going to survive but actually prosper.

The progress and popularity of TES has been much slower than expected. Although the technology is nothing new and uncomplicated in itself, it is surprising how many problems have clouded the success stories. In this paper we postulate that with a paradigm shift in the pricing of electricity from the "off peak" / "on peak" universe to a real time, the stage is set for TES to finally payoff through demand shifting resulting in significant cost savings.

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[26] Published in "Strategic Planning for Energy and the Environment" Vol. 18, No.4. 1999 under the title "Demand Shifting will boost TES"

TES CHALLENGES

The focus of most industry research in recent years has been on operating strategies and in designing control sequences. For instance, in the "Background" paragraph of the work statement for 1054-TRP of ASHRAE's Technical Committee TC 6.9 the following statement appears:

"THE REAL NEED IS TO DEVELOP A COMPREHENSIVE SYSTEM FOR ACCURATELY DESCRIBING AND PROPERLY SELECTING AN OPERATING STRATEGY FOR A GIVEN SYSTEM."

This statement of industry leaders in this field of technology brings to our attention the fact that we are in need of more information. The root cause of the problem is a lack of communications between various entities to implement TES solutions. Each party has its own agenda and along the way they often lose sight of the fundamental objective.

TES Playing Fields

There are many variables which affect TES systems. Each TES system is an entirely separate entity due to its size, type of equipment, load characteristics, discharge characteristics and rate schedule.

* **Rate Schedule:** The "first commandment" for TES systems: Thou shall have a rate schedule that allows to save energy costs by using TES. Without a rate schedule that differentiates between on-peak and off-peak rates whether it be in the form of energy costs or demand costs, a mixture of the two or just plain real time pricing, there is seldom justification for making plant operation more difficult with additional equipment and a multitude of control sequences.

  Utilities have created rate schedules that compensate them for the actual costs to produce electricity under the watchful eyes of some commission representing the public. The utilities overall electrical load profile will dictate the rules and rates under which TES operates to achieve savings that benefit the user. Therefore, TES systems are subjected to on-peak windows ranging from 4 hours to 14 hours to suit the requirements of the utility. There are on-peak, mid-peak and off-peak hours, demand charges and even maximum or non-time demand charges. To complicate matters even more there are ratchets and tier systems.

* **Load Profiles:** In most TES applications the load profile varies considerably from season to season and usually on a daily basis as well. The load shape also varies from project to project. As mentioned above, the customary approach has been to satisfy peak conditions and the job is done. TES has to adjust to every variable for optimal performance, resulting in more complex control strategies. Especially partial storage systems need closer attention to ensure that the storage capacity is not depleted too early, i.e. before the end of the on-peak demand period.

TES Team Players

* **HVAC engineers** are used to design for peak conditions and assume that the system will function at any load lower than that. It is considered to be the problem of the operator to tweak out maximum efficiency from the system. Therefore, engineers think their job is done.

* **Manufacturers** deliver the product, if it satisfies design conditions, job is done.

* The **Automatic Control Contractor** makes sure that the system functions according to the control modes that were specified. The control contractors are often in a tough situation, because they are expected to "fix" the system if there are any problems, commission it as they go along, smooth over any problems that may occur whether it is of their making or not. Control contractors know what to deliver and how to control, but they need to be told why. In other words they speak controls but do not necessarily "speak TES". If the three or four modes work that, hopefully, were specified, then job is done.

* The **Contractor** considers his job as done once all the equipment is installed.

* The **Owner** buys a complete system and expects that it will produce the savings as predicted or promised. Understandably the owner expects TES to work, just like replacing a light bulb with an energy efficient one.

* **Operators** are usually suspicious of something that makes their work more complex but they have to go along because it is expected of them. If they are lucky they get a few hours of training from the control contractor. This is equivalent to learning to drive a car. After a few starts and stops you get your drivers license. Job is done.

With all these variables and players it is not surprising that after so many years of TES experience, industry societies are still attempting to *"develop a framework for describing and characterizing cool storage operating and control strategies"*. We have not yet even managed to clearly define "full storage". To some it means full shift of the whole daily load. To others, it means shift of all load during the on-peak demand period. Obviously with the on-peak windows varying from 4 hours to 14 hours these definitions can become blurred.

So what went wrong? Once you have a drivers license you are surely not considered a professional driver with experience in fuel economy and good road sense. In other words, I would like to plagiarize a well known proverb about happiness and change it to:

TES IS NOT A DESTINATION, BUT A WAY OF TRAVELING

DEREGULATION - Effect on TES

With deregulation it is inevitable that the concept of REAL TIME PRICING (RTP) is entering the electricity market. After having completed a TES study comparing time-of-use and real time pricing rate schedules this author presented a paper "The Effect of Real Time Pricing on TES Systems" at AEE and IDEA conventions. This article was also published in "Strategic Planning for Energy and the Environment" and was also accepted as a poster presentation at the MEGASTOCK conference in Sapporo, Japan in June 1997.

For the TES study with RTP I soon realized that calculations ideally have to be done on an hourly basis for each and every day. This is obviously a cumbersome approach with 8,760 hours a year and possibly the same number of hourly prices.

Since the study however, I have come to realize that RTP and deregulation could be a blessing in disguise for TES. The dark clouds on the horizon promise even more rate schedules created by the new ESCO, ESP companies who will now create new rate schedules to convince any potential client into believing that they are getting electricity at a better price than before or from their competitor. How is TES going to adjust to this flood of rate schedules and the new ground rules that complicate things even more?

Current Software is inadequate

The HVAC industry has been geared to designing the chiller capacity to satisfy peak conditions. All software programs in the HVAC field were developed to find the peak cooling load. It was later on when energy conservation became more important that computer programs were upgraded to include conditions on an hourly basis all year round. These programs have become quite sophisticated and thus more difficult to use. In my personal opinion the results are often too theoretical and sometimes when one studies the results more closely, old Hollywood comes to mind: "Any similarity with real life is purely coincidental".

Design engineers who had the courage to take TES more seriously prepared their own spreadsheet type of software to assist them in calculating energy and cost savings. From my personal experience it was the software this author developed that gave him the versatility to be effective in the application of TES. Some of these ideas were subsequently integrated into the COOLAID program developed by EPRI.

COOLAID was developed to assist utilities in analyzing and developing sufficient information to interest their clients to consider TES seriously. It is not known how many engineers used it eventually as their design tool. The input allows for hot days, workdays, cold days and nonwork days. The operational sequence is only defined by the peak condition. For more accurate calculations it should be possible to input operational sequences for the other loads as well.

COOLAID is DOS based and may have become somewhat outdated in today's window based computer world. Some manufacturers developed their own software which, of course, is equipment and proprietary orientated.

The Department of Energy has developed various versions of DOE energy conservation programs. TES eventually found its way into the later versions but fails to adequately address TES application needs.

GREAT OPPORTUNITY

Deregulation forces new rules into the TES game. It is, therefore, time for a fundamentally new approach. What is the driving force that dominates studies, cost savings calculations, design and control sequences of TES? MONEY of course. TES must reduce operating costs. By using a totally new approach it is possible to reform TES strategies to be ready for the worst case scenario (given by RTP) and thus cater for any rate schedule that has thus far been developed.

If we accept the challenges which operators are facing, we must look at TES operating strategies on a daily basis with hourly increments (or even less if the rates so dictate) and everything will start to take on a new look. If we can develop a tool that allows us to calculate optimum performance on an hourly basis, every other rate schedule will fall into this mold. Actually, "conventional" rate schedules will then simplify calculations by being repetitive to some degree.

SOFTWARE BASED ON PRACTICALITY AND SIMPLICITY

If we have software that calculates the optimum method of producing the required cooling under given constraints of a load profile and rate structure, we can then derive the operational strategy for optimum savings for that day. The TES industry needs a software package that can be used by operators and engineers alike. Operators must be able to get a control sequence on a daily basis if RTP is involved.

KSEngineers intends to fill this gap and create an Off-peak Cooling Software for the 21st century. Deregulation provides the opportunity for us to define a new approach which satisfies future requirements and which at the same time corrects the deficiencies of the past. The intent is to develop a simple computer program for the TES industry that gives optimal control sequences for operators and at the same time provides the tool for the designers and engineers to evaluate TES projects. The program will be spreadsheet based which allows any control software to interface with control sequences input.

The basic concepts are not that difficult. Every system initially has certain inputs like chiller sizes, efficiencies, pumps etc. basically to define what it costs to produce one ton-hour of cooling. Part of this input is also the peak discharge performance of the TES system. This basic input will then be used to determine the cost to satisfy the cooling load at a given hour.

The program can be simply used on a daily basis or weekly or whichever is desired. For TES plants with RTP, the calculations will be done on a daily basis. For large TES systems on time-of-use rate schedules, it will also be done on a daily basis, especially if partial storage is involved.

For smaller systems the program should allow the operator to establish the best simple time clock type of controls. If the available controls are sophisticated enough, control sequences can then be based on whatever the existing controls can work with.

The program will facilitate simplification to allow reducing the 8,760 values to the accuracy that is desired. Design engineers can use the program to predict savings to any degree they wish to input. One can still do it on a monthly basis with four different typical daily load curves (as in COOLAID). The program will then automatically optimize the non-peak load profiles.

Time-of-use rate schedules with a window of on-peak demand charges will automatically develop a control sequence that will use the tank fully during the on-peak period because of the high cost per ton-hour during the on-peak period. If there is surplus capacity the program will automatically select the most cost effective shift of mid-peak load fully discharging the tank.

POSSIBILITY FOR ZERO COST ENERGY

At seminars on deregulation, zero cost energy during certain night hours is often discussed as a possibility. Even if this does not materialize, it certainly shows that very low cost electricity may be available for a few hours during the night.

This opens up a whole new world for the charging cycle of TES systems so far not even considered. Presently off-peak rates at night are constant. Chillers size was then selected to charge the system during the full off-peak period. With the possibility that another marked reduction could occur, say for five hours during the night, it may be economically feasible to increase chiller capacity to charge the system during those five hours instead of the customary use of the total off-peak period. In other words, the charging cycle can also be optimized to save energy cost using TES systems.

CONCLUSION

KSEngineers proposes to develop the tools for the TES industry that actually provides the operating strategy for operators in graphic form and, if needed, delivers system readable input for the automatic control system. Furthermore, the program will provide the designers and engineers with an analytical tool to estimate savings more accurately leading to better utilization of existing and future TES systems. With deregulation a reality in California and soon for the rest of the nation, it is imperative that the TES industry has the sophisticated tools available to respond to the vast and forever changing rate changes that will inevitably result from deregulation. Our solution does not only allow us to cope with the challenges of the future but also remedies the deficiencies of the past.

KSENGINEERS

Mechanical Engineering Consultants & Energy Engineers

KSEng Inc. dba

RESUME OF KLAUS J. SCHIESS, PRESIDENT

PERSONAL

* US Citizen. Languages: English, German, Afrikaans, Swiss, some French.

EDUCATION

* B.Sc Eng. (ME), 1961, University of the Witwatersrand, Johannesburg, South Africa.

REGISTRATION, CERTIFICATION & AWARDS

* Registered Professional Engineer, California, 1983; Maryland, 1979; South Africa, 1969.

* Certified Energy Manager (CEM), Association of Energy Engineers.

* Value Engineering Analyst.

* AEE Energy Professional Development Award for San Diego 1994

PROFESSIONAL ACTIVITIES & AFFILIATIONS

* Member of ASHRAE; Member of AEE, Who's Who in Engineering.

* Technical Speaker at "Conserving Energy - Using Evaporative Cooling Systems" conference at Virginia Polytechnic Institute and State University.

* Presentation of "Three-out-of-the Ordinary TES Systems" at the 1987 H.V.A.C. Systems and Building Congress for the West Coast, Anaheim, California. Text published in ENERGY ENGINEERING Aug/Sep 1987.

* Member of Expert Panel for TES Seminars organized by Southern California Edison Company, 1986 and 1987.

* Speaker at Energy Seminar for the Navy on "Low Cost/No Cost Energy Conservation Opportunities" in San Diego 1987.

* Presentation of TES Case Study: "McDonnell-Douglas Production Facility" at World Energy Engineering Congress 1989, Atlanta, Georgia.

* Presentation of "Commissioning HVAC Systems; from Design to Reality" at HVAC Solutions Seminar given by San Diego Gas & Electrics, San Diego, Oct. 1990.

* Speaker at Thermal Energy Storage, Commissioning Procedures Workshop presented by San Diego State University Energy Engineering Institute, San Diego, February 1991.

* Presentation of "An Overview on Thermal Energy Storage (TES) in the USA" at THERMASTOCK '91, 5th International Conference on TES, Scheveningen, The Netherlands, 13 - 16 May 1991.

* Presentation of Mount Carmel High School TES project: "Case Study of a Combined Thermal Energy Storage and Gas Engine Driven Chiller System to Replace 500 Ton Chiller" at 15th World Energy Engineering Congress 1992, Atlanta, Georgia.

* Presentation of "Thermal Energy Storage - The Natural Way" at 16th World Energy Engineering Congress 1993, Atlanta, Georgia.

* Presentation of "Commissioning" at 17th World Energy Engineering Congress 1994, Atlanta, Georgia. Text published in "Strategic Planning for Energy and the Environment" Fall 1995.

* Presentation of "The Effect of Real Time Pricing (RTP) on TES Systems" at the 11th Annual Cooling Conference of International District Energy Association (IDEA), October 1996, Chicago.

* Presentation of "The Effect of Real Time Pricing (RTP) on TES Systems" at the 19th World Energy Engineering Congress 1996, Atlanta, Georgia.

* Presentations “TES at the Crossroads” at Annual AEE Seminars, Southern California Chapter in Long Beach in 1998 & 1999.

* Presentation of “Two TES Technologies in One Central Plant….You must be kidding” ASHRAE 2004 Winter Meeting, Anaheim, CA

PUBLISHED PAPERS

Three Out-of-the-Ordinary Thermal Energy Systems	Energy Engineering Vol.84, No.5 * 1987
Case Study: McDonnell Douglas Production Facility	Energy Engineering Vol.87, No.6 * 1990
Commissioning of HVAC Systems	Strategic Planning for Energy and the Environment Vol.15, No.2 * 1995
Commissioning: Britain vs. US	Engineered Systems, May 1998
The Effect of Real Time Pricing (RTP) on TES Systems	Strategic Planning for Energy and the Environment * Fall 1996
RTP + TES = ?	Engineered Systems, October 1998
Demand Shifting Will Boost Thermal Energy Storage (TES)	Strategic Planning for Energy and the

ENERGY ENGINEERING

* Energy Survey for the new Navy Hospital in San Diego, CA with special emphasis on lighting, HVAC, Central Plant and EMCS improvements and operation.

* Steam Trap Survey (1320 traps) for Marine Corps Recruit Center, San Diego, CA.

* Pre-concept Study for Installation of Energy Monitoring and Control Systems at the Carlisle Barracks, Carlisle, Pennsylvania.

* Electric Peak Shaving Report for Naval Public Works Center, San Diego.

* Engineering Report to determine Heat Losses of Main Steam Distribution Line for Naval Station, San Diego, CA.

* Naval Air Depot, North Island, San Diego, California: Energy Study for Building 472, Cleaning and Stripping Shop.

* Energy Study for Single Building Controllers at Fleet Anti-Submarine Warfare Training Center, (Pacific) San Diego, CA.

* Air conditioning Tune-up Study for Dental Clinic and Dispensary at Marine Corps Recruit Depot, San Diego, CA.

* HVAC Energy Study for Bldg. 698 at Naval Air Station, North Island, San Diego, CA.

* Evaluation of Feasibility to replace HVAC System at Home Economics Buildings at Cal State University, Long Beach, CA.

* Eighty (80) Energy Conservation Reviews for New Construction Design Program for San Diego Gas & Electric Company. Develop and quantify energy conservation opportunities.

* Central plant master plan study for University of San Diego.

* Selected by California Energy Commission for the Energy Partnership Program (EEP) in the following categories:
  1. Energy Audits
  2. New Construction Design Assistance.

  Work Orders:

  Energy Audit for City of West Covina (after implementation the City received Energy Award from the CEC)

  Energy Audit/TES Assistance for Civic Center, Pasadena

  Energy Audit for Kern County

  Energy Audit for City of San Bernardino

  Energy Audit/TES and centralizing 5 systems study for Contra Costa County

  Design for Visalia Court House TES retrofit, County of Tulare

Facility Energy Plan: Developing energy conservation projects ETAP & ECIP

Balboa Naval Hospital, San Diego, California.

Naval Medical Clinic, Naval Station, San Diego, California.

Naval Construction Battalion Center, Port Hueneme, California.

Naval Ship Weapon System, Port Hueneme, California.

Naval Air Station, El Centro, California.

Naval Station, Long Beach, California.

Naval Shipyard, Long Beach, California.

Naval Amphibious Base, Coronado, San Diego, California.

Marine Corps Air Station, Yuma, Arizona.

Naval Electronics System Engineering Center, San Diego, CA.

Naval Air Rework Facility, North Island, San Diego,California.

Naval and Marine Corps Reserve Center, Los Angeles, CA.

Peak Load Reduction Plan and Energy Management and Control Systems Training

(California Energy Commission in collaboration with California Department of Corrections**)**

* Assist with preparing all 33 California State Prisons for demand shifting techniques before the expected black out alerts.

* Visit all 33 California State prisons and train operating personnel in energy conservation and energy management techniques to achieve electrical demand reduction and conserve energy.

* Feasibility Study and air conditioning and evaporative cooling comparison for typical "270" Housing Units for California State Prisons.

Present Workload

* 2003 to present: HVAC & Energy consultant for REM (Resource Efficiency Manager) and BTU (Building Tune Up) program for Navy Southwest Division. Winning awards for achieved Data Center Energy Conservation results.

* 2003 to present: HVAC and Energy Peer Consultant for 8 year bond program for Poway Unified School District.

H.V.A.C. DESIGN, ENGINEERING AND SPECIFICATION

* University of San Diego, expansion of TES system and HVAC design for Chancery.

* Study to centralize 7 chiller systems and implement variable flow for Beckman Instruments Inc., Fullerton, California. (Won 1990 ASHRAE Industrial Energy Award).

* General Atomics, La Jolla, California: HVAC for standards laboratory with Thermal Energy Storage (TES) system.

* Hotel Del Coronado, Options to improve existing TES and chiller system.

* Abraham & Strauss Department Store, Short Hills, New Jersey: 400 ton AC system.

* Naval Academy, Annapolis, Maryland: Solar heating for indoor Olympic size pool.

* Economizer improvements to Court House and Library, Orange County, California.

* Various mechanical systems for Quality Evaluation Laboratories for Naval Weapons System, Fallbrook, California.

* Engineering Report for Air Conditioning Modifications in the 3/14 Computer Complex, Goddard Space Flight Center, Greenbelt, Maryland.

* Nestle Headquarters in Randburg, South Africa: 500 ton VAV system for high-rise office building.

* National Institute of Metallurgy, Randburg, South Africa: 600 ton fan coil unit system with 70 laboratory fume hoods inclusive radioactive exhaust system.

* J.G.Strijdom Hospital, Johannesburg, South Africa: Doubling an existing 600 bed hospital to become a teaching hospital for Rand University. Addition of 13 operating rooms to existing, keeping hospital fully operational.

* Standard Bank Computer Center, Johannesburg, South Africa: Complete redesign of air conditioning system keeping computer center fully operational.

* Farmfare Chicken Hatchers and Processing Plant, Esakheni, Kwazulu, South Africa: Complete mechanical support system to hatchery and processing plant.

* Springbok Clothing Factory, Babelegi, Boputhatswana, South Africa: Evaporative cooling system for clothing factory.

THERMAL ENERGY STORAGE (TES)

Design and Specification for the following TES systems:

(****** Indicates KSE study resulted in TES implementation)

* Peer Review of TES study and TES Design for California Institute of Technology, Pasadena, CA.

* Reviewing Engineer for ESCO project for California Department of Correction Calipatria Prison chilled water TES system.

** College of the Desert, Palm Desert, CA: 2,500 ton-hour ice storage TES system, integrated with 2,500 ton-hour eutectic salt storage TES system.

** Sonoma State University, Rohnert Park, CA: 7,000 ton-hour chilled water storage TES system.

* University of San Diego, Expansion of existing TES system with cross connection to existing campus cogen - absorption chiller system.

** Court House, Visalia, Tulare County. Design of retrofit ice TES system (1,300 T-H).

** Pasadena Center, Pasadena, Study and Design of 2,500 T-H ice storage TES system with chiller system optimization.

** Mount Carmel High School, Poway Unified School District, TES (1,400 Ton-Hours) combined with gas fired chiller and heat recovery for swimming pool.

** Martin Luther King Jr. Hospital, Los Angeles, CA. 6,000 ton-hours eutectic salt.

** TES PLUS Project for Saddleback Community College, Mission Viejo, California. 4,800 ton hours eutectic salt system in conjunction with existing rejuvenated ice storage system.

** GA Technologies, Inc., La Jolla, California: 90 ton-hour Calmac System.

** TES Consultant to Transphase, Inc. (Engineer of Record) for 500,000 gals. fire reservoir to use as chilled water storage tank at McDonnell Douglas, Culver City, CA.

* TES Consultant to Transphase, Inc. (Engineer of Record) for 6,000 Ton-Hour Eutectic Salt TES system for Marriott Desert Springs, CA.

* TES Consultant to Transphase, Inc. (Engineer of Record) for 4,200 Ton-Hour Eutectic Salt TES system for Hughes Radar Systems Group, Los Angeles, CA.

** Sierra Mira Mesa Office Building, San Diego, CA. 1400 ton-hours Transphase Eutectic Salt system.

** Grossmont Hospital, La Mesa, California: 2600 ton-hours, Calmac Ice system.

** Joe Mueller Office Building, Laguna Niguel, CA. 100 ton-hours Calmac Ice System.

10/12/05

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BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Southern California Edison Company for Approval of Demand Response Programs, Goals, and Budgets for 2009-2011	))))	 Application 08-06-001 (Filed June 2, 2008)
Application of San Diego Gas & Electric Company for Approval of Demand Response Programs and Budgets for 2009-2011	))))	 Application 08-06-002 (Filed June 2, 2008)
Application of Pacific Gas & Electric Company For Approval of Demand Response Programs and Budgets for 2009-2011	))))	 Application 08-06-003 (Filed June 2, 2008)

Transphase's Exhibit D

Testimony of Mark M. MacCracken, P.E. In Support of a

California Thermal Storage Standard Offer

Summary of Testimony: Mark M. MacCracken

CALMAC Mfg. Corp. of Fair Lawn, New Jersey, with over 3,300 Cool Storage installations around the world, is providing this testimony in support of the proposals by Transphase to encourage the widespread adoption of thermal energy storage (TES) in California by implementation of rate designs and incentives that reflect the benefits of thermal storage to the environment, to the reliability of electrical energy supplies and to the economy of the State of California. This testimony is also intended to support the findings of the California Energy Commission with regard to the benefits of TES and to highlight Legislative Intent in support of peak load shifting as an important component of California energy policy. We are not providing testimony in support of any specific thermal storage technology or product, including our own, or to support any technical or competitive distinctions between TES technologies as may be implied in the Transphase Protest or otherwise. We believe that consumers, with the aid of engineers and design professionals, will continue to make rational economic and practical decisions about competitive technologies. We support the position stated by Transphase that incentives, rates and Standard Offers should be available to end users of all thermal storage technology where on-peak demand reductions can be measured and verified. We believe that programs can be set up with filters that can insure that only proven reliable technologies are supported so they can be depended on for the long term. It should be clear that the references to our technology and company history herein are provided only for background, including actual experience in the market, and not as means of elevating our technology or market position.

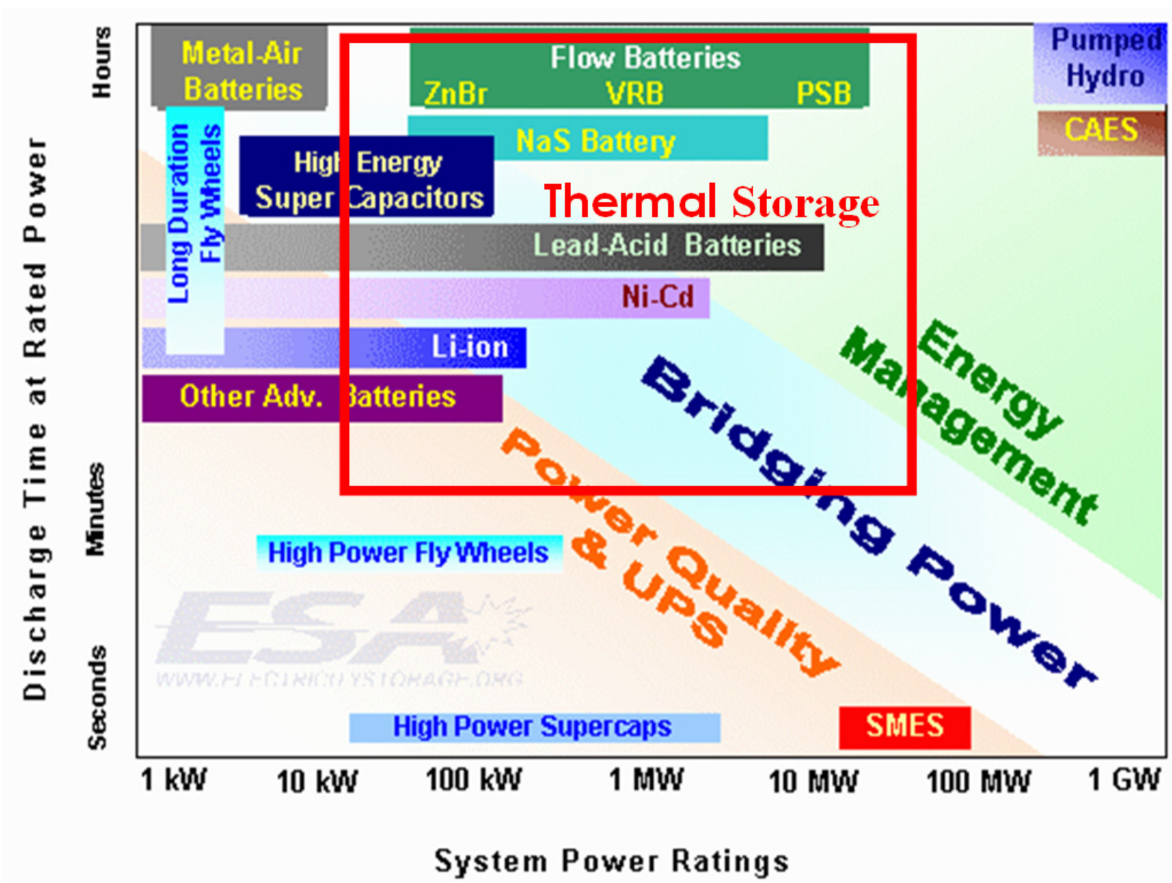
Finally, CALMAC believes that the cautious nature of the major utilities on California to re-engage with Cool Storage has been mostly justifiable because of negative experiences with some projects in the early days of the technology. However the technology has matured and is now available to be used as a vital tool towards a renewable future.

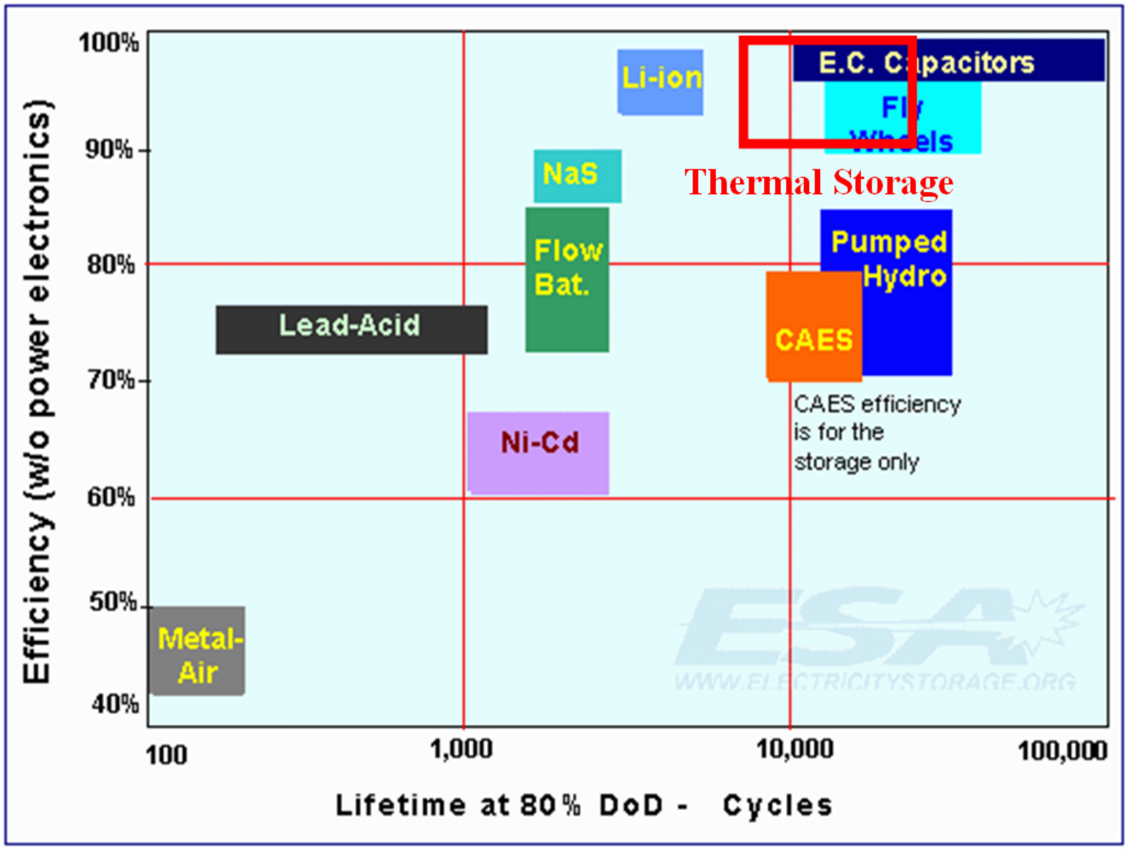
Energy Storage: A Vital Ingredient of a Renewable Energy Future.

One must only consider the following simple fact: Solar and Wind are forms of prime energy. You might say coal, oil and natural gas are also prime energy but you would be only partially correct. If you touch coal it is not hot, and oil in the barrel is not moving. Fossils fuels are actually forms of STORED Energy. If our society is going to successfully reduce our dependence on fossil fuels, we cannot ignore the "STORAGE" aspect of what we are replacing.

Because fossil fuels are stored energy, they can be dispatched when needed. Renewable energy lacks this ability and therefore its value to the Grid is lessened, or conversely, the cost to Customers will be much higher. The installed cost of Wind is running about $1.80 to $2.40/ Watt however in California only approximately 20% of that peak capacity is available during Grid Peak, so the cost is actually about $12 per Watt of Grid Peak ($12,000/kW). These costs are dramatically higher than any other form of generation. However if Storage is added, to make Renewable Resources dispatchable at peak, the installed value becomes competitive with fossil fuels plants, which is explained later in this testimony.

There are many ways to store energy: pumped hydro, compressed air, chemical batteries, inertia wheels, etc, however for large scale Energy Storage, by far the lowest cost, most energy efficient and proven is Thermal Energy Storage. The charts below (numbers are in 2002 dollars) show the comparisons of the different Energy Storage technologies in terms of Size, Cost and Cycle Efficiencies. These charts may seem unfair since many of these other types of storage can be supplied as electrons and Thermal Storage can not. However, because, as with most of the country, the California Grid Peak is based on the requirements for cooling, this re-conversion is not necessary. To summarize, it is extremely expensive to store "electrons" however it is not expensive to store what most of the electrons are needed for, namely cooling. Cool Storage is the simple and proven solution to Renewable Energy integration.

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Efficiency (w/o power electronics)
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E.C. Capacitors
Fly Wheels
NaS
Thermal Storage
Flow Bat.
Pumped Hydro
Lead-Acid
CAES
CAES efficiency is for the storage only
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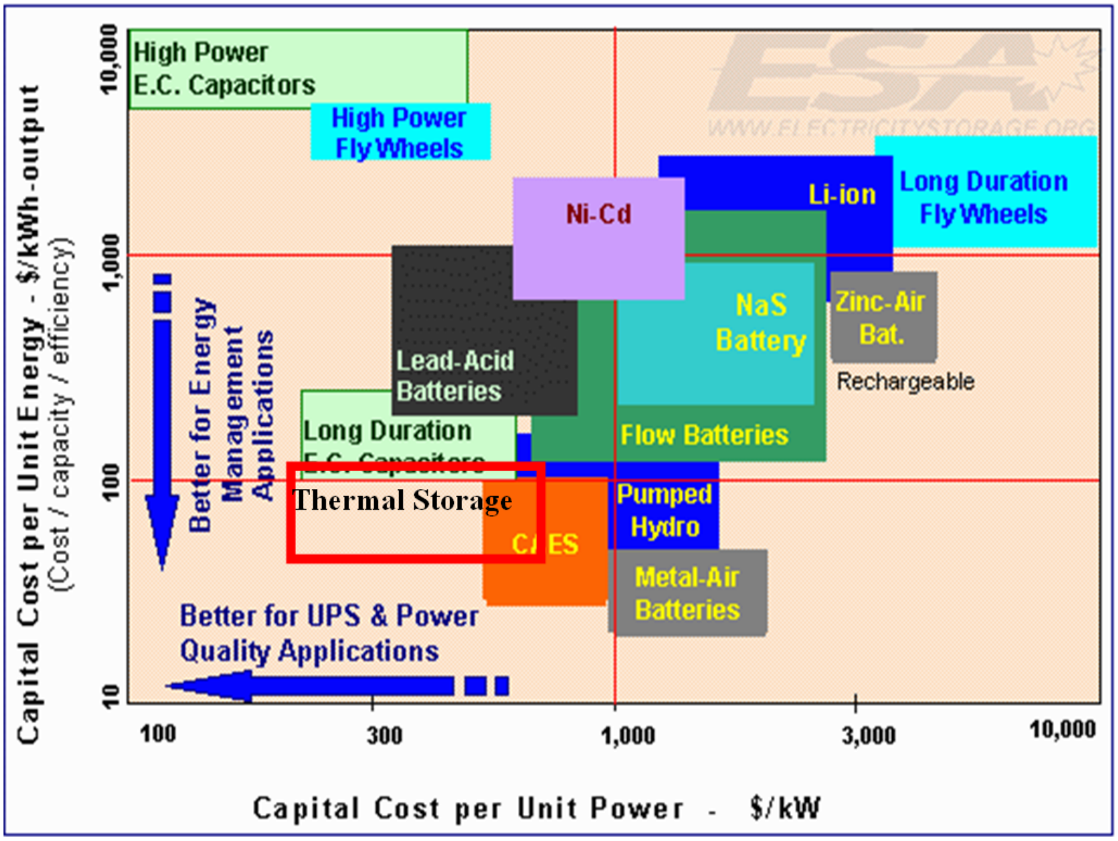
Lifetime at 80% DoD - Cycles



Cool Storage comes of Age

CALMAC Mfg. Corporation's IceBank Cool Storage is used 35 countries around the world for both New Construction and Retrofit installations. In the past 4 years in New York City, the most densely populated and energy intensive area in the country, Retrofit Cool Storage installations have been completed for Rockefeller Center, Credit Suisse, Morgan Stanley (2), The Durst Organization (the "Greenest" developer), and TIAA Cref (2nd largest Property owner in the USA) cooling approximately about 5 million Sqft of offices. Another 4.5 million sq. ft. of New Construction for The Bank of America Tower at One Bryant Park (2nd tallest building in NYC) and Goldman-Sachs HQ in Battery Park City (Green area of NYC) have been installed. The technology is proven, economically and reliable or these major corporations would not risk their buildings on it.

CALMAC Mfg. Corp. has over 3,300 installations including over 100 in California. Most of the California installations were installed in the early to mid 90's and are still in operation today. El Capitan project, Culver Studios, The West Valley Detention Center (Rancho Cucamonga), Tri-City Medical Center (Oceanside) and Gallo Winery

(Modesto), Kern High School District (Bakersfield) are but a few of our projects that are approximately 10 to 17 years old. We have about a dozen ASHRAE Award winning projects, many of which can be found on the www.CALMAC.com website. These have consistently provided reliable cooling, reduced Peak Demand and lower energy costs to customer while lowering source energy usage for the generator.

Successful Cool Storage Program Requires Consistent Long Term Policy

Florida Power and Light's and now New York's success in addressing peak load has come from consistent programs that clearly recognize the value of Peak Demand as well as Energy Efficiency. FPL started its program back when California's Utilities stated theirs however it was not abandoned in 1996 when "Deregulation" started. With a modest program ($300 per KW reduced) the program has had consistent modest results of about 60 MW removed from peak. While reducing peak demand, FPL has also dramatically cut source energy use because they are shifting form Single Cycle Combustion Turbines to Combined Cycle plants which are much more efficient (see ASHRAE Winter Meeting Proceeding Jan-2008). So to put Renewable Energy into perspective in past 15 years, FPL has invested $18 million in storage. If FPL wants those 60 MW to come from Carbon Free Wind Renewable Energy, to essentially meet Peak Demand, they will need to invest only $144 million more in Wind turbines. California will have to invest $720 million since they didn't support storage. The cost per kW in FL calculates to $2,700 per kW of carbon free Peak Energy vs. $12,000 for CA.

New York has also recognized these realities and in NYC alone, in just 5 years, with NYSERDA's support of $450/KW, almost 10 MW has been removed from peak by CALMAC's IceBank Storage Systems.

Electric Car Energy Storage to help Utilities meet Peak?

Some in the energy field think that the excess capacity, in the future electric car fleet, will be a source of stored energy to help meet Grid Peak demand. Even with a very smart Grid, we believe this goes against human nature and is unlikely. Grid Peak occurs somewhere between 3 and 6 pm in most places which is exactly when most people are just about to use or are using their commuter cars (good mileage ones). Sacrificing stored energy from your car battery and giving up travel freedom, just before a trip home, or risking going to gasoline (hybrid) for some unexpected miles just isn't realistic. We don't believe the CPUC can count on these resources to be reliably available, and certainly not in the near future.

CPUC Direction

The CPUC needs to show great leadership in order to prepare CA for clean energy future. There is no silver bullet technology that will solve all the problems. It takes a broad understanding of all the factors since the problem stretches from generation to consumer and resources to emissions. The CPUC is given the responsibility to regulate the utilities. In a New Jersey Master Energy Plan meeting, following a statement by the CEO of PSEG that the generation Heat Rates for On-Peak electricity is about "15,000 Btus/kWh and the Off-Peak Heat Rate is 10,000 Btus/kWh"., I asked then "why doesn't the utility support load shifting programs", and his reply was "we don't get compensated to do that. Speak to the NJ-BPU".

So I am speaking to you, the people responsible for much of the potential energy and environmental actions that must be taken, if we are to be able to economically and quickly change the dire course this country is on. And yes, I say country because California has always been and continues to be the pioneer state in smart Energy. Below is a summary of a Cool Storage whitepaper that was submitted to the CPUC about a decade ago (with minor changes). Little has changed and a decade has been lost:

Respectfully Submitted,

Mark M MacCracken

Mark M MacCracken. PE, Pte, LEED-AP

CEO

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Appendix 1 to MacCracken Testimony

Cool Storage Whitepaper

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WHAT IS THERMAL ENERGY STORAGE (TES)?

TES is a proven, energy conserving, nonpolluting technology that uses inexpensive off-peak electricity. Electricity is used during nighttime periods to produce and store cool energy in the form of ice or chilled water. The cool energy in storage is used the next day for air-conditioning or process cooling during periods of peak energy demand. There is no change to occupant comfort however the owner saves large amounts of money and saves energy.

HOW CAN TES HELP TO MITIGATE THE COUNTRY'S ENERGY SHORTAGE?

TES can mitigate the electric energy shortage by quickly shifting to existing, under utilized, lower cost, off-peak electrical generating capacity to reduce peak electrical cooling loads. Cooling loads can consume up to thirty percent of a facility's electricity demand on hot summer days. In the long run, peak demand charges and "time of use" rates, if reflective of real-time energy costs, may prove to be a sufficient incentive for architects and engineers to incorporate TES systems. In the near term, however, Federal and State advocacy and support of TES technology is needed to encourage its increased utilization.

IS TES A RELIABLE AND PROVEN TECHNOLOGY?

Yes. More than five thousand systems have been operating world-wide for years in a variety of cooling applications in hospitals, schools, airports, churches, government facilities, office buildings and industry. ARI Standard 900 has been specifically developed for testing TES systems. In addition, sizing and system selection specifics are governed by ARI Guideline T.

DOES TES CONSERVE ENERGY?

Yes. The California Energy Commission (CEC) published a report in 1996 entitled Source Energy and Environmental Impacts of Thermal Energy Storage. This report highlights the fact that TES technology conserves energy at both the electricity generation source and the point of use. In addition, the CEC report goes on to say that TES should be considered a priority in the ranking of Demand Side Management technologies in energy policy decisions.

DOES TES REDUCE POLLUTION AND GREENHOUSE GASES?

Yes. This results from more efficient electrical generating plant nighttime heat rejection, full load efficiencies, and reduced transmission line losses.

WHY SHOULD INCREASED USE OF TES BE ENCOURAGED?

TES should be used because it is in the interest of consumers and power suppliers alike to shift existing on-peak loads to off-peak periods. For every 4 buildings that install TES, a fifth can be powered with no additional equipment. (Another way to look at it is that we can create up to 20 % reserve of capacity without building any new power plants.) TES can shift load for a cost of one half to one third the cost of adding new generating capacity. The alternative is to invest in the construction of expensive, difficult to site, conventional generating capacity where cost, pollution, adjacent property, and fuel supply issues will create time consuming, and likely litigious impediments. Obviously we need to build some power plants but we can utilize our existing assets much better with TES.

HOW DOES TES RELATE TO RENEWABLE ENERGY RESOURCES?

Solar and Wind are forms of prime energy. You might say coal, oil and natural gas are also prime energy but you would be only partially correct. If you touch coal it is not hot, and oil in the barrel is not moving. Fossils fuels are actually forms of STORED Energy. If our society is going to successfully reduce our dependence on fossil fuels, we cannot ignore the “STORAGE” aspect of what we are replacing.

HOW SHOULD TES BE ENCOURAGED?

Widespread use of TES systems can be implemented by helping building owners purchase the systems. An incentive in the range of what utilities are paid for capacity for all load shifted reliably to off peak periods should be paid to building owners, design engineers, architects, or installing contractors to accomplish this objective. In the long run, true off-peak rates and proper metering and/or dispatch signal programs will sustain TES markets and peak-shifting projects that have been jump-started by State incentives.

References for Further Information, Independent Analysis and Opinion:

1. California Energy Commission Report , "Source Energy and Environmental Impacts of Thermal Energy Storage" P500-95-005 (http://www.energy.ca.gov/reports/500-95-005_TES-REPORT.PDF)

2. Northwest Power Planning Council Report - Document 2000-18, October 11, 2000. (http://www.nwppc.org/welcome.htm)

Witness Qualifications of Mark M. MacCracken, P.E., LEED-AP

President and CEO of CALMAC Mfg. Corp. - Fair Lawn, NJ

Manufacturer of IceBank Thermal Storage Equipment - Since 1979

Mr. MacCracken has 32 years of experience in the field of thermal energy storage including research and development, system design, installation, testing, marketing, manufacturing and development of industry standards.

USGBC - Board of Directors 2006-2008

AHRI - Board of Directors 2004-2008

Energy Engineer of the Year, Association of Energy Engineers- NYCity 2008

Distinguished Lecturer for ASHRAE -2004-Present

NARUC Annual Meeting =TES Talk Annual Meeting, NYC 2007

Chairman - ARI Thermal Storage Equipment Section 1998 - 2006

Member - ARI Thermal Storage Section Engineering Committee responsible for industry test standards, 1993 - 2008

Professional Engineer - Licensed in New Jersey

3 U.S. Patents

Chairman ASHRAE Technical Committee Member: TC 6.9 TES 1997-2000

Mechanical Engineer - BSME, University of Rhode Island - 1976

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Application of Southern California Edison Company for Approval of Demand Response Programs, Goals, and Budgets for 2009-2011	)	Application 08-06-001 (Filed June 2, 2008)
Application of San Diego Gas & Electric Company for Approval of Demand Response Programs and Budgets for 2009-2011	)	Application 08-06-002 (Filed June 2, 2008)
Application of Pacific Gas & Electric Company For Approval of Demand Response Programs and Budgets for 2009-2011	)	Application 08-06-003 (Filed June 2, 2008)

Transphase's Exhibit E

Testimony of Freeman Ford In Support of a

Thermal Storage Standard Offer

Fafco Inc endorses the use of Thermal Energy Storage in CA:

Fafco has installed over one thousand Thermal Energy Storage systems over nearly a thirty year period. Many of these are installed in California. The majority are installed in Asia where peak shifting or load leveling is practiced before the construction of new generating capacity.

It is ironic that as I write this, PG&E is constructing a new peaking plant in northern California but has ample existing capacity to meet its current peaking demand.

Fafco employees over one hundred employees, is the oldest and largest solar water manufacturer in the US and has ample capacity to meet CA peaking demand with reliable TES technology proven over nearly thirty years.

TES reduces greenhouse emissions, is cost effective and reduces carbon footprint. I look forward to supplying more testimony in support of the use of TES in CA.

Respectfully submitted,

Freeman Ford, Chairman
Fafco Inc, Chico CA
530 332 2120

Project Name	City	State	Sales Rep	590	420	400	280	200	140	100	HX
Folsom College	Folsom	CA	March Equipment Comp.	4							
Mira Costa College	San Diego	CA	DMG	2							
Saddleback Church	Lake Forrest	CA	DMG	4							
Agoura Hills High School	Agoura Hills	CA	Marcus Company					2		1	
Anaheim City Utility Building	Anaheim	CA	DMG	9							
Bakersfield High School		CA	DMG								
Bernardo Heights Middle School	San Diego	CA	DMG			8					
Berringer Wine World Warehouse	Napa	CA	Irapp				5				
Buchanan Elementary School	Los Angeles	CA	DMG				1				
CBS Television City	Los Angeles	CA	DMG	7					3		
Central Union High School	Fresno	CA	Harlan Mechanical Systems	8			2				
Clark Elementary School	Clovis	CA	Marcus Company					3	1		
Clos Du Bois Winery	Geyersville	CA	Marcus Company	3							
Clovis Unified School District	Fresno	CA	Harlan Mechanical Systems				14		2		
Compton College	Compton	CA									30
Del Ray Union School	Sanger	CA	Marcus Company					2			
Delano High School	Delano	CA	Harlan Mechanical Systems				1				
Dinuba High School	Dinuba	CA	Koller Plumbing					4			
Dry Creek Elementary School	Clovis	CA	Marcus Company					1		1	
Exeter Union High School	Exeter	CA	Marcus Company					6			
Fairmont Elementary School	Sanger	CA	Marcus Company					2			
Fairmont Union School	Hanford	CA	Marcus Company			1					
Fremont Elementary School	Merced	CA	Marcus Company					1		1	
Garfield Elementary School	Clovis	CA	Harlan Mechanical Systems	2							
Hanford High School - East Campus	Hanford	CA	Harlan Mechanical Systems	2							
Irvine Valley College	Irvine	CA	DMG					3			
Jefferson Elementary School	Dinuba	CA	Harlan Mechanical Systems					3			
Jefferson Junior High School	Madera	CA	Harlan Mechanical Systems					3			
Lincoln School	Dinuba	CA	Marcus Company					2			
Lonestar Union School	Sanger	CA	Marcus Company					2			
Maple Creek Elementary School	Fresno	CA	Harlan Mechanical	2							

			Systems						
Marriott Hotel	San Francisco	CA	Carrier Corporation	6					
Maryknoll High School - HI	Hayward	CA	Nustate Aircon						
Mira Costa College	Oceanside	CA	DMG				6		
New Northside Elementary School	Porterville	CA	Harlan Mechanical Systems		2				
Pinedale Elementary School	Clovis	CA	Marcus Company				3		
San Joaquin Elementary School	San Joaquin	CA	Harlan Mechanical Systems	2					
Schurr High School	Montebello	CA	DMG				3		
Sierra Vista Elementary School	Clovis	CA	Harlan Mechanical Systems	1					
Sierra Vista School	Clovis	CA	Environmental Aire				2	1	
Stockdale High School North	Bakersfield	CA	RP Richards	4					
Washington Elementary School	Madera	CA	Marcus Company			2			
Washington Junior High School	Sanger	CA	Marcus Company						4
Weldon Elementary School	Clovis	CA	Harlan Mechanical Systems				3		
Whittier College	Whittier	CA	DMG	2					
Wine World, Inc.	Napa	CA	DMG			5			
Bodega Bay	Bodega	CA	?						
700 California St	San Francisco	CA	?						
Kaweah Hospital	Visilia	CA	Harlen						
Oceanside City Hall (HX)	Oceanside	CA	?						

Certificate of Service

I hereby certify that on November 24, 2008, I served by email in accordance with Rule 1.10 a true and correct copy of the foregoing document, "Transphase's Testimony of Douglas A. Ames, Victor J. Ott, P.E., Klaus J. Schiess, P.E., Mark M. MacCracken, P.E., and Freeman Ford In Support of a Thermal Storage Standard Offer" including as a separate excel attachment "Transphase's Cost Effectiveness Spreadsheets in Support of Testimony," on each individual listed on the CPUC Service List for Application 08-06-001 et al., the utilities' consolidated Demand Response Applications for 2009-2011. I further certify that on November 24, 2008, I overnight mailed hard-copies of this document to Administrative Law Judge Jessica T. Hecht and Assigned Commissioner Rachelle B. Chong.

Executed on November 24, 2008 in Huntington Beach, California.

__/s/ Douglas A. Ames

Douglas A. Ames

CPUC A. 08-06-001 et al.

Applications of SCE, PG&E and SDG&E for Approval of Demand Response Programs for 2009-2011

Cost Effectiveness Spreadsheets in Support of Proposed California Thermal Storage Standard Offer

Table No. 1 In Support of Transphase Testimony

SCE Avoided Costs For One kW- 'Higher' CT Avoided Cost

Year	Avoided CT Capital Cost ($/kW)	Avoided T&D Capital Cost ($/kW)	Avoided Energy Summer On-Pe ($/kWh)	Avoided Energy Summer Off-Peak ($/kWh)	Total Avoided Energy For Summer	Winter Energy Mid-Peak/kWh	Winter Energy Off-Peak	Total Avoided Energy for Winte	GHG Adder $/ton	GHG Adder $/ kW	Customer Bill Savings $/kW
1	170.5	29.7	0.0993	0.0544	19.20	0.071	0.052	12.90	10.21	$3.25	177.33
2	175.6	30.6	0.1023	0.0561	19.77	0.073	0.054	13.29	10.72	$3.41	182.64
3	180.9	31.5	0.1053	0.0577	20.37	0.075	0.056	13.69	11.26	$3.59	188.12
4	186.3	32.5	0.1085	0.0595	20.98	0.077	0.057	14.10	11.82	$3.76	193.77
5	191.9	33.5	0.1118	0.0612	21.61	0.079	0.059	14.52	12.41	$3.95	199.58
6	197.6	34.5	0.1151	0.0631	22.25	0.082	0.061	14.96	13.03	$4.15	205.57
7	203.6	35.5	0.1186	0.0650	22.92	0.084	0.063	15.41	13.68	$4.36	211.74
8	209.7	36.6	0.1221	0.0669	23.61	0.087	0.064	15.87	14.37	$4.58	218.09
9	216.0	37.6	0.1258	0.0689	24.32	0.089	0.066	16.35	15.09	$4.80	224.63
10	222.4	38.8	0.1296	0.0710	25.05	0.092	0.068	16.84	15.84	$5.04	231.37
11	229.1	39.9	0.1335	0.0731	25.80	0.095	0.070	17.34	16.63	$5.29	238.31
12	236.0	41.1	0.1375	0.0753	26.57	0.098	0.073	17.86	17.46	$5.56	245.46
13	243.1	42.4	0.1416	0.0776	27.37	0.101	0.075	18.40	18.20	$5.79	252.82
14	250.3	43.6	0.1458	0.0799	28.19	0.104	0.077	18.95	19.20	$6.11	260.41
15	257.9	45.0	0.1502	0.0823	29.04	0.107	0.079	19.52	20.10	$6.40	268.22
16	265.6	46.3	0.1547	0.0848	29.91	0.110	0.082	20.10	21.0	$6.69	276.27
17	273.6	47.7	0.1594	0.0873	30.80	0.113	0.084	20.71	21.9	$6.97	284.55
NPV	$2,031.9	$354.2			$228.8			$153.8		$44.5	$2,113.5

Notes:
1. Avoided CT capital cost of $156.40 per kW taken from Table A2 in "SCE's Responses to ALJ Ruling" dated 11/03/08 in R.07-01-041.
Added to the generation avoided cost is a line loss assumption of 9 percent. See SCE's Appendix C, "Demand Response Avoided Capacity Valuation Methodology" p. C-10.
2. Avoided T&D capital cost from SCE's Appendix C, "Demand Response Avoided Capacity Valuation Methodology," p. C-12
3. Time-differentiated avoided energy costs were not provided by the utility. Instead, these numbers were derived from the time-differentiated heat rates provided in response to a data request.
4. Total Avoided Summer Energy Costs equal the avoided on-peak energy rate minus avoided off-peak times 6 hours times .9 diversity factor times 22 week days per month times 4 summer months, with another 90% utilitization factor
5. Total Avoided Winter Energy Costs equal the avoided winter mid-peak energy rate minus avoided winter off-peak energy rate times the storage capacity times 22 week days per month
times eight winter months times a 75% utilitization factor.
6. These calculations assume either 1-in-2 or 1-in-10 temperature summers.
7. GHG adder uses cost per ton figures from PG&E data response to Transphase and 1.34 lbs. per kWh from U.S. DOE's "Carbon Dioxide Emissions from Generation of Electric Power in the United States"
8. Customer Summer Bill Savings Use 2007 Rates (Post 06 GRC) and were developed in SCE's GRC phase 2 Transphase spreadsheets/testimony as reproduced in the spreadsheets to the right beginning at column 'U'.

			Table No. 2 In Support of Transphase Testimony						
			Cost Effectiveness Tests for SCE with "Higher" CT Capital Cost						
	Utility		Customer Added		Utility Program		Participant's Retention of Incentive (assumed)		
	Incentive	NPV	Costs		Costs	NPV			
	($/kW)								
	800	<u>$1,238.19</u>	300		196	<u>$242.04</u>	0	<u>$245.26</u>	
	200				24		100		
	200				24		100		
	200				24		100		
Total Resource Cost Test= utility avoided costs / (incentives + participant added costs + program admin. costs)									
TRC=	1.56		(Assumes No GHG adder)						
TRC=	1.56		(With GHG emissions adder)						
Participant Test= (participant's retention of incentive + bill changes)/participant costs									
PT=	7.86		(all tests assume customer keeps 100% of the bill savings)						
Rate Impact Test = utility avoided costs/ (program admin. Costs + incentives + bill changes)									
RIM =	0.78								
Utility Cost Test = utility avoided costs/(program admin. + incentives)									
UC=	1.90								

Table No. 3

SCE Avoided Costs For One kW- "Low" Avoided CT Capital Cost

Year	Avoided CT Capital Cost ($/kW)	Avoided T&D Capital Cost ($/kW)	Avoided Energy Summer On-Pe ($/kWh)	Avoided Energy Summer Off-Peak ($/kWh)	Total Avoided Energy For Summer	Winter Energy Mid-Peak/kWh	Winter Energy Off-Peak	Total Avoided Energy for Winte	GHG Adder cost per ton	GHG Adder avoided cost per summer kW	Customer Bill Savings $/kW
1	122.8	29.7	0.0993	0.0544	19.20	0.071	0.052	12.90	10.21	$3.25	177.33
2	126.5	30.6	0.1023	0.0561	19.77	0.073	0.054	13.29	10.72	$3.41	180.87
3	130.3	31.5	0.1053	0.0577	20.37	0.075	0.056	13.69	11.26	$3.59	184.49
4	134.2	32.5	0.1085	0.0595	20.98	0.077	0.057	14.10	11.82	$3.76	188.18
5	138.3	33.5	0.1118	0.0612	21.61	0.079	0.059	14.52	12.41	$3.95	191.94
6	142.4	34.5	0.1151	0.0631	22.25	0.082	0.061	14.96	13.03	$4.15	195.78
7	146.7	35.5	0.1186	0.0650	22.92	0.084	0.063	15.41	13.68	$4.36	199.70
8	151.1	36.6	0.1221	0.0669	23.61	0.087	0.064	15.87	14.37	$4.58	203.69
9	155.6	37.6	0.1258	0.0689	24.32	0.089	0.066	16.35	15.09	$4.80	207.76
10	160.3	38.8	0.1296	0.0710	25.05	0.092	0.068	16.84	15.84	$5.04	211.92
11	165.1	39.9	0.1335	0.0731	25.80	0.095	0.070	17.34	16.63	$5.29	216.16
12	170.0	41.1	0.1375	0.0753	26.57	0.098	0.073	17.86	17.46	$5.56	220.48
13	175.1	42.4	0.1416	0.0776	27.37	0.101	0.075	18.40	18.20	$5.79	224.89
14	180.4	43.6	0.1458	0.0799	28.19	0.104	0.077	18.95	19.20	$6.11	229.39
15	185.8	45.0	0.1502	0.0823	29.04	0.107	0.079	19.52	20.10	$6.40	233.98
16	191.4	46.3	0.1547	0.0848	29.91	0.110	0.082	20.10	21.0	$6.69	238.66
17	197.1	47.7	0.1594	0.0873	30.80	0.113	0.084	20.71	21.9	$6.97	243.43
NPV	$1,464.1	$354.2			$228.8			$153.8		$44.5	$1,974.4

Notes:
1. Avoided CT capital cost of $112.70 per kW taken from Appendix C, "Demand Response Avoided Capacity Valuation Methodology," p. C-5, Table C-1, line 9.
Added to the generation avoided cost is a line loss assumption of 9 percent. See SCE's Appendix C, "Demand Response Avoided Capacity Valuation Methodology" p. C-10.
2. Avoided T&D capital cost from SCE's Appendix C, "Demand Response Avoided Capacity Valuation Methodology," p. C-12
3. Time-differentiated avoided energy costs were not provided by the utility. Instead, these numbers were derived from SCE's time-differentiated heat rate provided in response to a data request.
4. Total Avoided Summer Energy Costs equal the avoided on-peak minus avoided off-peak times 6 hours times .9 diversity factor times 22 week days per month times 4 summer months, with another 90% utilization factor.
5. Total Avoided Winter Energy Costs equal the avoided winter mid-peak minus avoided winter off-peak energy avoided costs times the storage capacity times 22 week days per month
times eight winter months times a 75% utilitization factor.
6. These calculations assume either 1-in-2 or 1-in-10 temperature summers for a partial storage design, or full storage 1-in-2 sizing critereon.
7. GHG adder uses cost per ton figures from PG&E data response to Transphase and 1.34 lbs. per kWh from U.S. DOE's "Carbon Dioxide Emissions from Generation of Electric Power in the United States"
8. Customer Summer Bill Savings Use 2007 Rates (Post 06 GRC) and were developed in SCE's GRC phase 2 Transphase spreadsheets/testimony as reproduced in the spreadsheets to the right beginning at column 'U'.

			Table No. 4 In Support of Transphase Testimony						
		Cost Effectiveness Tests for SCE with "Low" CT Capital Cost							
	Utility		Customer Added		Utility Program		Participant's Retention of Incentive (assumed)		
	Incentive	NPV	Costs		Costs	NPV			
	($/kW)								
	800	$1,238.19	300		196	$242.04	0	$245.26	
	200				24		100		
	200				24		100		
	200				24		100		
Total Resource Cost Test= utility avoided costs / (incentives + participant added costs + program admin. costs)									
TRC=	1.24		(Assumes No GHG adder)						
TRC=	1.26		(With GHG emissions adder)						
Participant Test= (participant's retention of incentive + bill changes)/participant costs									
PT=	7.40								
Rate Impact Test = utility avoided costs/ (program admin. Costs + incentives + bill changes)									
RIM =	0.65								
Utility Cost test= utility avoided costs/(program admin. + incentives)									
UC=	1.52								
All tables and spreadsheets prepared by Doug Ames, Transphase, 11/24/08									

Table No. 5

Example of Load Impact for Large Office Building- 1000 kW Load Shift from TES

			Conventional Weekday			Thermal Storage Weekday		
			A/C Load	Non-A/c Lo	Total	a/c load	non-a/c loa	Total
Peak Demand, kW								
Summer	On-Peak		1000	400	1400	0	400	400
	Part Peak		600	300	900	600	300	900
	Off-Peak		0	200	200	675	200	875
Winter	Part Peak		500	400	900	0	400	400
Energy Consumption, kWh								
Summer	On-Peak		5400	2400	7800	**0**	2400	2400
	Part Peak		3600	2160	5760	3600	2160	5760
	Off-Peak		0	1800	1800	5400	1800	7200
		Total Kwh	9000	6360	15360	9000	6360	15360
Winter	Part Peak		4500	4560	9060	0	4560	4560
	Off-Peak		0	1800	1800	4500	1800	6300
		Total kWh	4500	6360	10860	4500	6360	10860

Table No.6

Calculation of SCE Bill Savings

TOU-8 Rate- Primary

(Effective 2008)

		Conventional (no TES)		Building With TES		Bill Savings	Bill Savings
		$/mo.	$/ yr.	$/mo.	$/ yr.	$/yr.	$/kW- yr.
Demand Charges ($/kW/month)						(1000 kW TES)	
Max. Peak Summer	15.62	21868	87472	6248	24992	62480	62.48
Max. Part Peak Summer	5.29	4761	19044	4761	19044	0	0
Max. Demand Summer	9.2	12880	51520	8050	32200	19320	19.32
Max. Part Peak Winter	0	0	0	0	0	0	0.00
Max. Demand Winter	9.2	8280	66240	3680	29440	36800	36.8
Total Demand Charges			224276		105676	118600	118.60
Energy Charges ($/kWh/month)							
Peak Summer	0.10175	17460	69841	5372	21490	48352	48.35
Part Peak Summer	0.07391	9366	37464	9366	37464	0	0.00
Off-Peak Summer	0.03737	1480	5919	5919	23678	-17758	-17.76
Part-Peak Winter	0.07674	15296	122367	7699	61588	60778	60.78
Off-Peak Winter	0.04122	1632	13058	5713	45705	-32646	-32.65
Total Energy Charges			248649		189924	58725	58.73
Total Demand and Energy Charges			472925		295600	177325	177

CPUC A. 08-06-001 et al.
Applications of SCE, PG&E and SDG&E for Approval of Demand Response Programs for 2009-2011
Transphase's Proposed California Thermal Storage Standard Offer

Table No. 1

PG&E Avoided Costs For One kW- 'Higher' CT Avoided Cost

Year	Avoided CT Capital Cost ($/kW)	Avoided T&D Capital Cost ($/kW)	Avoided Energy Summer On-Peak ($/kWh)	Avoided Energy Summer Off-Peak ($/kWh)	Total Avoided Energy For Summer	Winter Energy Mid-Peak/kWh	Winter Energy Off-Peak	Total Avoided Energy for Winter	GHG Adder $/ton	GHG Adder $/ kW	Customer Bill Savings $/kW-yr.
1	165.5	29.7	0.1077	0.0683	22.45	0.101	0.078	11.50	10.21	$3.25	162.8
2	170.5	30.6	0.1109	0.0703	23.12	0.104	0.080	11.85	10.72	$3.41	167.7
3	175.6	31.5	0.1142	0.0725	23.82	0.107	0.083	12.20	11.26	$3.59	172.7
4	180.9	32.5	0.1177	0.0746	24.53	0.110	0.085	12.57	11.82	$3.76	177.9
5	186.3	33.5	0.1212	0.0769	25.27	0.114	0.088	12.94	12.41	$3.95	183.3
6	191.9	34.5	0.1248	0.0792	26.03	0.117	0.090	13.33	13.03	$4.15	188.8
7	197.7	35.5	0.1286	0.0816	26.81	0.121	0.093	13.73	13.68	$4.36	194.4
8	203.6	36.6	0.1324	0.0840	27.61	0.124	0.096	14.14	14.37	$4.58	200.3
9	209.7	37.6	0.1364	0.0865	28.44	0.128	0.099	14.57	15.09	$4.80	206.3
10	216.0	38.8	0.1405	0.0891	29.29	0.132	0.102	15.01	15.84	$5.04	212.4
11	222.5	39.9	0.1447	0.0918	30.17	0.136	0.105	15.46	16.63	$5.29	218.8
12	229.2	41.1	0.1490	0.0945	31.08	0.140	0.108	15.92	17.46	$5.56	225.4
13	236.0	42.4	0.1535	0.0974	32.01	0.144	0.111	16.40	18.20	$5.79	232.1
14	243.1	43.6	0.1581	0.1003	32.97	0.148	0.114	16.89	19.20	$6.11	239.1
15	250.4	45.0	0.1629	0.1033	33.96	0.153	0.118	17.40	20.10	$6.40	246.3
16	257.9	46.3	0.1677	0.1064	34.98	0.157	0.121	17.92	21.0	$6.69	253.7
17	265.7	47.7	0.1728	0.1096	36.03	0.162	0.125	18.46	21.9	$6.97	261.3
NPV	$1,973.1	$354.2			$267.6			$137.1		$44.5	$1,940.7

Notes:

1. Avoided CT capital cost of $151.88 per kW "total fixed" capital cost taken from Table A2 in "PG&E's Responses to ALJ Ruling" dated 11/03/08 in R.07-01-041.
Added to the generation avoided cost is a line loss assumption of 9 percent. See SCE's Appendix C, "Demand Response Avoided Capacity Valuation Methodology" p. C-10.
2. Avoided T&D capital cost from SCE's Appendix C, "Demand Response Avoided Capacity Valuation Methodology," p. C-12
3. Time-differentiated avoided energy costs were taken from PG&E's time-differentiated heat rates provided in response to data request no. 15.
4. Total Avoided Summer Energy Costs equal the avoided on-peak energy rate minus avoided off-peak times 6 hours times .9 diversity factor times 22 week days per month times 6 summer months, with another 80% utilizatior
5. Total Avoided Winter Energy Costs equal the avoided winter mid-peak energy rate minus avoided winter off-peak energy rate times the storage capacity times 22 week days per month
times six winter months times a 70% utilitization factor.
6. These calculations assume either 1-in-2 or 1-in-10 temperature summers.
7. GHG adder uses cost per ton figures from PG&E data response to Transphase and 1.34 lbs. per kWh from U.S. DOE's "Carbon Dioxide Emissions from Generation of Electric Power in the United States"
8. Customer Bill Savings developed using PG&E E-20 and calculated beginning in Column S on this sheet.

Table No. 2 In Support of Transphase Testimony
Cost Effectiveness Tests for PG&E with "Higher" CT Capital Cost

Utility Incentive ($/kW)	NPV	Customer Added Costs	Utility Program Costs	NPV	Participant's Retention of Incentive (assumed)	
800	$1,238.19	300	196	$242.04	0	$245.26
200			24		100	
200			24		100	
200			24		100	

Total Resource Cost Test= utility avoided costs / (incentives + participant added costs + program admin. costs)
TRC= 1.53 (Assumes No GHG adder)
TRC= 1.53 (With GHG emissions adder)

Participant Test= (participant's retention of incentive + bill changes)/participant costs
PT= 7.29

Rate Impact Test = utility avoided costs/ (program admin. Costs + incentives + bill changes)
RIM = 0.81
Utility Cost Test = utility avoided costs/(program admin. + incentives)
UC= 1.88

Table No. 3

PG&E Avoided Costs For One kW- "Low" Avoided CT Capital Cost

Year	Avoided CT Capital Cost ($/kW)	Avoided T&D Capital Cost ($/kW)	Avoided Energy Summer On-Peak ($/kWh)	Avoided Energy Summer Off-Peak ($/kWh)	Total Avoided Energy For Summer	Winter Energy Mid-Peak/kWh	Winter Energy Off-Peak	Total Avoided Energy for Winter	GHG Adder cost per ton	GHG Adder avoided cost $/ summer kW	Customer Bill Savings $/kW-yr.
1	137.4	29.7	0.1077	0.0683	22.45	0.101	0.078	11.50	10.21	$3.25	162.82
2	141.5	30.6	0.1109	0.0703	23.12	0.104	0.080	11.85	10.72	$3.41	167.71
3	145.7	31.5	0.1142	0.0725	23.82	0.107	0.083	12.20	11.26	$3.59	172.74
4	150.1	32.5	0.1177	0.0746	24.53	0.110	0.085	12.57	11.82	$3.76	177.92
5	154.6	33.5	0.1212	0.0769	25.27	0.114	0.088	12.94	12.41	$3.95	183.26
6	159.2	34.5	0.1248	0.0792	26.03	0.117	0.090	13.33	13.03	$4.15	188.76
7	164.0	35.5	0.1286	0.0816	26.81	0.121	0.093	13.73	13.68	$4.36	194.42
8	168.9	36.6	0.1324	0.0840	27.61	0.124	0.096	14.14	14.37	$4.58	200.25
9	174.0	37.6	0.1364	0.0865	28.44	0.128	0.099	14.57	15.09	$4.80	206.26
10	179.2	38.8	0.1405	0.0891	29.29	0.132	0.102	15.01	15.84	$5.04	212.45
11	184.6	39.9	0.1447	0.0918	30.17	0.136	0.105	15.46	16.63	$5.29	218.82
12	190.1	41.1	0.1490	0.0945	31.08	0.140	0.108	15.92	17.46	$5.56	225.39
13	195.8	42.4	0.1535	0.0974	32.01	0.144	0.111	16.40	18.20	$5.79	232.15
14	201.7	43.6	0.1581	0.1003	32.97	0.148	0.114	16.89	19.20	$6.11	239.11
15	207.8	45.0	0.1629	0.1033	33.96	0.153	0.118	17.40	20.10	$6.40	246.29
16	214.0	46.3	0.1677	0.1064	34.98	0.157	0.121	17.92	21.0	$6.69	253.67
17	220.4	47.7	0.1728	0.1096	36.03	0.162	0.125	18.46	21.9	$6.97	261.28
NPV	$1,637.1	$354.2			$267.6			$137.1		$44.5	$1,940.7

Notes:

1. Avoided CT capital cost of $126.01 per kW taken from PG&E's Total Fixed Capital Costs in Table A1 in ALJ's October 16, 2008 Ruling in R. 07-01-041.
Added to the generation avoided cost is a line loss assumption of 9 percent. See SCE's Appendix C, "Demand Response Avoided Capacity Valuation Methodology" p. C-10.
2. Avoided T&D capital cost from SCE's Appendix C, "Demand Response Avoided Capacity Valuation Methodology," p. C-12
3. Time-differentiated avoided energy costs were taken from PG&E's time-differentiated heat rates provided in response to data request no. 15.
4. Total Avoided Summer Energy Costs equal the avoided on-peak energy rate minus avoided off-peak times 6 hours times .9 diversity factor times 22 week days per month times 6 summer months, with another 80% utilizatic
5. Total Avoided Winter Energy Costs equal the avoided winter mid-peak energy rate minus avoided winter off-peak energy rate times the storage capacity times 22 week days per month
times six winter months times a 70% utilitization factor.
6. These calculations assume either 1-in-2 or 1-in-10 temperature summers for a partial storage design, or full storage 1-in-2 sizing critereon.
7. GHG adder uses cost per ton figures from PG&E data response to Transphase and 1.34 lbs. per kWh from U.S. DOE's "Carbon Dioxide Emissions from Generation of Electric Power in the United States"
8. Customer Bill Savings developed using PG&E E-20 and calculated beginning in Column S on this sheet.

					Table No. 4				
				Cost Effectiveness Tests for PG&E with "Low" CT Capital Cost					
	Utility		Customer Added		Utility Program		Participant's Retention of Incentive (assumed)		
	Incentive	NPV	Costs		Costs	NPV			
	($/kW)								
	800	$1,238.19	300		196	$242.04	0	$245.26	
	200				24		100		
	200				24		100		
	200				24		100		
					0				
Total Resource Cost Test= utility avoided costs / (incentives + participant added costs + program admin. costs)									
TRC=	1.35		(Assumes No GHG adder)						
TRC=	1.37		(With GHG emissions adder)						
Participant Test= (participant's retention of incentive + bill changes)/participant costs									
PT=	7.29								
Rate Impact Test = utility avoided costs/ (program admin. Costs + incentives + bill changes)									
RIM =	0.71								
Utility Cost= utility avoided costs/(program admin. + incentives)									
UC=	1.65								
All tables and spreadsheets prepared by Doug Ames, Transphase, 11/24/08									

Table No. 5

Example of Load Impact for Large Office Building- 1000 kW Load Shift from TES

			Conventional Weekday				Thermal Storage Weekday		
			A/C Load	Non-A/c Load	Total		a/c load	non-a/c load	Total
Peak Demand, kW									
Summer	On-Peak		1000	400	1400		0	400	400
	Part Peak		600	300	900		600	300	900
	Off-Peak		0	200	200		675	200	875
Winter	Part Peak		600	400	1000		0	400	400
Energy Consumption, kWh									
Summer	On-Peak		5400	2400	7800		0	2400	2400
	Part Peak		3600	2160	5760		3600	2160	5760
	Off-Peak		0	1800	1800		5400	1800	7200
		Total Kwh	9000	6360	15360		9000	6360	15360
Winter	Part Peak		4500	4560	9060		0	4560	4560
	Off-Peak		0	1800	1800		4500	1800	6300
		Total kWh	4500	6360	10860		4500	6360	10860

Table No. 6

Calculation of PG&E Bill Savings

Electric Schedule E-20- Primary Voltage

(rate effective 10/1/08)

	E-20 Rate	Conventional (no TES)		Building With TES		Bill Savings	Bill Savings
		$/mo.	$/ yr.	$/mo.	$/ yr.	$/yr.	$/kW- yr.
Demand Charges ($/kW/month)						(1000 kW TES)	
Max. Peak Summer	11.43	16002	96012	4572	27432	68580	68.58
Max. Part Peak Summer	2.63	2367	14202	2367	14202	0	0
Max. Demand Summer	5.85	8190	49140	5118.75	30712.5	18428	18.43
Max. Part Peak Winter	0.64	640	3840	256	1536	2304	2.30
Max. Demand Winter	5.85	5850	35100	2340	14040	21060	21.06
Total Demand Charges			198294		87922.5	110372	110.37
Energy Charges ($/kWh/month)							
Peak Summer	0.14081	24163	144978	7435	44609	100369	100.37
Part Peak Summer	0.09525	12070	72420	12070	72420	0	0.00
Off-Peak Summer	0.07554	2991	17948	11966	71793	-53845	-53.84
Part-Peak Winter	0.08176	16296	97778	8202	49213	48565	48.57
Off-Peak Winter	0.07178	2842	17055	9949	59692	-42637	-42.64
Total Energy Charges			350180		297728	52453	52.45
Total Demand and Energy Charges			548474		385650	162824	163

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Cost Effectiveness Spreadsheets in Support of Proposed California Thermal Storage Standard Offer

SDG&E Table No. 1 In Support of Transphase Testimony
Proposed Thermal Storage Standard Offer
SDG&E Avoided Costs For One kW- 'Higher' CT Avoided Cost

Year	Avoided CT Capital Cost ($/kW)	Avoided T&D Capital Cost ($/kW)	Avoided Energy Summer On-Peak ($/kWh)	Avoided Energy Summer Off-Peak ($/kWh)	Total Avoided Energy For Summer	Winter Energy Mid-Peak/kWh	Winter Energy Off-Peak	Total Avoided Energy for Winter	GHG Adder $/ton	GHG Adder $/ kW	Customer Bill Savings $/kW-yr.
1	165.7	29.7	0.1077	0.0683	21.05	0.101	0.078	14.38	10.21	$3.25	92.61
2	170.7	30.6	0.1109	0.0703	21.68	0.104	0.080	14.81	10.72	$3.41	95.39
3	175.8	31.5	0.1142	0.0725	22.33	0.107	0.083	15.25	11.26	$3.59	98.25
4	181.0	32.5	0.1177	0.0746	23.00	0.110	0.085	15.71	11.82	$3.76	101.20
5	186.5	33.5	0.1212	0.0769	23.69	0.114	0.088	16.18	12.41	$3.95	104.23
6	192.1	34.5	0.1248	0.0792	24.40	0.117	0.090	16.67	13.03	$4.15	107.36
7	197.8	35.5	0.1286	0.0816	25.13	0.121	0.093	17.17	13.68	$4.36	110.58
8	203.8	36.6	0.1324	0.0840	25.89	0.124	0.096	17.68	14.37	$4.58	113.90
9	209.9	37.6	0.1364	0.0865	26.66	0.128	0.099	18.21	15.09	$4.80	117.31
10	216.2	38.8	0.1405	0.0891	27.46	0.132	0.102	18.76	15.84	$5.04	120.83
11	222.7	39.9	0.1447	0.0918	28.29	0.136	0.105	19.32	16.63	$5.29	124.46
12	229.3	41.1	0.1490	0.0945	29.13	0.140	0.108	19.90	17.46	$5.56	128.19
13	236.2	42.4	0.1535	0.0974	30.01	0.144	0.111	20.50	18.20	$5.79	132.04
14	243.3	43.6	0.1581	0.1003	30.91	0.148	0.114	21.11	19.20	$6.11	136.00
15	250.6	45.0	0.1629	0.1033	31.84	0.153	0.118	21.75	20.10	$6.40	140.08
16	258.1	46.3	0.1677	0.1064	32.79	0.157	0.121	22.40	21.0	$6.69	144.28
17	265.9	47.7	0.1728	0.1096	33.77	0.162	0.125	23.07	21.9	$6.97	148.61
NPV	$1,974.7	$354.2			$250.9			$171.3		$44.5	$1,103.8

Notes:

1. Avoided CT capital cost of $152 per kW "total fixed" capital cost taken from Table A2 in "SDG&E Response dated 10/31/2008" in R.07-01-041.

Added to the generation avoided cost is a line loss assumption of 9 percent. See SCE's Appendix C, "Demand Response Avoided Capacity Valuation Methodology" p. C-10.

2. Avoided T&D capital cost from SCE's Appendix C, "Demand Response Avoided Capacity Valuation Methodology," p. C-12

3. Time-differentiated avoided energy costs were taken from PG&E's time-differentiated heat rates provided in response to data request no. 15.

4. Total Avoided Summer Energy Costs equal the avoided on-peak energy rate minus avoided off-peak times 6 hours x.9 diversity factor x 22 week days per month x 5 summer months, with a 90% utilization facto

5. Total Avoided Winter Energy Costs equal the avoided winter mid-peak energy rate minus avoided winter off-peak energy rate times the storage capacity times 22 week days per month
times seven winter months times a 75% utilitization factor.

6. These calculations assume either 1-in-2 or 1-in-10 temperature summers.

7. GHG adder uses cost per ton figures from PG&E data response to Transphase and 1.34 lbs. per kWh from U.S. DOE's "Carbon Dioxide Emissions from Generation of Electric Power in the United States"

8. Customer Bill Savings developed using PG&E E-20 and calculated beginning in Column S on this sheet.

Table No. 2 for SDG&E
Proposed Thermal Storage Standard Offer
Cost Effectiveness Tests for SDG&E with "Higher" CT Capital Cost

Utility Incentive ($/kW)	NPV	Customer Added Costs	Utility Program Costs	NPV	Participant's Retention of Incentive (assumed)	
800	$1,238.2	300	196	$242.04	0	$245.26
200			24		100	
200			24		100	
200			24		100	

Total Resource Cost Test= utility avoided costs / (incentives + participant added costs + program admin. costs)
TRC= 1.55 (Assumes No GHG adder)
TRC= 1.55 (With GHG emissions adder)

Participant Test= (participant's retention of incentive + bill changes)/participant costs
PT= 4.50

Rate Impact Test = utility avoided costs/ (program admin. Costs + incentives + bill changes)
RIM = 1.08
Utility Cost Test= utility avoided costs/(program admin. + incentives)
UC Test= 1.89

Table No. 3 for SDG&E
SDG&E Avoided Costs For One kW- "Low" Avoided CT Capital Cost

Year	Avoided CT Capital Cost ($/kW)	Avoided T&D Capital Cost ($/kW)	Avoided Energy Summer On-Peak ($/kWh)	Avoided Energy Summer Off-Peak ($/kWh)	Total Avoided Energy For Summer	Winter Energy Mid-Peak/kWh	Winter Energy Off-Peak	Total Avoided Energy for Winter	GHG Adder cost per ton	GHG Adder avoided cost $/ summer l	Customer Bill Savings $/kW-yr.
1	147.2	29.7	0.1077	0.0683	21.05	0.101	0.078	14.38	10.21	$3.25	92.61
2	151.6	30.6	0.1109	0.0703	21.68	0.104	0.080	14.81	10.72	$3.41	95.39
3	156.1	31.5	0.1142	0.0725	22.33	0.107	0.083	15.25	11.26	$3.59	98.25
4	160.8	32.5	0.1177	0.0746	23.00	0.110	0.085	15.71	11.82	$3.76	101.20
5	165.6	33.5	0.1212	0.0769	23.69	0.114	0.088	16.18	12.41	$3.95	104.23
6	170.6	34.5	0.1248	0.0792	24.40	0.117	0.090	16.67	13.03	$4.15	107.36
7	175.7	35.5	0.1286	0.0816	25.13	0.121	0.093	17.17	13.68	$4.36	110.58
8	181.0	36.6	0.1324	0.0840	25.89	0.124	0.096	17.68	14.37	$4.58	113.90
9	186.4	37.6	0.1364	0.0865	26.66	0.128	0.099	18.21	15.09	$4.80	117.31
10	192.0	38.8	0.1405	0.0891	27.46	0.132	0.102	18.76	15.84	$5.04	120.83
11	197.8	39.9	0.1447	0.0918	28.29	0.136	0.105	19.32	16.63	$5.29	124.46
12	203.7	41.1	0.1490	0.0945	29.13	0.140	0.108	19.90	17.46	$5.56	128.19
13	209.8	42.4	0.1535	0.0974	30.01	0.144	0.111	20.50	18.20	$5.79	132.04
14	216.1	43.6	0.1581	0.1003	30.91	0.148	0.114	21.11	19.20	$6.11	136.00
15	222.6	45.0	0.1629	0.1033	31.84	0.153	0.118	21.75	20.10	$6.40	140.08
16	229.3	46.3	0.1677	0.1064	32.79	0.157	0.121	22.40	21.0	$6.69	144.28
17	236.1	47.7	0.1728	0.1096	33.77	0.162	0.125	23.07	21.9	$6.97	148.61
NPV	$1,753.8	$354.2			$250.9			$171.3		$44.5	$1,103.8

Notes:
1. Avoided CT capital cost of $135 per kW taken from SDG&E's Total Fixed Capital Costs for Mirimar II in Table A1 in ALJ's October 16, 2008 Ruling in R. 07-01-041.
Added to the generation avoided cost is a line loss assumption of 9 percent. See SCE's Appendix C, "Demand Response Avoided Capacity Valuation Methodology" p. C-10.
2. Avoided T&D capital cost from SCE's Appendix C, "Demand Response Avoided Capacity Valuation Methodology," p. C-12
3. Time-differentiated avoided energy costs were taken from PG&E's time-differentiated heat rates provided in response to data request no. 15.
4. Total Avoided Summer Energy Costs equal the avoided on-peak energy rate minus avoided off-peak times 6 hours x.9 diversity factor x 22 week days per month x 5 summer months, with a 90% utilization facto
5. Total Avoided Winter Energy Costs equal the avoided winter mid-peak energy rate minus avoided winter off-peak energy rate times the storage capacity times 22 week days per month
times seven winter months times a 75% utilitization factor.
6. These calculations assume either 1-in-2 or 1-in-10 temperature summers for a partial storage design, or full storage 1-in-2 sizing critereon.
7. GHG adder uses cost per ton figures from PG&E data response to Transphase and 1.34 lbs. per kWh from U.S. DOE's "Carbon Dioxide Emissions from Generation of Electric Power in the United States"
8. Customer Bill Savings developed using PG&E E-20 and calculated beginning in Column S on this sheet.

Table No. 4 for SDG&E
Cost Effectiveness Tests for SDG&E with "Low" CT Capital Cost

Utility Incentive ($/kW)	NPV	Customer Added Costs	Utility Program Costs	NPV	Participant's Retention of Incentive (assumed)	
800	$1,238.2	300	196	$242.04	0	$245.26
200			24		100	
200			24		100	
200			24		100	

Total Resource Cost Test= utility avoided costs / (incentives + participant added costs + program admin. costs)
TRC= 1.42 (Assumes No GHG adder)
TRC= 1.45 (With GHG emissions adder)

Participant Test= (participant's retention of incentive + bill changes)/participant costs
PT= 4.50

Rate Impact Test = utility avoided costs/ (program admin. Costs + incentives + bill changes)
RIM = 1.00

Utility Cost Test= utility avoided costs/(program admin. + incentives)
UC= 1.74

All tables and spreadsheets prepared by Doug Ames, Transphase, 11/24/08

Table No. 5 for SDG&E Territory
Example of Load Impact for Large Office Building- 1000 kW Load Shift from TES

			Conventional Weekday			Thermal Storage Weekday		
			A/C Load	Non-A/c Load	Total	a/c load	non-a/c load	Total
Peak Demand, kW								
Summer	On-Peak		1000	400	1400	0	400	400
	Part Peak		600	300	900	600	300	900
	Off-Peak		0	200	200	675	200	875
Winter	Part Peak		600	400	1000	0	400	400
Energy Consumption, kWh								
Summer	On-Peak		5400	2400	7800	**0**	2400	2400
	Part Peak		3600	2160	5760	3600	2160	5760
	Off-Peak		0	1800	1800	5400	1800	7200
		Total Kwh	9000	6360	15360	9000	6360	15360
Winter	Part Peak		4500	4560	9060	0	4560	4560
	Off-Peak		0	1800	1800	4500	1800	6300
		Total kWh	4500	6360	10860	4500	6360	10860

Table No. 6 for SDG&E Territory
Calculation of SDG&E Bill Savings
SDG&E's Electric Schedule CPP-D Rate
(rate effective 5/1/08)

		Conventional (no TES)		Building With TES		Bill Savings	Bill Savings
	Primary	$/mo.	$/ yr.	$/mo.	$/ yr.	$/yr.	$/kW- yr.
<u>Electric Energy Charges ($/kWh)</u>							
CPP Period	1.02	15912	79560	4896	24480	55080	55.08
Peak Summer	0.10094	15747	94480	4845	29071	65409	65.41
Part Peak Summer	0.08086	10247	61479	10247	61479	0	0.00
Off-Peak Summer	0.05953	2357	14144	9430	56577	-42433	-42.43
Part-Peak Winter	0.09067	18072	108434	9096	54576	53858	53.86
Off-Peak Winter	0.06617	2620	15722	9171	55027	-39305	-39.30
Total Electric Charges			<u>373820</u>		<u>281211</u>	<u>92609</u>	<u>93</u>

1. Assumes two CPP events called per summer month for five months.