Appendix A

Discussion of Cost-Effectiveness Calculations

The law states that the Commission's appliance standards may not "result in any added total costs to the consumer over the design life of the appliance." (Public Resources Code section 25402(c)(1).) This means that over the life of an appliance, consumers must be better off monetarily (or at least no worse off) if the appliance is subject to the applicable standard than they would be if the appliance were not subject to the standard. This concept is also referred to as "cost-effectiveness."

There are two basic ways in which consumers are affected financially by a new appliance standard. First, consumers (usually) must pay more for a more efficient appliance, because what typically makes the appliance more efficient are additional materials, parts, or research and development, all of which tend to cost more money. Second, consumers save money because they pay less in energy costs to run the appliance. (There may be other costs or savings, such as in maintenance costs, but those tend not to be effected by changes in efficiency.) A proposed standard is cost-effective if the cost savings resulting from the standard would equal or exceed the additional costs resulting from the standard, over the "design life" of the appliance. In most cases, the design life of the appliance is not changed by the standard. The formula that follows assumes that this is the case.

The Commission evaluates cost-effectiveness by comparing the present values of costs and benefits. Following is the generalized equation showing how this comparison is made. (see endnote i,ii)

Added (Reduced) Total Costs over the Design Life of the Appliance	= Added First Cost	- Present value of electricity cost savings	- Present value of gas cost savings	+ Present value of added maintenance cost (if any)	- Present value of reduced maintenance cost (if any)

Some appliances use both gas and electricity. Most appliances use one or the other.

There may be circumstances, though not within this proceeding, where higher efficiency appliances have slightly higher maintenance costs. A few appliances within this proceeding have significantly lower maintenance costs; however, maintenance costs for most higher-efficiency appliances are unchanged since the fundamental technologies used to achieve the higher efficiencies are no different than those used in current production products.

If **Added Total Costs** are equal to or less than zero, then the proposed standard is cost-effective.

Added First Cost, expressed in dollars, are all of the added costs that a standard imposes on a typical consumer, including the additional costs to purchase the appliance (first cost) and any other additional costs such as added installation costs. For instance, some very efficient gas water heaters require more expensive venting systems, which are not part of the water heater. Added First Cost, expressed in dollars, is calculated by comparing the estimated purchase price of a "base-case" appliance of the most common size and design sold today[1] with the estimated purchase price of an appliance, of that same size and design, which barely meets the proposed standard. **Added First Cost** includes added sales tax paid by the consumer.

Energy Costs assumed in calculating cost effectiveness are based on the costs of energy paid by consumers. These costs depend on whether the appliance is commonly used by residential or commercial energy customers. A forecast model developed for the Energy Commission's Energy Information and Analysis Division was used to estimate future energy costs. Electricity costs are from recent analysis by the Commission's Energy Information and Analysis Division; natural gas prices are based on the Commission's *Natural Gas Market Outlook 2000 – 2020*, Appendices C and H. These costs are based on aggregated statewide average analysis.

Design Life is the expected life of the appliance. In most cases the expected life does not change with a new standard. There are, however, notable exceptions such as lamps. In these cases, the cost effectiveness calculation becomes more complicated. For instance, if the base case lamp has a two year life and the more efficient lamp has a ten year life, the comparison is made over ten years and assumes, for the base case, that the lamp is replaced four times in the ten years.

Discount Rate is based on the real after-tax cost of capital for building owners or purchasers of commercial equipment on the basis that major purchases can be funded through financing with tax deductible interest. A simple way to estimate the discount rate is shown by the following examples:

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[1] For those appliances for which a minimum performance standard already exists, the "base-case" appliance typically is one that just complies with that standard.

Estimated Discount Rate, 30-Year Fixed Rate Home Loan

	6.04%	interest rate for loan
X	63.00%	tax effect (assuming 28% federal tax rate and 7.75% state tax rate)
=	3.81%	after-tax interest rate
-	1.74%	inflation rate (see endnote iii)
=	2.07%	real after-tax discount rate

Estimated Discount Rate, $10,000 Home Equity Loan

	6.83%	interest rate for loan
X	63.00%	tax effect (assuming 28% federal tax rate and 7.75% state tax rate)
=	4.30%	after-tax interest rate
-	1.74%	inflation rate (see endnote iii)
=	2.56%	real after-tax discount rate

Estimated Discount Rate, Credit Union 7-Year Fixed Home Equity Loan

	4.99%	interest rate for loan
X	63.00%	tax effect (assuming 28% federal tax rate and 7.75% state tax rate)
=	3.14%	after-tax interest rate
-	1.74%	inflation rate (see endnote iii)
=	1.40%	real after-tax discount rate

Estimated Discount Rate, Credit Union 20-Year Fixed Home Equity Loan

	6.99%	interest rate for loan
X	63.00%	tax effect (assuming 28% federal tax rate and 7.75% state tax rate)
=	4.40%	after-tax interest rate
-	1.74%	inflation rate (see endnote iii)
=	2.66%	real after-tax discount rate

Estimated Discount Rate, SAFE Credit Union Visa Platinum Credit Card

	6.90%	Annual Percentage Rate
X	0.00%	tax effect (not applicable for non-mortgage or non-equity loan)
=	6.90%	after-tax interest rate
-	1.74%	inflation rate (see endnote iii)
=	5.16%	real after-tax discount rate

The average of the current wide-ranging interest rates shown in the above examples is 2.77%.

Different assumptions for the interest rate, tax rate, and inflation rate could yield different discount rates, but the 3 percent rate is plausible for reasonable combinations of assumptions, since higher interest rates would be correlated with higher inflation rates. (see endnote iv)

The **Present Value** of a dollar of savings (or costs) in each future year is calculated by reducing the savings (or costs) by the **Discount Rate**.

The equation for determining the present value of a dollar in a future year is:

$$\Pr esentValue = \frac{FutureValue}{(1 + DiscountRate)}$$

The present value for one year is then:

$$\Pr esentValue = \frac{1}{(1 + 0.03)} = 0.970874$$

The **Present Value** of a dollar saved (or spent) two years from now is:

$$\Pr \mathrm{esentValue} = \frac{1}{(1 + 0.03)^2} = 0.942596$$

and so on. All costs and savings that occur in any year other than the first year of the **Design Life** are reduced to a present value.

Following is a table showing the present worth of one dollar in each of 30 future years.

Table 21 - Present Worth of Dollar for Next 30 Years

Single Payment Present Worth Factors	
Year Number	Present value of one dollar
1	0.970874
2	0.942596
3	0.915142
4	0.888487
5	0.862609
6	0.837484
7	0.813092
8	0.789409
9	0.766417
10	0.744094
11	0.722421
12	0.70138
13	0.680951
14	0.661118
15	0.641862
16	0.623167
17	0.605016
18	0.587395
19	0.570286
20	0.553676
21	0.537549
22	0.521893
23	0.506692
24	0.491934
25	0.477606
26	0.463695
27	0.450189
28	0.437077
29	0.424346
30	0.411987

Since energy costs normally occur monthly, but an annual analysis is used for simplicity, an approximation is made to account for timing of the monthly costs. This approximation assumes the first years cost occur at the beginning of the first period and therefore are not discounted and then assumes that all other future costs occur at the end of each period. For example, if a standard is adopted for an electric appliance with a five-year useful life expectancy, to take effect on January 1, 2006, the present worth of the energy savings (in 2006) is the sum of:

[iv] Website, Bankrate.com, May 10, 2004; 30 Year Fixed rate home loan – 6.04%, Home equity loan, $10,000 – 6.83%, 5-Year New car loan – 5.61%.

Website, Golden1.com, May 7, 2004; Credit Union 15-Year Fixed home equity loan – 5.49%, Credit Union 7-Year Fixed home equity loan – 4.99%, Credit Union 20-Year Fixed home equity loan – 6.99%.

Website, Safecu.org, May 10, 2004; Visa Platinum no fee credit card interest rate – 5.16%.

[vii] Simple Payback is a simpler, but less precise, method of calculating cost-effectiveness. Simple payback = added first cost divided by the first year energy cost savings; The simple payback period is the number of years required to make up for the added cost through energy cost savings.

SUMMARY OF COST EFFECTIVENESS

METHODOLOGY AND ASSUMPTIONS

March 29, 1990

Since it is important that we have as much agreement as possible on the life cycle cost methodology, staff is sending out this summary of proposed methodology and assumptions. This summary includes recommendations made at the workshop held on January 17, 1990. Staff is prepared to discuss the subjects included in this report.

The initial costs of efficency improving measures will be the subject of a separate report.

Jon Leber P.E.

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This report presents the methodologies and assumptions that staff proposes to use in the life cycle cost analysis of the efficiency standards for new buildings planned for adoption by January of 1991. Staff intent, in developing these proposed equations, is to simplify the LCC analysis while still including the parameters to which the analysis is most sensitive.

1. Criteria for Selecting Energy Budget

Individual measures or groups of measures will be evaluated based on their effect on the total life cycle cost of owning and operating a building in comparison to a building with measures as they are currently required by the building standards. If a measure reduces total life cycle cost, the measure is cost-effective.

2. Equation for Determining the Change in Life Cycle Cost

The general equation for determining the differences in life cycle costs is:

$$\binom{\text{Change}}{\text{in LCC}} = \binom{\text{Initial Cost}}{\text{of measure}} - \binom{\text{Present value of}}{\text{electricity cost savings}} - \binom{\text{Present value of}}{\text{gas cost savings}}$$

Where the value of electricity and natural gas cost savings are calculated as:

$$\binom{\text{Present value of}}{\text{energy cost savings}} = \binom{\text{Energy saved}}{\text{per year}} \times \binom{\text{Present value of the cost of}}{\text{energy over the measure life}}$$

If the change in life cycle cost is negative, the measure is cost effective.

This general equation is most applicable to a single measure or a group of measures being analyzed together. To compare the life cycle cost effect of individual measures as each is added to the building, equations for determining the total life cycle cost of all measures is more convenient.

Staff proposes to use the form of the two following equations to determine the life cycle cost of alternatives.

Residential

$$DLCC = 1.000DC + (DAGC)(14.08) + (DAEC)(1.946) + \sum_{i=1}^{30} \frac{DRC_i}{(1+DRS)^i}$$

Nonresidential

$$DLCC = 1.000DC + (DAGC)(6.472) + (DAEC)(1.043) + \sum_{i=1}^{15} \frac{DRC_i}{(1+DRS)^i}$$

Where:

DC	=	Difference in initial Cost in dollars
DAGC	=	Difference in annual natural gas use in therms
DAEC	=	Difference in annual electricity use in kWh
DRC_i	=	Difference in replacement costs in year i
DRS	=	0.03 (Annual real discount rate expressed as a fraction.)

The Commission's Building and Appliance Efficiency program has historically used a net present value analysis for economic comparisons. This analysis method allows a ready comparison of alternatives that effect the initial cost of the building.

Staff intends to use an incremental life cycle cost for the 1991 standards.

In this analysis, only the cost and savings of specific measures are included in an iteration of the analysis. The measure is compared to a structure with measures as they are currently required by the standards. If the resulting life cycle cost with the additional measure is lower than without the measure, the measure is life cycle cost effective. To analyze the measures already required by the standards, each measure will be individually moved to the next lower practical efficiency level and the life cycle cost of the resultant structure will be compared with the cost of the structure that includes the measure.

3. Determining Energy Use and Savings

A. Residential Structures

The energy use of residential structures will be estimated using the CALRES 1.10 compliance computer program. The analysis will be based on efficiency measures installed in 2 prototypical structures in each of the 5 typical climate zones in California, 3, 7, 13, 15, and 16. One of these structures is a 1761 square foot, 2 story, single family dwelling unit. The other is a 64,820 square foot multifamily unit with interior located hallways. Four additional prototypes will be tested in the 3 climate zones 9, 12, and 16 to examine the sensitivity of the analysis to the prototype selection. The appliance efficiency for these structures will be based on the appliance standards that are scheduled to be in effect on January 1, 1993. The description of the input parameters for the six prototype buildings is included in the staff report titled "Residential Building Prototypes for Analysis of 1991 Standards".

B. Nonresidential Structures

The energy use of nonresidential structures will be estimated using the DOE 2.1D computer program. The analysis will be based on efficiency measures installed in ~~a~~ prototypical structures in each of the 5 typical climate zones in California, 3, 7, 13, 15, and 16. The structure is a 10,000 square foot, 1 story, commercial building with a 15 foot perimeter zone and based on a prototype building used for ASHRAE Standard 90.1. The appliance efficiency for these structures will be based on the appliance standards that are scheduled to be in effect on January 1, 1993. The description of the input parameters for the prototype buildings is included in the staff report titled "Nonresidential Building Prototypes for analysis of 1991 Standards".

4. Lifetime of Systems and Measures

A. Residential

The lifetime of all residential measures except those listed below is assumed to be 30 years. These lifetimes will be verified when the Commission determines the costs of measures.

- Central Air Conditioners - 15 years
- Furnaces - 15 years
- External Shade Screens - 5 years
- Roller Shades - 1 year
- Water Heaters - 10 years

B. Nonresidential

The lifetime of all nonresidential measures except those listed below is assumed to be 15 years. These lifetimes will be verified when the Commission determines the costs of measures.

- Economizers - 7.5 years
- Retail Lighting - 5 years
- Other lighting - 7.5 years

5. Energy Costs

Staff proposes to use the average costs of providing the additional energy required by the buildings constructed to the new standards.

The costs of energy are those used for the Commission's Electricity Report 90 proceedings. These were formally adopted by the Commission in early 1990. Separate energy prices are forecast for electricity and natural gas and for residential and nonresidential users. The prices are forecast for each year over 20 years for each of the 5 major electric utility planning areas in

California (PG&E, SCE, SDG&E, SMUD and LADWP) and over 30 years for the three major gas utilities (PG&E, SCG and SDG&E). Electricity prices are extrapolated to years 20 through 30 assuming a linear real growth rate in the energy prices. These prices are weighted by expected additions to houses and commercial floor space in each utility planning area to develop a statewide average price for each year. These price series are shown in Tables A-1 through A-3 of Appendix A. The following table shows the present worth of 1 kWh per year and of 1 therm per year calculated at 3% discount rate and using single payment present worth factors for each year of the tables in Appendix A.

Present Worth of Energy for Selected Periods of Analysis

	Residential			Nonresidential		
Period (Years)	1	15	30	1	15	30
Electricity ($/(kWh/yr))	0.096	1.177	1.946	0.088	1.043	1.733
Natural Gas ($/(therm/yr))	0.535	7.565	14.083	0.458	6.472	12.209

Note that we will not include the effects of time-of-use rates that apply to most nonresidential customers. There are two reasons for this. First, rates are designed to include a number of different variables: customer cost ($ per month), demand charge ($ per kW-month), and the energy charge ($/kWh). Experience has shown that the relative cost of these charges has been changed dramatically by the PUC and utilities over the past years, which makes it impossible to forecast what future rate designs will be like. To assume current rate designs will be held constant would give the analyses an artificial appearance of accuracy, when in fact future time-of-use rates will be different.

The second reason is that including time-of-use rates would require calculating energy savings by time-of-use which would be very difficult. Since the savings is more sensitive to specific building use patterns than energy use alone the resulting complication of the analysis would not increase the accuracy of the results.

6. Inflation Index

To adjust nominal costs to real values, we will use the inflation forecast adopted by the CEC in its demand forecast to adjust all costs to 1989 dollars. The price deflator indices that result from that forecast are shown in Table A-4 of Appendix A.

7. Discount Rate

The staff is recommending a 3 percent discount rate. This rate is based on an estimate of the real after-tax cost of capital to building owners. A real rate is used because taxes affect market interest rates and it is not practical to exclude their effects (evidenced by the different interest rates paid on taxable and nontaxable bonds). While there are many ways the discount rate could be estimated, a simple way to estimate the discount rate would be:

	11%	interest rate for loan
	x 63%	tax effect (assuming 28% Federal tax rate and 9% State tax rate)
=	6.9%	after-tax interest rate
	- 4%	inflation rate (as forecast by the Council of Economic Advisors)
=	2.9%	real after-tax discount rate

Different assumptions for the interest rate, tax rate, and inflation rate could yield different discount rates, but the 3 percent rate is plausible for reasonable combinations of assumptions, since higher interest rates would be correlated with higher inflation rates.

The Department of Energy recently proposed a similar calculation to derive discount rates to be used to evaluate Federal agency in-house energy management programs (Notice of Proposed Rulemaking, Federal Register, January 25, 1990). In their calculation they take the long-term Treasury bond interest rate (currently 8.5%) and subtract the Council of Economic Advisors inflation forecast (currently 4%) and estimate a discount rae of 4.5%. This rate is applicable for Federal investments because the Federal government does not pay taxes, and consequently an after-tax rate has no meaning. However, if the Federal government included the fact that bondholders pay Federal tax (about 28%) on Treasury bonds, the after-tax discount rate would be 2.1%.

8. Other Factors

In previous analyses of building standards the CEC had performed detailed evaluations of the effects of taxes, costs of replacements and insurance, and value for resale at the end of the life of the equipment or building. These items complicate the analysis greatly, and have a small effect on the results. Therefore, in this analysis we will not include these effects.

APPENDIX A

ENERGY PRICE AND INFLATION PARAMETERS

TABLE A-1

ELECTRICITY PRICE IN $ PER kWh PER YEAR, USING PRESENT WORTH OF ANNUAL COSTS

	RESIDENTIAL						COMMERCIAL					
WEIGHT->	0.399	0.401	0.119	0.041	0.040	WTD STATE	0.366	0.353	0.094	0.059	0.128	WTD STATE
UTILITY->	PGE	SCE	SDGE	SMUD	LADWP	AVG	PGE	SCE	SDGE	SMUD	LADWP	AVG
DISCOUNT RATE						15 YEARS						
0.030	1.215	1.149	1.239	1.017	1.054	1.177	1.088	1.021	1.023	0.999	1.010	1.043
0.040	1.145	1.085	1.166	0.956	0.988	1.109	1.025	0.965	0.963	0.939	0.947	0.983
0.060	1.024	0.972	1.040	0.851	0.875	0.992	0.916	0.866	0.859	0.836	0.839	0.878
						30 YEARS						
0.030	1.995	1.886	2.104	1.641	1.899	1.946	1.789	1.668	1.745	1.604	1.803	1.733
0.040	1.778	1.681	1.868	1.463	1.673	1.733	1.594	1.488	1.549	1.431	1.590	1.542
0.060	1.445	1.367	1.508	1.190	1.330	1.406	1.294	1.213	1.249	1.164	1.267	1.250

PRICES FROM "Transmittal of ER 90's Systemwide Average Electricity Prices" November 13, 1989 memo from Scott Matthews to Sy Goldstone. Estimates are adjusted to 1989 dollars, extrapolated to 2018 using escalation rate for 2004 to 2009 and distributed by the growth rate in each utility planning area from Mike Jaske.

GAS PRICES IN $ PER THERM PER YEAR, PRESENT WORTH OF ANNUAL COSTS
FROM BILL WOOD (4-3189) - 2/7/90

	RESIDENTIAL				COMMERCIAL			
WEIGHT->	0.438	0.443	0.119	WTD STATE	0.423	0.484	0.093	WTD STATE
UTILITY->	PGE	SCG	SDGE	AVG	PGE	SCG	SDGE	AVG
DISCOUNT RATE				15 YEARS				
0.030	7.033	8.183	7.219	7.565	6.486	6.330	7.144	6.472
0.040	6.592	7.666	6.768	7.089	6.079	5.929	6.698	6.064
0.060	5.832	6.775	5.990	6.268	5.377	5.237	5.928	5.361
				30 YEARS				
0.030	13.099	15.284	13.229	14.083	12.177	12.065	13.107	12.209
0.040	11.508	13.421	11.641	12.371	10.690	10.574	11.532	10.712
0.060	9.096	10.596	9.229	9.777	8.437	8.319	9.140	8.446

PRICES FROM "Long Range Natural Gas Price Forecast" February 7, 1990 memo from John Rozsa to Elena Schmid. Prices are redistributed by growth rate in each utility planning area as provided by Mike Jaske.

03/12/90

TABLE A-2

GAS PRICES
FROM BILL WOOD (4-3189) - 2/7/90

	RESIDENTIAL				COMMERCIAL			
				WTD				WTD
WEIGHT->	0.438	0.443	0.119	STATE	0.423	0.484	0.093	STATE
YEAR	PGE	SCG	SDGE	AVG	PGE	SCG	SDGE	AVG
1989	0.519	0.554	0.521	0.535	0.478	0.429	0.516	0.458
1990	0.510	0.595	0.530	0.550	0.471	0.456	0.524	0.469
1991	0.521	0.603	0.534	0.559	0.481	0.465	0.529	0.478
1992	0.527	0.628	0.556	0.575	0.486	0.482	0.550	0.490
1993	0.541	0.627	0.568	0.582	0.498	0.483	0.562	0.497
1994	0.555	0.643	0.579	0.597	0.510	0.495	0.572	0.509
1995	0.565	0.657	0.584	0.608	0.520	0.507	0.578	0.519
1996	0.580	0.691	0.591	0.630	0.534	0.530	0.585	0.537
1997	0.590	0.700	0.601	0.640	0.543	0.538	0.595	0.545
1998	0.601	0.710	0.618	0.651	0.554	0.548	0.611	0.556
1999	0.611	0.718	0.626	0.660	0.564	0.557	0.619	0.566
2000	0.622	0.726	0.636	0.670	0.574	0.565	0.630	0.575
2001	0.631	0.736	0.641	0.679	0.583	0.576	0.635	0.584
2002	0.641	0.747	0.646	0.689	0.593	0.586	0.639	0.594
2003	0.654	0.762	0.658	0.702	0.606	0.601	0.652	0.608
2004	0.668	0.776	0.670	0.716	0.620	0.615	0.663	0.622
2005	0.685	0.791	0.686	0.732	0.636	0.630	0.680	0.637
2006	0.694	0.812	0.700	0.747	0.645	0.648	0.693	0.651
2007	0.708	0.832	0.711	0.763	0.659	0.666	0.705	0.667
2008	0.727	0.853	0.723	0.782	0.678	0.684	0.717	0.685
2009	0.745	0.873	0.734	0.800	0.696	0.702	0.728	0.702
2010	0.752	0.893	0.752	0.814	0.706	0.720	0.746	0.716
2011	0.772	0.912	0.768	0.834	0.726	0.737	0.762	0.735
2012	0.791	0.933	0.785	0.853	0.745	0.756	0.779	0.753
2013	0.809	0.951	0.799	0.871	0.763	0.772	0.793	0.770
2014	0.827	0.969	0.813	0.888	0.780	0.789	0.807	0.787
2015	0.844	0.987	0.827	0.905	0.797	0.805	0.821	0.803
2016	0.861	1.005	0.841	0.922	0.815	0.821	0.835	0.820
2017	0.879	1.023	0.857	0.940	0.832	0.838	0.852	0.837
2018	0.903	1.046	0.876	0.963	0.856	0.859	0.871	0.859

GAS % HOUSEHOLD CHANGES BY UPA

	RES %			NONRES
PGE	42.800	43.808	41.700	42.2
SCG	43.300	44.319	47.800	48.4
SDGE	11.600	11.873	9.200	9.3
TOTAL	97.700	100.000	98.700	100.0

TABLE A-3

1.000

ELECTRICITY

PRICES FROM JOHN WILSON TABLES REDISTRIBUTED BY GROWTH RATE IN EACH UPA

EPMC CORRECTION ON COMMERCIAL APPLIED FROM 1995 OUT TO PGE - T. GORIN

	RESIDENTIAL						COMMERCIAL					
						WTD						WTD
WEIGHT->	0.399	0.401	0.119	0.041	0.040	STATE	0.366	0.353	0.094	0.059	0.128	STATE
YEAR	PGE	SCE	SDGE	SMUD	LADWP	AVG	PGE	SCE	SDGE	SMUD	LADWP	AVG
1989	0.100	0.093	0.106	0.079	0.082	0.096	0.092	0.090	0.088	0.078	0.079	0.088
1990	0.105	0.103	0.105	0.088	0.073	0.102	0.092	0.094	0.087	0.086	0.070	0.089
1991	0.105	0.104	0.103	0.078	0.076	0.102	0.092	0.093	0.085	0.077	0.072	0.088
1992	0.106	0.105	0.102	0.079	0.083	0.103	0.093	0.092	0.084	0.078	0.080	0.089
1993	0.105	0.103	0.100	0.081	0.082	0.102	0.093	0.090	0.083	0.079	0.078	0.088
1994	0.103	0.100	0.099	0.083	0.083	0.100	0.092	0.088	0.081	0.082	0.079	0.087
1995	0.101	0.097	0.099	0.085	0.085	0.098	0.091	0.085	0.081	0.084	0.081	0.086
1996	0.099	0.094	0.097	0.088	0.086	0.096	0.090	0.083	0.080	0.086	0.082	0.085
1997	0.097	0.092	0.098	0.088	0.088	0.094	0.088	0.080	0.081	0.087	0.085	0.084
1998	0.095	0.088	0.100	0.087	0.091	0.092	0.085	0.077	0.082	0.085	0.087	0.082
1999	0.093	0.086	0.101	0.085	0.093	0.091	0.083	0.075	0.084	0.084	0.089	0.081
2000	0.092	0.083	0.100	0.079	0.095	0.089	0.083	0.073	0.083	0.078	0.091	0.080
2001	0.091	0.081	0.099	0.081	0.094	0.088	0.082	0.071	0.082	0.079	0.090	0.079
2002	0.091	0.079	0.099	0.079	0.093	0.087	0.081	0.070	0.082	0.078	0.090	0.078
2003	0.090	0.079	0.101	0.079	0.094	0.087	0.081	0.069	0.083	0.078	0.090	0.078
2004	0.090	0.079	0.101	0.079	0.095	0.087	0.081	0.069	0.084	0.078	0.091	0.078
2005	0.091	0.080	0.101	0.078	0.094	0.087	0.081	0.071	0.088	0.077	0.090	0.079
2006	0.091	0.083	0.106	0.075	0.096	0.089	0.082	0.073	0.087	0.074	0.092	0.080
2007	0.093	0.085	0.106	0.075	0.102	0.091	0.083	0.075	0.088	0.073	0.098	0.082
2008	0.094	0.088	0.107	0.075	0.102	0.0[illegible]	0.084	0.078	0.089	0.074	0.098	0.084
2009	0.097	0.090	0.107	0.074	0.104	0.095	0.087	0.078	0.090	0.073	0.099	0.085
2010	0.098	0.092	0.109	0.076	0.106	0.096	0.089	0.080	0.091	0.074	0.101	0.086
2011	0.100	0.094	0.110	0.077	0.108	0.098	0.090	0.082	0.092	0.075	0.102	0.088
2012	0.101	0.096	0.111	0.079	0.110	0.100	0.091	0.085	0.093	0.076	0.103	0.090
2013	0.103	0.099	0.113	0.080	0.112	0.102	0.093	0.087	0.094	0.077	0.104	0.091
2014	0.104	0.101	0.114	0.082	0.114	0.104	0.094	0.089	0.095	0.079	0.105	0.093
2015	0.106	0.104	0.115	0.084	0.117	0.106	0.095	0.091	0.096	0.080	0.107	0.094
2016	0.107	0.107	0.116	0.085	0.119	0.108	0.097	0.093	0.097	0.081	0.108	0.096
2017	0.109	0.109	0.118	0.087	0.121	0.110	0.098	0.096	0.097	0.082	0.109	0.098
2018	0.110	0.112	0.119	0.089	0.123	0.112	0.099	0.098	0.098	0.083	0.110	0.099

PRICES FROM 2009 THROUGH 2018 EXTRAPOLATED FROM 2009 USING AVERAGE GROWTH RATE FROM 2004 THROUGH 2009.

Table A-4

PRICE DEFLATOR
(1989 = 1.000)

YEAR	DEFLATOR
1980.000	0.677
1981.000	0.743
1982.000	0.790
1983.000	0.821
1984.000	0.850
1985.000	0.876
1986.000	0.900
1987.000	0.929
1988.000	0.961
1989.000	1.000
1990.000	1.046
1991.000	1.096
1992.000	1.148
1993.000	1.206
1994.000	1.269
1995.000	1.336
1996.000	1.410
1997.000	1.488
1998.000	1.570
1999.000	1.656
2000.000	1.749
2001.000	1.845
2002.000	1.944
2003.000	2.047
2004.000	2.156
2005.000	2.270
2006.000	2.390
2007.000	2.515
2008.000	2.646
2009.000	2.783

Source: CEC Staff. "GNP Price Deflator Projections for CFM 8," memo from D. Johnson prepared for ER 90, dated June 1, 1989

State of California — The Resources Agency of California

Memorandum

To : Building Efficiency Committee

Date : March 14, 1990

Telephone: ATSS (   )
(   )

From : California Energy Commission
1516 Ninth Street
Sacramento 95814-5512

Elena Schmid (d2b)
Elena Schmid
Building and Appliance Efficiency Office

Subject : Determination of Energy Prices for Developing the Life Cycle Cost Analysis for the Energy Efficiency Standards for New Buildings

Attached are the energy prices, in 1989 dollars, that staff plans to use for the life cycle cost analysis. The price series used for each major utility area for natural gas is shown in Table A-2. The price series used for each major utility for electricity is shown in Table A-3. A summary of the prices are shown in Table A-1. This summary shows the present worth of the energy prices from Tables A-2 and A-3 for discount rates of 3%, 4% and 6%.

These tables are similar to those shown in the staff report prepared for the January 17, 1990 workshop, but have been revised to include comments by Mr. Wood of the Commissions's Fossil Fuels office, and Mr. Jaske and Mr. Gorin of the Commission's Demand Forecasting Office.

The January 17, 1990 tables were provided by Mr. Wilson and were based on the system wide energy prices developed for ER 90. These values were only available for 20 years (through 2009) and were therefore extrapolated to 30 years (through 2018). The extrapolation applied the growth rate for the years 2004 through 2009 to the years from 2009 to 2018.

Mr. Wood noted that the gas prices appeared too high in some years for some utilities and provided a new gas price series. This series was incorporated into Table A-2.

Mr. Jaske noted that the distribution of the prices by utility area, as provided for the ER was not the same as the distribution of prices be new construction in each utility area. Mr. Jaske suggested the latter would be a better distribution and provided those utility distribution weights to staff. These distribution weights were incorporated into Table A-2 and Table A-3.

Mr. Gorin noted that there the electricity price tables needed to be adjusted to bring them into line with the values being used in the forecast. Mr. Gorin provided a new electricity price series. Mr. Gorin also recommended the commercial price series for Pacific Gas and Electric be increased by 3% each year for the years following 1994. The new values were incorporated in Table A-3.

The March 12, 1990 tables incorporate these recommendations.

APPENDIX B

TIME OF USE RATES

STATE OF CALIFORNIA—THE RESOURCES AGENCY GEORGE DEUKMEJIAN, *Governor*

CALIFORNIA ENERGY COMMISSION
R KEVORKIAN, COMMISSIONER
51 NTH STREET
SACRAMENTO, CA 95814-5512
(916) 324-3259

MEMORANDUM

March 27, 1990

TO: Efficiency Standards Committee
Dick Bilas
Art Kevorkian

FROM: John Wilson

SUBJECT: Time-of-Use Rates in Cost-Effectiveness Analysis

Several parties in the nonresidential standards project have suggested using time-of-use (TOU) rates to evaluate the cost-effectiveness of conservation measures. While is it intuitively appealing to value peak electricity more than off-peak, there are important practical and policy reasons why we should not use TOU rates in the upcoming nonresidential standards rulemaking.

The practical reason is that using TOU rates would only create the illusion of accuracy in the cost-effectiveness analysis, while greatly increasing the effort required to revise the standards, and probably creating an unacceptable delay in the adoption date. The variation in TOU rates is described below, and shows that the rate differences are so large that a hypothetical statewide average TOU rate would not accurately reflect any customer's utility bill. While it makes sense to do sensitivity analysis on *specific* buildings and *specific* utility service areas, there is no plausible way to derive a statewide average TOU rate to use to set the standards.

In the absence of a statewide TOU rate, it is tempting to propose setting standards based on actual tariffs. However, we are setting *statewide* standards for *minimum* efficiency. The *statewide* aspect is important because using utility-specific TOU rates would require setting different standards for different utility service areas and by size of building (based on kW load), which would greatly complicate the standards.

The *minimum* efficiency aspect is important because the standards do not attempt to mandate every efficiency option. While using TOU rates may result in finding more lighting and cooling measures to be cost-effective (since they are on-peak energy uses), there are other ways to encourage additional peak conservation without involving standards. For example, if there are issues associated with peak energy use for a specific utility then they could offer incentives for new buildings designed to discourage on-peak energy use (or encourage off-peak use).

The following discussion describes some of the issues in using TOU rates to cost-effectiveness analysis.

TOU rates vary within a utility. Utility tariffs differ according to **size** (measured in monthly maximum kW) and **voltage level** at which service is taken ("secondary" which is less than 2 kV, "primary" which is 2 to 50 kV, and "transmission" which is greater than 50 kV). "Medium light and power" customers are commercial customers with demands less than 500 kW, and are offered the *option* of a non-TOU or a voluntary TOU rate. "Large light and power" customers are on mandatory TOU rates that are different for 5 to 1,000 kW, and greater than 1,000 kW. The differences in these rates can be large. For example for PGandE customers less than 500 kW are charged a demand charge of $3.30/kW-month (non-time-differentiated), and customers over 500 kW are charged $12.70/kW-month for summer peak kW (secondary voltage), $11.40/kW-month (primary voltage), and $7.90/kW-month (transmission voltage).[1] Energy charges ($/kWh) display similar variation, with about a 5 to 10 percent difference between customers according to both size and voltage level.

TOU rates vary between utilities. Utility tariffs differ according to **rates** for energy and demand, and according to the definition of **TOU periods**. Tariffs differ between utilities partly because their costs are different (which also affects the average rates). Since the Commission does not receive tariffs from all the utilities, especially the numerous municipal utilities, it is impossible to know how different the TOU rates are. (The average rates proposed by staff do, however, average all the utilities because the costs of all utilities are included). Rates are also different because utilities pursue different rate design strategies that affect the relative cost of energy and demand. For example, a PGandE customer less than 500 kW pays $3.30/kW-month, while an SCE customer of the same size pays $15.55/kW-month in the summer and $2.90 in the winter. Not only are the rate designs different between utilities, but rate designs of utilities have

[1] Partial-peak and off-peak rates are less.

changed significantly over time within utilities, according to changing utility strategies and PUC policies. Hence, another problem in deriving a statewide TOU rate is the uncertainty in forecasting future rate designs.

Time-of-use periods also differ between utilities for both time-of-*day* and *season*. For example, SMUD's summer peak period is 12:00 noon to 10:00 p.m. Monday through Saturday, while PGandE's summer peak period is 12:00 noon to 6:00 p.m. Monday through Friday. SMUD's winter peak period is 7 a.m. to 10:30 pm Monday through Saturday, while PGandE has no winter peak period.

The vast majority of nonresidential customers are not on TOU rates. Since TOU rates are mandatory only for the largest customers, most customers (85 percent) are not on TOU rates, as shown by the distribution of PGandE's customers for their tariffs:

Tariff	Applicability	Customers	Sales (BkWh)
A-10 (less than 500 kW)	Non-TOU	32,429	10.7
A-11 (less than 500 kW)	Voluntary TOU	2,897	2.3
E-19 (500-1,000 kW)	TOU	1,592	4.1
E-20 (greater than 1,000 kW)	TOU	1,035	13.2