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2001 Update, Assembly Bill 970 Appliance Efficiency Standards Life Cycle Cost Analysis

STAFF EPORT

November 2001
P400-01-028

Gray Davis, *Governor*

CALIFORNIA ENERGY COMMISSION

R. Michael Martin and Jim Holland
Principal Authors

R. Michael Martin
Project Manager

G. William Pennington
Office Manager
Residential Buildings and Appliances Office

Valerie Hall
Deputy Director
Energy Efficiency and Demand Analysis Division

Robert L. Therkelsen
Executive Director

CALIFORNIA ENERGY COMMISSION

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R. Michael Martin
Jim Holland

Docket Number 01-AB970-APSTD

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PURPOSE AND LEGISLATIVE CRITERIA

The California Energy Commission is proposing to adopt amendments to appliance efficiency regulations. Existing law (Public Resources Code Section 25402(c)) requires the Commission to adopt regulations that prescribe minimum efficiency levels for appliances. The Commission first adopted appliance efficiency standards in the late 1970s and has periodically revised them since.

On September 6, 2000, Governor Davis signed Assembly Bill 970, designed to provide a balanced response to the electricity problems facing the state through significant new investments in environmentally superior electricity generation and in conservation programs. Assembly Bill 970 directed the Commission to adopt and implement updated and cost-effective appliance efficiency standards.

The proposed amendments are designed to respond to AB 970 and to meet the requirements of the Public Resources Code 25402(c). One of the requirements of Public Resources Code 25402(c) is that new or upgraded standards must not result in any added cost to the consumer over the design life of the appliance. The added total cost is obtained by comparing the cost and performance of a typical model that a consumer would be expected to purchase with the proposed upgraded or new standard in effect, to the cost and performance of a typical model that the consumer would be expected to purchase without the proposed upgraded or new standard in effect. This Life Cycle Cost Analysis report has been developed to determine if the proposed amendments are cost effective (that they do not add cost to the consumer over the design life of the appliance).

A full description of how cost effectiveness calculations are performed is provided as Appendix B of this report.

THREE MAJOR GROUPS OF EFFICIENCY STANDARDS

The proposed standards are divided into three groups as follows:

a) California adoption of federal standards for federally regulated appliances (Section 1605.1)

b) California adoption of more stringent standards for federally regulated appliances (Section 1605.2)

c) California standards for non-federally regulated appliances (Section 1605.3)

CALIFORNIA ADOPTION OF FEDERAL STANDARDS FOR FEDERALLY REGULATED APPLIANCES (SECTION 1605.1)

The standards in this section are identical to existing federal standards. Since the standards must be complied with nationwide, there is no additional cost required for compliance within California. Thus for these appliances the California standards do “not result in added total cost to the consumer over the design life of the appliances.” The appliances in this category are listed in Table 1.

Table 1 – Federally Regulated Appliances

Subsection	***Appliance Type***
1605.1(a)	Consumer product refrigerators, refrigerator-freezers, and freezers
1605.1(b)	Room air conditioners and heat pumps, packaged terminal air conditioners and heat pumps
1605.1(c)	Central air conditioners and heat pumps
1605.1(e)	Wall furnaces, floor furnaces, room heaters, boilers, and central furnaces
1605.1(f)	Water heaters
1605.1(g)	Pool heaters
1605.1(h)	Plumbing fittings
1605.1(i)	Plumbing fixtures
1605.1(j)	Fluorescent lamp ballasts
1605.1(k)	Lamps
1605.1(o)	Consumer product dishwashers
1605.1(p)	Consumer product clothes washers
1605.1(q)	Consumer product clothes dryers
1605.1(r)	Consumer product cooking products
1605.1(s)	Electric motors

CALIFORNIA ADOPTION OF MORE STRINGENT STANDARDS FOR FEDERALLY REGULATED APPLIANCES (1605.2)

The U.S. Department of Energy and the California Energy Commission both conducted rulemakings for air cooled central air conditioners and air source heat pumps The differences are discussed in detail in the Energy Commission's "Staff Report on Appliance Rulemaking for Central Air Conditioners and Small Water Heaters" dated February 2, 2001.

The situation with single phase air-cooled air conditioners and air-source heat pumps with cooling capacity up to 65,000 Btu per hour has become very complicated. The U.S. Department of Energy adopted an SEER 13.0 standard, and then subsequently initiated a rulemaking aimed at adopting an SEER 12.0 standard. Thus this cost effectiveness report calculates cost effectiveness on the basis of three conceivable scenarios:

- A future federal standard of SEER 13.0
- A future federal standard of SEER 12.0
- No new federal standard (SEER 10.0)

The residential air conditioner data are based on 3-ton capacity specifications, and the commercial air conditioner data are based on 9-ton capacity specifications

The proposed California standards are cost effective under each of the three scenarios.

Table 2 – Typical (Base Case) Models With or Without California's Proposed Standards

Subsection and Table	***Appliance***	***Typical Model With No California Standard In Effect***	***Typical Model With California Standard In Effect***	***Added First Cost of Proposed California Standard-Meeting Model Over Indicated Base Model***	***Annual Unit Reduction of Energy Use of Proposed California Standard-Meeting Model Over Indicated Base Model***	***Implementation Date of Proposed California Standard****
1605.2(c) Table C-6	Residential air conditioners and heat pumps	SEER 10.0 HSPF 6.8	SEER 13.0 EER 11.6 HSPF 7.9 with TXV	$289	410 kWh	January 23, 2006
1605.2(c) Table C-6	Residential air conditioners and heat pumps	SEER 12.0 HSPF 7.7	SEER 13.0 EER 11.6 HSPF 7.9 with TXV	$121	209 kWh	January 23, 2006
1605.2(c) Table C-6	Residential air conditioners and heat pumps	SEER 13.0 HSPF 7.7	SEER 13.0 EER 11.6 HSPF 7.9 with TXV	$38	130 kWh	January 23, 2006
1605.2(c) Table C-6	Commercial air conditioners and heat pumps	EER 8.9 COP 3.0	EER 11.0 COP 3.4 with TXV	$160	2,790 kWh	January 23, 2006

* The effective date of this standard is the effective date of the waiver from preemption issued by the U.S. Department of Energy. This date is not known. For the purpose of this table, it is assumed that the waiver will become effective on the same date as the related federal standards for units with cooling capacity less than 65,000 Btu per hour.

The reduction in electrical energy use indicated in Table 2 reflects the potential energy savings when the proposed California efficiency standards for air conditioners and heat pumps are compared to a particular base model. This comparison shows the difference in energy consumption between the more efficient model meeting California's proposed standard and a base model with lower efficiency ratings

The first cost dollar amounts in Table 2 are the additional costs of the equipment based on the additional costs involved in making the affected equipment more efficient by a variety of means by the manufacturer, such as R&D, materials, etc., as well as adding devices that ensure correct refrigerant charges and thus result in the equipment operating more efficiently. The data for central air conditioners and heat pumps was supplied by Andrew DeLaski of Appliance Standards Awareness Project and Steve Nadel of American Council for an Energy Efficient Economy (see Appendix A).

Table 3 shows the simple payback for the California standards based on the conservative rates of $0.115 per kWh and also a near doubling of those rates to indicate the results of the current trend toward higher energy costs. In all cases, the simple payback (in years) is a fraction of the design life (in years).

The design life of the appliances listed in Table 3 are given by the Department of Energy in the applicable Federal Register (see Appendix A).

Table 3 - Simple Payback (see endnote vii)

Subsection and Table	***Appliance***	***Added First Cost***	***Annual Unit Reduction of Energy Use***	***Based on $0.115 per kWh and $0.81 per therm***		***Based on $0.20 per kWh and $1.62 per therm***		***Design Life (years)***
				Annual Unit Reduction in Operating Cost	***Simple Payback (years)***	***Annual Unit Reduction in Operating Cost***	***Simple Payback (years)***	
1605.2(c) Table C-6	Residential air conditioners and heat pumps 10 SEER base with TXV	$289	410 kWh	$47.15	6.1	$82.00	3.5	18
1605.2(c) Table C-6 1605.2(c) Table C-6	Residential air conditioners and heat pumps12 SEER base with TXV	$121	209 kWh	$24.04	5.0	$41.80	2.9	18
1605.2(c) Table C-6	Residential air conditioners and heat pumps 13 SEER base with TXV	$38	130 kWh	$14.95	2.5	$26.00	1.5	18
1605.2(c) Table C-6	Commercial air conditioners and heat pumps EER 8.9 to 11.0 with TXV	$160	2,790 kWh	$320.85	0.5	$558.00	0.3	15

Graphic Representation of Table 3

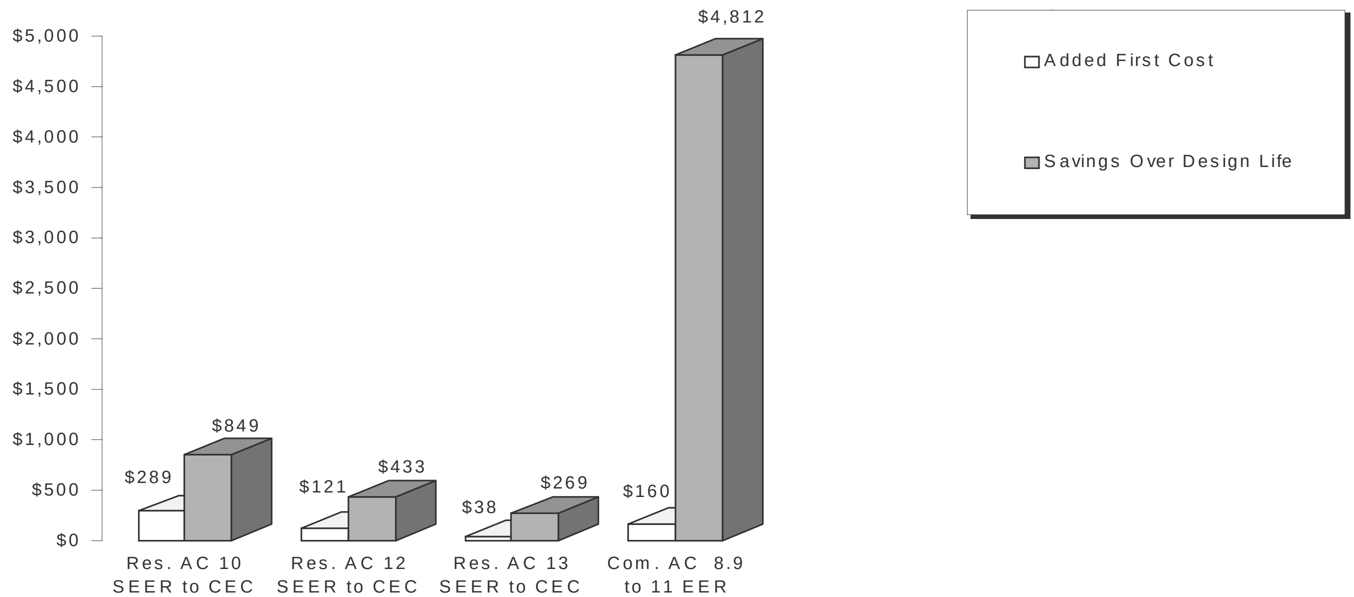


Table 4 calculates the "added total cost to the consumer," categorized by Utility Customer Class as designated by the Commission, using the present worth method under which money saved due to future savings is discounted at a rate of three percent per year, and the unit cost of energy is based on the forecast described in Appendix B, which varies from year to year. These values were developed by the California Energy Commission's Electricity Analysis Office in August 2000 and are generally accepted as being quite conservative.

Table 4
Reduced Total Cost over Appliance Design Life

Appliance Measure	Utility Customer Class	Design Life (Years)	Present Values for Electricity ($/kWh)	Increase of Purchase Price	Reduction in Electrical Energy Use (KWh/Yr)	Reduced Total Cost Over the Design Life of the Appliance ($)
Commercial Air Conditioners change from EER 8.9 to 11.0	Medium Commercial	15	0.982	$160.00	2790	2579.78
Residential Air Conditioners 10 SEER base	Residential	18	1.461	$289.00	410	310.00
Residential Air Conditioners 12 SEER base	Residential	18	1.461	$121.00	209	184.40
Residential Air Conditioners 13 SEER base	Residential	18	1.461	$38.00	130	151.90

Table 4 shows that even with the conservative assumption of unit energy costs, the reduced total cost to the consumer is positive or zero. The zero values are for those appliances where there is no increase in efficiency and therefore no increase in purchase price, nor energy savings. Thus, no matter what assumptions are made, there is no added cost to the consumer over the design life of the appliance.

The reduction in electrical energy use indicated in Table 4 reflects the potential energy savings when the proposed California efficiency standards for air conditioners and heat pumps are compared to a particular base model. This comparison shows the difference in energy consumption between the more efficient model meeting California's proposed standard and a base model with lower efficiency ratings

Each of these calculations is based on the assumption that the typical air conditioner or heat pump is installed with the correct refrigerant charge, and has a single one-speed compressor.

The support documentation for John Proctor's comments on the central air conditioner and heat pump notice of proposed regulations (NOPR) indicates that air conditioners are frequently installed with incorrect refrigerant changes, resulting in less than the designed efficiency. Since this problem tends to occur more frequently in refrigerant systems with control devices other than thermostatic expansion valves (TXVs), the regulations require the use of TXVs, but allow several other means of ensuring proper operation.

The TXV has been calculated to cost an additional $21.00 per air conditioning unit when installed at the factory.

SEER is based on performance at 82 ^{0}F. EER is based on performance at 95 ^{0}F. A typical model with SEER of 13.0 has a single one-speed compressor and an EER of 11.6. Models with more than one compressor tend to operate using only one compressor when tested at 82 ^{0}F and two compressors when tested at 95 ^{0}F. For this reason efficiency at 95 ^{0}F tends to be much lower than 11.6 EER and is sometimes as low as 9.7 EER. Performance at 95 ^{0}F and higher is very important, since peak energy demand tends to occur during hot weather. The inclusion of the EER standard insures that compliance is not obtained by units which are only efficient during less severe temperatures.

CALIFORNIA STANDARDS FOR NON-FEDERALLY REGULATED APPLIANCES (1605.3)

The following table (Table 5) summarizes all the standards in Section 1605.3. Of the 19 groups of standards, five are standards that are already in effect and for which no change of level is being proposed (wine chillers, water-source air conditioners, boilers, small water heaters, and gas/oil pool heaters). Three groups (ground-water-source and ground-source heat pumps, computer room air conditioners, and tub spout diverters) include both existing and upgraded standards. Four of the groups are special cases:

- The scope of the federal standards for freezers that are consumer products includes those up to 30 cubic feet. These standards are shown in 1605.1(a). The scope is being changed in California from 30 cubic feet to 39 cubic feet for consistency with the corresponding standards for consumer product refrigerators and refrigerator-freezers. We find no evidence of consumer product freezers in this size range, but conclude that if there were, the cost justification for the new federal standards for freezers up to 30 cubic feet, shown in section 1605.1(a)(1) would apply, based on the linearity of construction costs and retail price structure. Thus there is no need for further cost effectiveness calculations.
- The upgraded standards for ground water source heat pumps and ground source heat pumps are the same standards that are described in Section 1605.1(c)(1) for water source heat pumps when tested at different rating conditions. Models that comply with the federal standards described in Section 1605.1(c)(1) also comply with the California standards in 1605.3(c)(1) Thus no further cost effectiveness calculation is needed for the standards in 1605.3(c)(1).
- The upgraded standards for computer room air conditioners in 1605.3(c)(3) are the same standards that are described in Sections 1605.1(c) and 1605.2(c), when tested using a different test method (ANSI/ASHRAE 127-1988). Thus no further cost effectiveness calculation is needed for the standards in 1605.3(c)(3).
- When the staff developed its proposed 3.5 COP standard for heat pump pool heaters, some existing models on the market failed to achieve this level. Subsequently, a new product directory was published by the industry certification program in which <u>all</u> models comply with the 3.5 COP proposed standard. This directory claims to include all the products of manufacturers supplying over 80% of residential units made in the U.S. There is no data available concerning the performance of the remaining units (less than 20%), but it is reasonable to assume that when they are included in the heat pump pool heater directory, consumer pressure will result in their costing no more than the existing complying models. Thus there is no need for a cost effectiveness calculation.

There remain 10 groups of standards in Section 1605.3 for which cost effectiveness calculations are needed.

Table 5 – Appliances for which Cost Effectiveness Calculations are Needed

Section 1605.3 Subsection and Table	***Appliance***	***Existing or Proposed***	***Cost Effectiveness Study Needed?***
Subsection A-1	Wine chillers	Existing	No
Subsection A-2 Table A-4	Freezers 30 – 39 cubic feet (consumer products)	Proposed new	No
Subsection A-3	Vending machines	Proposed new	**Yes**
Subsection A-4 Table A-5	Commercial refrigerators and freezers	Proposed new	**Yes**
Subsection C-1 Table C-7	Water-source air conditioners	Existing	No
Subsection C-1 Table C-7 and C-8	Ground-water-source and ground-source heat pumps	Existing and proposed upgraded	No
Subsection C-3 Tables C-9 & C-10	Computer room air conditioners	Existing and proposed upgraded	No
Subsection E-1 Tables E-5, E-6, & E-7	Boilers, furnaces, duct furnaces, & unit heaters	Existing	No
Subsection F-1	Hot water dispensers	Proposed new	**Yes**
Subsection F-2 Table F-6	Small water heaters	Existing	No
Subsection G-1, 2, & 3	Gas and oil pool heaters	Existing	No
Subsection G-4	Heat pump pool heaters	Proposed new	No
Subsection H-1 Table H-2	Tub spout diverters	Existing and proposed upgraded	**Yes**
Subsection L Table L	Emergency lighting (exit signs)	Proposed new	**Yes**
Subsection M Table M	Traffic signal modules	Proposed new	**Yes**
Subsection N	Torchieres	Proposed new	**Yes**
Subsection P-1 Table P-3	Commercial clothes washers (performance standard)	Proposed new	**Yes**
Subsection P-2	Commercial clothes washers (design standard)	Proposed new	**Yes**
Subsection T Table T	Distribution transformers	Proposed new	**Yes**

New or upgraded standards must not result in any added total cost to the consumer over the design life of the appliance. The added total cost is obtained by comparing the cost and performance of a typical model that the consumer would be expected to purchase with the proposed upgraded or new standard in effect, to the cost and performance of a typical model that the consumer would be expected to purchase without the proposed upgraded or new standard in effect. In some cases, it is not obvious what typical unit should be assumed as the typical model with no standard. For instance, 78 percent of sales of emergency lighting (exit signs) already comply with the proposed standards. Thus the model that the typical consumer would be expected to buy with the standard in place would generally be the same one that he or she would be expected to buy without the standard in place. In several cases, including this one, we have used excessively conservative assumptions in compiling the following table:

Table 6 – Typical (Base Case) Models With or Without Proposed Standards

Subsection and Table	***Appliance***	***Typical Model with No Standard in Effect***	***Typical Model with Standard in Effect***	***Added First Cost***	***Annual Unit Reduction of Energy Use***	***Effective Date of Standard***
Subsection A-3	Vending machines	Unit with T12 lamps and magnetic ballasts	Unit with T8 lamps and electronic ballasts	$25	351 kWh per year	12 months after adoption by Commission
Subsection A-4 Table A-5	Commercial refrigerators and freezers	24 cubic foot unit using current practice (with T12 lamps and magnetic ballasts for those units with transparent doors)	24 cubic foot model meeting proposed standard (with T8 lamps and electronic ballasts for those models with transparent doors)	$382	1504 kWh per year for those with transparent doors 2064 kWh per year for those with solid doors	First level 12 months after adoption by Commission Second level August 2004
Subsection F-1	Hot water dispensers	Model with 35 watts standby loss	Model with 35 watts standby loss	$ 0	Zero	12 months after adoption by Commission
Subsection H-1 Table H-2	Tub spout diverters	Model with 0.1 gpm leakage	Model with 0.01 gpm leakage	$0	1.2 therms	12 months after adoption by Commission
Subsection L Table L	Emergency lighting (exit signs)	Model with an incandescent lamp	Model with LED	$20	315 kWh per year	12 months after adoption by Commission
Subsection M Table M	Traffic signal modules	Model with incandescent lamp	Model with LED module	$142 each	300 kWh ea. per year (weighted average of red, amber, and green)	12 months after adoption by Commission
Subsection N	Torchieres	Model with 250 watt halogen lamp	Model with 98 watt compact fluorescent lamp	$20	394 kWh per year	12 months after adoption by Commission
Subsection P-1 Table P-3	Commercial clothes washers (performance standard)	Model with 1.18 energy factor	Model with 1.26 modified energy factor and 9.5 water factor	$300	340 kWh to operate washer, 70 therms gas to heat water plus **72 kWh in water pumping energy, plus 44 kWh in wastewater processing energy, 21,000 gallons of water saved**	January 2005 (M.E.F.), **[January 2007 (W.F.)]**
Subsection P-2	Commercial clothes washers (design standard)	Model with unheated rinse water option	Model with unheated rinse water option	$0	None	January 2005
Subsection T Table T	Distribution transformers	Model using current practice	Model meeting proposed standard	$506	2,690 kWh per year	12 months after adoption by Commission

The reduction in electrical energy use indicated in Table 6 reflects the potential energy savings when the proposed California efficiency standards are compared to a particular base model. This comparison shows the difference in energy consumption between the more efficient model meeting California's proposed standard and a base model with lower efficiency ratings

The first cost dollar amounts in Table 6 are the additional costs of the equipment based on the additional costs involved in making the affected equipment more efficient by a variety of means by the manufacturer, such as R&D, materials, etc.

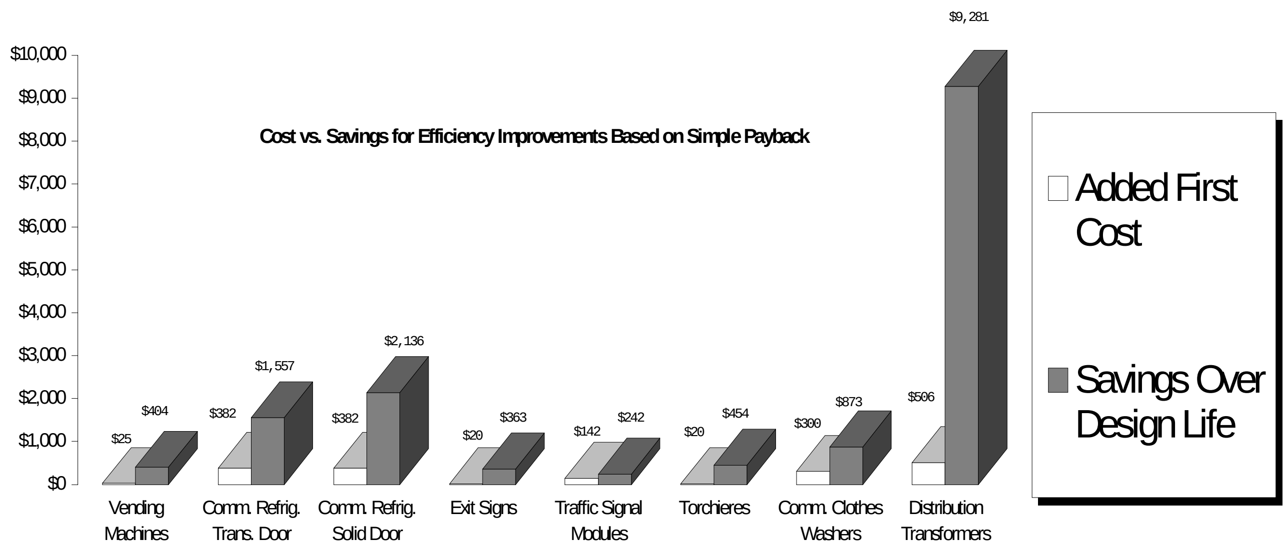
See Appendix A for the following citations:

- The data for vending machines was supplied by Rachel Schmeltz of the Environmental Protection Agency and Noah Horowitz of the National Resources Defense Council.
- The data for commercial refrigerators and freezers was supplied by Steve Nadel of the American Consortium for an Energy Efficient Economy and Arthur D. Little Co.
- The data for hot water dispensers was derived from the California Energy Commission appliance database.
- The data for tub spout diverters was derived from the California Energy Commission appliance database.
- The data for emergency lighting was supplied by Patrick Eilert of Pacific Gas and Electric. .
- The data for traffic signal modules was supplied by Virginia Lew of the California Energy Commission.
- The data for torchieres was supplied by Chris Calwell of Ecos Consulting and Noah Horowitz of the National Resources Defense Council.
- The data for commercial clothes washers was supplied by Ted Pope of Energy-Solutions.
- The data for distribution transformers was supplied by Patrick Eilert of Pacific Gas and Electric and Robert Huang of the Cadmus Group Inc.

There are two methods commonly used for determining cost effectiveness. The first is the simple payback method. Simple payback is defined as the added first cost divided by the first year energy cost savings. The following table is based on the first year costs at $0.115 per kWh and $0.81 per therm. In view of recent increases in cost of energy, simple payback is also shown for comparison purposes based on $0.20 per kWh and $1.62 per therm.

Table 7 – Simple Payback (see endnote vii)

Subsection and Table	*Appliance*	*Added First Cost*	*Annual Unit Reduction of Energy Use*	*Based on $0.115 per kWh and $0.81 per therm*		*Based on $0.20 per kWh and $1.62 per therm*		*Design Life (years)*
				Annual Unit Reduction in Operating Cost	*Simple Payback (years)*	*Annual Unit Reduction in Operating Cost*	*Simple Payback (years)*	
Subsection A-3	Vending machines	$25	351 kWh per year	$40.37	0.6	$70.20	0.4	10
Subsection A-4 Table A-5	Commercial refrigerators and freezers	$382	1504 kWh per year for those with transparent doors 2064 kWh per year for those with solid doors	$172.96 $237.36	2.2 1.6	$300.80 $416.80	1.3 0.9	9
Subsection F-1	Hot water dispensers	$ 0	Zero	$0.00	0.0	$0.00	0.0	12
Subsection H-1 Table H-2	Tub spout diverters	$0	1.2 therms	$1.00	0.0	$1.90	0.0	10
Subsection L Table L	Emergency lighting (exit signs)	$20	315 kWh per year	$36.25	0.6	$63.00	0.3	10
Subsection M Table M	Traffic signal modules (weighted average of red, amber, and green)	$142	300 kWh per year	$34.50	4.1	$60.00	2.4	7
Subsection N	Torchieres	$20	394 kWh per year	$45.31	0.4	$78.80	0.3	12
Subsection P-1 Table P-3	Commercial clothes washers (performance standard)	$300	456 kWh and 70 therms per year	$52.44 (elec. Savings) + $56.70 (gas savings) $109.14 Total	2.7	$91.20 (elec.) + $113.40 (gas) $204.60	1.5	8
Subsection P-2	Commercial clothes washers (design standard)	$0	None	$0.00	0.0	$0.00	0.0	8
Subsection T Table T	Distribution transformers	$506	2,690 kWh per year	$309.35	1.6	$510.00	1.0	30



Graphic Representation of Table 7

The second method for demonstrating cost effectiveness is to calculate the added total cost to the consumer over the design life of the appliance. This is done by subtracting the present value of the savings from the present value of the added initial cost. Future costs and savings are discounted in this calculation. (see Appendix B for discussion of present value, discount rate, etc.)

Table 8 – Reduced Total Costs Over Appliance Design Life

Appliance Measure	*Utility Customer Class*	*Design Life (Years)*	*Present Values for Electricity ($/kWh)*	*Present Values for Natural Gas ($/therm)*	*Increase of Purchase Price*	*Reduction in Electrical Energy Use (kWh/Yr)*	*Reduction in Natural Gas Use (Therms/Yr)*	*Reduced Total Cost Over the Design Life of the Appliance ($)*
Com Clothes Washer	Small Commercial	8	0.793 (for EF standard) 0.949 (for WF standard)	4.331	$300.00	456	70	382.87
Comm refrig/freez trans. door	Medium Commercial	9	0.649		$382.00	1,504		594.10
Comm refrig/freez solid door	Medium Commercial	9	0.649		$382.00	2,064		957.54
Distribution Transformers	Medium Commercial	30	1.589		$506.00	2,690		3,768.00
Hot water dispensers	Residential	12	1.075		$0.00	0		0.00
Emergency lighting (exit signs)	Medium Commercial	10	0.709		$20.00	315		203.34
Tub spout diverters	Residential	10		5.997	$0.00		1.2	7.20
Torchiere Fixtures	Residential	12	1.075		$20.00	394		403.55
Traffic Signals	Medium Commercial	7	0.526		$142.00	300		12.80
Vending Machines	Small Commercial	10	0.949		$25.00	351		308.10

APPENDIX A

Studies, Reports, and Documents Relied On

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U.S. Department of Energy. Final Rule for Clothes Washers; Federal Register, January 12, 2001.

U.S. Department of Energy. Final Rule for Commercial Heating, Air Conditioning, and Water Heating Equipment; Federal Register, January 12, 2001.

U.S. Department of Energy. Final Rule for Water Heaters; Federal Register, January 17, 2001.

APPENDIX B

A Generic 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 Total Costs (also known as change in life-cycle cost)	= Added First Cost	- Present value of electricity cost savings	- Present value of gas cost savings	+ Present value of added maintenance cost	- Present value of reduced maintenance cost

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

There may be circumstances, though not within this rulemaking, where higher efficiency appliances have slightly higher maintenance costs. A few appliances within this rulemaking 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 an appliance of the most common size and design sold today. **(**For those appliances, for which there already exists a minimum performance standard, this is typically one that just complies with that standard.) with the estimated purchase price of an appliance, of that size and design, that 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 vary from appliance to appliance, depending on the type of tariff charged and the time of year that the appliance is typically used. For instance for residential size water heaters, use is year round and the costs to consumers are those for residential customers; whereas for large air conditioners, the use is predominantly in the hotter months and the costs are those for nonresidential building customers. The fundamental differences in these costs often relate to the economies of scale related to large quantities of sales of energy. Although time of day charges are rarely used for the appliances in this analysis, seasonal tariffs are generally used. Energy costs are not the same as rates. Often rates are designed to accomplish goals that are separate from costs. An example of this is the baseline rates that limit the rate charged for the first block of energy purchased. This baseline may not represent the true cost of energy. Similarly, the marginal costs of providing new services may be spread across all customers in a utility and not charged directly to the ratepayer. This analysis is an aggregated statewide average analysis; this analysis uses an estimated statewide average cost to provide energy to each appliance type. These costs vary by time of use, a forecast model developed for the Energy Commission's Energy Information and Analysis Division was used to estimate future cost by each time of use. The actual costs per kWh, therm, or gallon are identified in the discussion for each type of appliance.

Electricity costs are from recent analysis by the Commission's Energy Information and Analysis Division [see endnote iii] ; natural gas prices are taken from the Commission's *Natural Gas Market Outlook 2000 – 2020,* [see endnote iv] Appendices C and H. The prices are different for residential, small commercial, and medium-size commercial customers. Energy costs vary from year to year.

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 the 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:

Estimated Discount Rate

	8.9%	interest rate for loan
X	63.0%	tax effect (assuming 28% federal tax rate and 9% state tax rate)
=	5.6%	after-tax interest rate
-	2.6%	inflation rate (as forecast by Council of Economic Advisors) [see endnote v]
=	3.0%	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. In the current market, even without tax considerations, loan rates are approximately 3 percentage points above inflation. (see endnote vi)

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:

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

The present value for one year is then:

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

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

$$PresentValue = \frac{1}{(1 + 0.03)^2} = 0.942596$$

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 9
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 life expectancy, to take effect on January 1, 2003, the present worth of the energy savings (in 2003) is the sum of:

1.000 X electricity cost savings in 2003,
0.942596 X electricity cost savings in 2004,

0.915142 X electricity cost savings in 2005,
0.888487 X electricity cost savings in 2006, and
0.862609 X electricity cost savings in 2007.

Electricity Rates

Electric analysis spreadsheets are derived from the October 2000 version (the last official release) of the sheets for nominal utility prices from Ruben Tavares of the California Energy Commission. This sheet was used to provide the nongeneration costs for each time of use time block.

Time of use generation costs were linked into a separate spreadsheet for each of 6 time periods:

- Summer on-peak: Monday through Friday hours 1100-1800
- Summer semi-peak: Monday through Friday hours 0600-1000, 1900-2200
- Summer off-peak: Saturday and Sunday hours 0100-2400, Monday through Friday hours 0100-0500, 2300-2400
- Winter on-peak: Monday through Friday hours 1700-1900
- Winter semi-peak: Monday through Friday hours 0600-1600, 2000-2100
- Winter off-peak: Saturday and Sunday hours 1-24, Monday through Friday hours 0100-0500, 2200-2400

The generation costs for each of these were derived from a file that aggregated costs for transmission, distribution, market clearing price, trust transfer amount, competition transition charge, and similar costs. This file was derived from a file with the transmission and distribution values set to zero. This file was a best estimate of generation costs based on the Public Utilities Commission Administrative Law Judge recommendations on pricing during peak periods. The generation costs in this file are extended out to the year 2025. Extension from 2020 to 2025 is at 5 percent; the six spreadsheets used for this peak analysis extend nominal prices out to 2025 at this same rate.

Table 10 shows the results of this analysis for various analysis periods and energy tariffs.

Table 10
Energy Commission Average Statewide Present Value of Electricity and Natural Gas

CEC	***Electricity ($/kWh)***			***Natural Gas ($/therm)***		
Utility Customer Class	***Residential***	***Small Commercial***	***Medium Commercial***	***Residential***	***Small Commercial***	***Medium Commercial***
7 Year	.699	.712	.526	4.519	3.902	3.902
8 Year	.778	.793	.588	5.025	4.331	4.331
9 Year	.855	.872	.649	5.518	4.75	4.75
10 Year	.931	.949	.709	5.997	5.156	5.156
12 Year	1.075	1.098	.824	6.911	5.935	5.935
15 Year	1.276	1.306	.982	8.198	7.035	7.035
18 Year	1.461	1.495	1.002	N/A	N/A	N/A
30 Year	2.047	2.106	1.589	13.27	11.435	11.435

Tables 11 A, B, & C

Direct Energy Cost Tables

Table 11A

Residential

Direct energy costs		$/kWh						$/Therm
Year	Count	S_ON	S_SEM	S_OFF	W_ON	W_SEM	W_OFF	NGAS
2001	1	0.141	0.117	0.098	0.131	0.124	0.107	0.90
2002	2	0.149	0.119	0.101	0.131	0.124	0.108	0.82
2003	3	0.139	0.115	0.098	0.124	0.118	0.103	0.70
2004	4	0.132	0.105	0.095	0.118	0.113	0.099	0.62
2005	5	0.131	0.109	0.094	0.118	0.112	0.098	0.62
2006	6	0.131	0.108	0.094	0.116	0.109	0.098	0.61
2007	7	0.131	0.108	0.093	0.116	0.109	0.098	0.62
2008	8	0.123	0.100	0.086	0.108	0.102	0.093	0.62
2009	9	0.124	0.101	0.086	0.108	0.102	0.093	0.62
2010	10	0.124	0.101	0.086	0.109	0.102	0.094	0.63
2011	11	0.125	0.101	0.086	0.109	0.102	0.094	0.62
2012	12	0.125	0.101	0.086	0.109	0.103	0.094	0.62
2013	13	0.125	0.101	0.085	0.109	0.102	0.094	0.63
2014	14	0.125	0.101	0.085	0.109	0.102	0.094	0.63
2015	15	0.126	0.101	0.086	0.110	0.103	0.094	0.63
2016	16	0.126	0.101	0.086	0.110	0.103	0.094	0.63
2017	17	0.127	0.102	0.086	0.110	0.103	0.094	0.63
2018	18	0.127	0.102	0.086	0.111	0.104	0.095	0.64
2019	19	0.128	0.102	0.086	0.111	0.104	0.095	0.64
2020	20	0.128	0.103	0.087	0.112	0.104	0.095	0.64
2021	21	0.127	0.102	0.086	0.111	0.104	0.095	0.64
2022	22	0.126	0.101	0.085	0.110	0.103	0.094	0.64
2023	23	0.124	0.100	0.085	0.109	0.102	0.094	0.64
2024	24	0.123	0.100	0.084	0.108	0.101	0.093	0.65
2025	25	0.122	0.099	0.084	0.107	0.100	0.093	0.65
2026	26	0.121	0.099	0.084	0.107	0.100	0.092	0.65
2027	27	0.121	0.098	0.083	0.106	0.100	0.092	0.65
2028	28	0.120	0.098	0.083	0.106	0.100	0.092	0.65
2029	29	0.119	0.098	0.083	0.105	0.099	0.092	0.65
2030	30	0.119	0.097	0.083	0.105	0.099	0.091	0.65

Table 11B

Small Commercial

Direct energy costs		$/kWh						$/Therm
Year	Count	S_ON	S_SEM	S_OFF	W_ON	W_SEM	W_OFF	NGAS
2001	1	0.146	0.122	0.102	0.136	0.128	0.111	0.81
2002	2	0.151	0.120	0.103	0.132	0.126	0.110	0.72
2003	3	0.141	0.117	0.100	0.126	0.120	0.104	0.60
2004	4	0.134	0.107	0.097	0.120	0.114	0.100	0.52
2005	5	0.133	0.110	0.096	0.119	0.113	0.100	0.52
2006	6	0.132	0.110	0.095	0.117	0.111	0.100	0.52
2007	7	0.132	0.109	0.095	0.117	0.111	0.101	0.53
2008	8	0.125	0.102	0.087	0.110	0.103	0.096	0.53
2009	9	0.125	0.102	0.087	0.110	0.103	0.098	0.53
2010	10	0.126	0.102	0.087	0.110	0.104	0.099	0.53
2011	11	0.126	0.103	0.087	0.111	0.104	0.099	0.53
2012	12	0.127	0.103	0.088	0.111	0.104	0.099	0.53
2013	13	0.127	0.103	0.088	0.111	0.105	0.099	0.54
2014	14	0.128	0.103	0.088	0.112	0.105	0.100	0.54
2015	15	0.128	0.104	0.088	0.112	0.105	0.100	0.54
2016	16	0.129	0.104	0.088	0.112	0.106	0.100	0.54
2017	17	0.129	0.104	0.088	0.113	0.106	0.100	0.54
2018	18	0.130	0.105	0.089	0.113	0.106	0.100	0.55
2019	19	0.130	0.105	0.089	0.114	0.107	0.100	0.55
2020	20	0.131	0.105	0.089	0.114	0.107	0.101	0.55
2021	21	0.130	0.105	0.089	0.113	0.106	0.100	0.55
2022	22	0.128	0.104	0.088	0.112	0.105	0.100	0.56
2023	23	0.127	0.103	0.088	0.111	0.105	0.099	0.56
2024	24	0.126	0.102	0.087	0.111	0.104	0.099	0.56
2025	25	0.125	0.102	0.087	0.110	0.103	0.098	0.56
2026	26	0.124	0.101	0.086	0.109	0.103	0.098	0.57
2027	27	0.124	0.101	0.086	0.109	0.103	0.098	0.57
2028	28	0.123	0.101	0.086	0.109	0.102	0.098	0.57
2029	29	0.123	0.100	0.086	0.108	0.102	0.098	0.57
2030	30	0.122	0.100	0.085	0.108	0.101	0.098	0.58

Table 11C

Medium Commercial
Direct energy costs

		$/kWh						$/Therm
Year	Count	S_ON	S_SEM	S_OFF	W_ON	W_SEM	W_OFF	NGAS
2001	1	0.126	0.100	0.079	0.116	0.107	0.091	0.81
2002	2	0.116	0.086	0.069	0.098	0.092	0.081	0.72
2003	3	0.108	0.083	0.067	0.093	0.087	0.077	0.60
2004	4	0.101	0.074	0.064	0.087	0.082	0.073	0.52
2005	5	0.101	0.079	0.064	0.087	0.082	0.073	0.52
2006	6	0.101	0.079	0.064	0.086	0.080	0.073	0.52
2007	7	0.102	0.079	0.065	0.087	0.081	0.074	0.53
2008	8	0.101	0.079	0.064	0.086	0.080	0.075	0.53
2009	9	0.102	0.079	0.064	0.087	0.080	0.076	0.53
2010	10	0.102	0.079	0.064	0.087	0.080	0.076	0.53
2011	11	0.103	0.079	0.065	0.087	0.081	0.077	0.53
2012	12	0.103	0.080	0.065	0.088	0.081	0.077	0.53
2013	13	0.102	0.079	0.063	0.087	0.080	0.076	0.54
2014	14	0.103	0.079	0.064	0.087	0.080	0.076	0.54
2015	15	0.103	0.079	0.064	0.087	0.081	0.076	0.54
2016	16	0.104	0.079	0.064	0.088	0.081	0.076	0.54
2017	17	0.104	0.080	0.064	0.088	0.081	0.077	0.54
2018	18	0.105	0.080	0.064	0.089	0.082	0.077	0.55
2019	19	0.105	0.080	0.064	0.089	0.082	0.077	0.55
2020	20	0.106	0.081	0.065	0.089	0.082	0.077	0.55
2021	21	0.105	0.080	0.064	0.088	0.081	0.077	0.55
2022	22	0.103	0.079	0.064	0.087	0.081	0.076	0.56
2023	23	0.102	0.078	0.063	0.087	0.080	0.076	0.56
2024	24	0.101	0.078	0.062	0.086	0.079	0.075	0.56
2025	25	0.099	0.077	0.062	0.085	0.078	0.075	0.56
2026	26	0.099	0.076	0.062	0.084	0.078	0.074	0.57
2027	27	0.098	0.076	0.061	0.084	0.078	0.074	0.57
2028	28	0.098	0.076	0.061	0.084	0.077	0.074	0.57
2029	29	0.097	0.075	0.061	0.083	0.077	0.074	0.57
2030	30	0.096	0.075	0.061	0.082	0.076	0.073	0.58

Tables 12 A, B, & C

Fractional Year / Present Value Tables

Table 12A

Residential

Fraction of year	0.0879	0.11301	0.221	0.05137	0.2226	0.30411	1	1
Hours in operation	770	990	1936	450	1950	2664		8760
Constant Load							Gas	Elec
30 Year PV	$0.228	$0.238	$0.396	$0.117	$0.479	$0.590	$13.270	$2.047
15 Year PV	$0.141	$0.148	$0.248	$0.073	$0.299	$0.366	$8.198	$1.276
12 Year PV	0.119	0.125	0.209	0.062	0.253	0.308	$6.911	$1.075
10 Year PV	0.103	0.108	0.181	0.054	0.219	0.266	$5.997	$0.931
9 Year PV	0.095	0.099	0.167	0.049	0.202	0.244	$5.518	$0.855
8 Year PV	0.086	0.090	0.152	0.045	0.184	0.221	$5.025	$0.778
7 Year PV	0.077	0.081	0.137	0.040	0.166	0.198	$4.519	$0.699

Table 12B

Small Commercial

Fraction of year	0.0879	0.11301	0.221	0.05137	0.2226	0.30411	1	1
Hours in operation	770	990	1936	450	1950	2664		8760
Constant Load							Gas	Elec
30 Year PV	$0.232	$0.243	$0.406	$0.120	$0.489	$0.617	$11.435	$2.106
15 Year PV	$0.144	$0.151	$0.253	$0.074	$0.305	$0.379	$7.035	$1.306
12 Year PV	0.121	0.127	0.213	0.063	0.257	0.317	5.935	$1.098
10 Year PV	0.104	0.110	0.185	0.054	0.223	0.273	5.156	$0.949
9 Year PV	0.096	0.101	0.170	0.050	0.205	0.250	4.750	$0.872
8 Year PV	0.087	0.092	0.155	0.046	0.187	0.226	4.331	$0.793
7 Year PV	0.078	0.083	0.139	0.041	0.169	0.202	3.902	$0.712

Table 12C

Medium Commercial

Fraction of year	0.0879	0.11301	0.221	0.05137	0.2226	0.30411	1	1
Hours in operation	770	990	1936	450	1950	2664		8760
Constant Load							Gas	Elec
30 Year PV	$0.185	$0.183	$0.289	$0.092	$0.371	$0.469	$11.435	$1.589
15 Year PV	$0.114	$0.113	$0.179	$0.057	$0.230	$0.288	$7.035	$0.982
12 Year PV	0.096	0.095	0.151	0.048	0.194	0.241	5.935	$0.824
10 Year PV	0.082	0.082	0.130	0.042	0.167	0.206	5.156	$0.709
9 Year PV	0.075	0.075	0.119	0.038	0.154	0.189	4.750	$0.649
8 Year PV	0.068	0.068	0.108	0.035	0.140	0.171	4.331	$0.588
7 Year PV	0.061	0.060	0.096	0.031	0.125	0.152	3.902	$0.526

Table 13 – Statewide Energy and Dollar Savings Over the Lifetime of the Appliance ($0.13/kWh, $0.81/Therm, in 2001 dollars)

Appliance	*Statewide Energy Savings*	*Statewide Dollar Savings*	*Statewide Dollar Costs*	*Savings to Cost Ratio*
Commercial A/C	1.1 TWh	$143 billion	$62.4 million	2292:1
Commercial Clothes Washers	164.8 GWh 28 million therms	$21.4 billion $22.7 million	$120 million	179:1
Commercial Refrigerators-Solid Door	209 GWh	$27 billion	$38.7 million	698:1
Commercial Refrigerators-Transparent Doors	456.8 GWh	$59.4 billion	$116 million	512:1
Emergency Lighting	504 GWh	$65 billion	$32 million	2031:1
Heat Pump Pool Heaters	3.5 GWh	$455 million	$675,000	674:1
Residential A/C	792.6 GWh	$103 billion	$446.5 million	231:1
Torchieres	6 TWh	$780 billion	$312 million	2500:1
Traffic Signals	2.1 TWh	$273 billion	$994 million	275:1
Transformers	756.6 GWh	$98.4 billion	$151.8 million	648:1
Tub Spout Diverters	240,000 therms	$194,400	0	
Vending Machines	166.7 GWh	$21.7 billion	$11.9 million	1824:1

Endnotes

[i] E. L. Grant and W. G. Ireson, Principles of Engineering Economy, © 1964, Ch. 7.

[ii] Summary of Cost Effectiveness, Methodology and Assumptions, March 29, 1990, J. Leber

[iii] California Energy Demand 2000-2010, June 2000, MCP estimates from CEC Staff (Richard Grix etc.) Updates for DSM programs. Assumptions provided in Market Clearing Prices Under Alternative Resource Scenarios 2000-2010, Feb.2000, Sales by customer class are from the Demand Office (Richard Roeher) demand estimates, various utility financial statements, and business plans

[iv] Gas price estimates in 1998 real dollars were provided in supporting documentation to the Commission's Natural Gas Market Outlook 2000-2020. These prices were updated to 2001 real dollars for this analysis.

[v] Council of Economic Advisors, Economic Report to the President, January, 2001

[vi] Website, Bankrate.com, March 19, 2001, 30 Year Fixed rate home loan – 6.83%, Home equity loan - 8.8%, New car loans – 9.49%.

[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.

CALIFORNIA ENERGY COMMISSION

Amendments to the:

2001 Update, Assembly Bill 970
Appliance Efficiency Standards
Life Cycle Cost Analysis

Publication #400-01-028

February 1, 2003

Addendum to the
2001 Update, AB 970 Appliance Efficiency Standards
Life Cycle Cost Analysis, Publication #P400-01-028
February 1, 2002

Additional Data Related to
Commercial Air Conditioners and Heat Pumps, 135,000-240,000 Btu/h

The Consortium for Energy Efficiency in conjunction with the American Council for an Energy Efficient Economy conducted a cost effectiveness analysis for this range of equipment. Their study compares the current federal standard of 8.5 EER and 2.9 COP with the Commission's proposed levels of 10.8 EER and 3.3 COP. This analysis shows that, for the California marketplace, the added first cost (to go from current to proposed efficiency levels) would be $1,516, and would save 6,057 kWh/year. This equates to $697 per year in energy savings at 11.5 cents per kWh. At this rate of savings, the payback period would be 2.2 years, far less than the 15-year life span for this equipment. This study can be found at http://www.cee1.org/com/hecac/hecac-main.php3.

Subsection and Table	***Appliance***	***Added First Cost***	***Annual Unit Reduction in Energy Use***	***Annual Unit Reduction in Operating Cost @11.5 cents/kWh***	***Simple Payback (years)***
1605.2(c) Table C-6	Commercial air conditioners ≥135,000 and <240,000 Btu/hr EER 8.5 to 11.0	$1,516	6,057 kWh	$697	2.2

Summary of Cost Effectiveness Calculations

Table 13 in the original Life Cycle Cost Analysis was unclear. The following text shows the data in much greater detail and is thus more easily understood.

Tables 13A and 13B summarize the cost effectiveness data, explained in detail within the report.

Table 13A shows additional cost to the consumer related to the purchase and use of one single appliance of each type. The results confirm that the proposed standards do not result in added costs to the consumer over the design life of the appliance.

- The savings from the standards for emergency lighting and traffic signals are understated since not only is the energy use for these appliance types greatly reduced, but also the useable life of the appliance is greatly increased. The useful life of emergency lighting increases from 1-2 years to 10 years and the useful life of traffic signals increases from 3 years to 7 years.
- Since there is no change in the cost of maintenance due to the standards for any of the appliances, no mention of these costs appear in the table.
- The data related to residential air conditioners assumes an increase from 12.0 SEER to 13.0 SEER.
- The standard for commercial washing machines consists of two parts. The calculations take into account the energy factor standard, but not the water factor standard, which takes effect two years later.

Table 13B uses the same basic data as Table 13A, but displays results on a statewide basis, using expected annual sales numbers within the state for each appliance type. This table also lists the reduction of peak demand based on the first complete year that each newly designed appliance is in use. Since twice as many appliances will have been installed at the end of the second year, and three times as many by the end of the third year, this energy savings and peak reduction grow rapidly from year to year.

Table 13A – Cost Effectiveness for Individual Consumers

			Simple Payback Method								Present Worth Method		
			Lifetime	Energy Costs		Electricity Savings		Gas Savings		Simple Payback			
Appliance	Number of Units Sold per year	Added First Cost Dollars per unit	Years	Electricity Dollars per kWh	Gas Dollars per therm	kWh per year	Dollars per year	Therms per year	Dollars per year	Years	Total Added Costs $/Lifetime per consumer	Gross Dollar Savings Over Lifetime	Net Dollar Savings Over Lifetime
Residential Air Conditioner	205,000	121	18	0.115		209	24			5.0	121	305.35	184.35
Commercial Air Conditioner	26,000	160	15	0.115		2,790	321			0.5	160	2,739.78	2,579.78
Vending Machine	47,500	25	10	0.115		351	40			0.6	25	333.10	308.10
Commercial Refrigerator and Freezer with Transparent Door	33,750	382	9	0.115		1,504	173			2.2	382	976.10	594.10
Commercial Refrigerator and Freezers with Solid Door	11,250	382	9	0.115		2,064	237			1.6	382	1,339.54	957.54
Tub Spout Diverter	200,000	0	10	0.115	0.81	-	0	1.2	1.00	0.0	0	7.20	7.20
Emergency Lighting	160,000	20	10	0.115		315	36			0.6	20	223.34	203.34
Traffic Signal	1,000,000	142	7	0.115		300	35			4.1	142	157.80	15.80
Torchiere Fixture	1,300,000	20	12	0.115		394	45			0.4	20	423.55	403.55
Commercial Clothes Washer	50,000	300	8	0.115	0.81	340	39	70	56.70	3.1	300	572.79	272.79
Distribution Transfer	10,000	506	30	0.115		2,690	310			1.6	506	4,274.41	3,768.41

Table 13B – Cost Effectiveness - Statewide

			Simple Payback Method								Present Worth Method			
			Lifetime	Energy Costs		Electricity Savings		Gas Savings		Simple Payback				Peak Reduction
Appliance	Number of Units Sold per year	Added First Cost in Millions of Dollars	Years	Electricity Dollars per kWh	Gas Dollars per therm	Millions of kWh per year	Millions of Dollars per year	Millions of Therms per year	Millions of Dollars per year	Years	Total Added Costs in Millions of Dollars	Gross Dollar Savings Millions of Dollars	Net Savings Over Lifetime Millions of Dollars	Reduced Peak Demand* *MW
Residential Air Conditioner	205,000	24.8	18	0.115		42.8	4.9			5.0	24.8	62.6	37.8	9.6
Commercial Air Conditioner	26,000	4.2	15	0.115		72.5	8.3			0.5	4.2	71.2	67.1	8.7
Vending Machine	47,500	1.2	10	0.115		16.7	1.9			0.6	1.2	15.8	14.6	1.9
Commercial Refrigerator and Freezer with Transparent Door	33,750	12.9	9	0.115		50.8	5.8			2.2	12.9	32.9	20.1	6.9
Commercial Refrigerator and Freezers with Solid Door	11,250	4.3	9	0.115		23.2	2.7			1.6	4.3	15.1	10.8	2.3
Tub Spout Diverter	200,000	0.0	10	0.115	0.81		0.0	0.24	0.20	0.0	0.0	1.4	1.4	0.0
Emergency Lighting	160,000	3.2	10	0.115		50.4	5.8			0.6	3.2	35.7	32.5	5.8
Traffic Signal	1,000,000	142.0	7	0.115		300.0	34.5			4.1	142.0	157.8	15.8	34.0
Torchiere Fixture	1,300,000	26.0	12	0.115		512.2	58.9			0.4	26.0	550.6	524.6	58.5
Commercial Clothes Washer	50,000	15.0	8	0.115	0.81	17.0	2.0	3.50	2.84	3.1	15.0	28.6	13.6	2.9
Distribution Transfer	10,000	5.1	30	0.115		26.9	3.1			1.6	5.1	42.7	37.7	3.1
TOTALS											238.7	1,014.4	776.0	133.7

Addendum to the
2001 Update, AB 970 Appliance Efficiency Standards
Life Cycle Cost Analysis, Publication #P400-01-028
February 6, 2002

Table 13 in the original Life Cycle Cost Analysis was unclear. The following table augments the original data..

Tables 13C summarizes the dollar savings for all covered appliances during the first 10 years after the adoption of the appliance standards.

Table 13C - Net Dollar Savings: All Appliances Purchased During First 10 Years After Adoption of Standards
(10-Year Cost Effectiveness Calculations)
February 5, 2002

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Sub-Totals
Residential Air Conditioners					205000	410000	615000	820000	1025000	1230000	1435000	
					14.7	**12.6**	**10.5**	**8.4**	**6.3**	**4.2**	**2.1**	**58.80**
Commercial Air Conditioners		26000	52000	78000	104000	130000	156000	182000	208000	234000	260000	
		44.73333	**40.26**	**35.78667**	**31.31333**	**26.84**	**22.36667**	**17.89333**	**13.42**	**8.946667**	**4.473333**	**246.03**
Vending Machines		47500	95000	142500	190000	237500	285000	332500	380000	427500	475000	
		14.6	**13.14**	**11.68**	**10.22**	**8.76**	**7.3**	**5.84**	**4.38**	**2.92**	**1.46**	**80.30**
Commercial Refrigerators and Freezer with Transparent Door		33750	67500	101250	135000	168750	202500	236250	270000	303750	337500	
		22.33333	**20.1**	**17.86667**	**15.63333**	**13.4**	**11.16667**	**8.933333**	**6.7**	**4.466667**	**2.233333**	**122.83**
Commercial Refrigerators and Freezer with Solid Door		11250	22500	33750	45000	56250	67500	78750	90000	101250	112500	
		12	**10.8**	**9.6**	**8.4**	**7.2**	**6**	**4.8**	**3.6**	**2.4**	**1.2**	**66.00**
Tub Spout Diverters		200000	400000	600000	800000	1000000	1200000	1400000	1600000	1800000	2000000	
		1.4	**1.26**	**1.12**	**0.98**	**0.84**	**0.7**	**0.56**	**0.42**	**0.28**	**0.14**	**7.70**
Emergency Lighting		160000	320000	480000	640000	800000	960000	1120000	1280000	1440000	1600000	
		32.5	**29.25**	**26**	**22.75**	**19.5**	**16.25**	**13**	**9.75**	**6.5**	**3.25**	**178.75**
Traffic Signals		1000000	2000000	3000000	4000000	5000000	6000000	7000000	8000000	9000000	10000000	
		22.57143	**20.31429**	**18.05714**	**15.8**	**13.54286**	**11.28571**	**9.028571**	**6.771429**	**4.514286**	**2.257143**	**124.14**
Torchiere Fixture		13000000	26000000	39000000	52000000	65000000	78000000	91000000	1.04E+08	1.17E+08	1.3E+08	
		437.1667	**393.45**	**349.7333**	**306.0167**	**262.3**	**218.5833**	**174.8667**	**131.15**	**87.43333**	**43.71667**	**2404.42**
Commercial Clothes Washer		50000	100000	150000	200000	250000	300000	350000	400000	450000	500000	
		17	**15.3**	**13.6**	**11.9**	**10.2**	**8.5**	**6.8**	**5.1**	**3.4**	**1.7**	**93.50**
Distribution Transformer		10000	20000	30000	40000	50000	60000	70000	80000	90000	100000	
		12.56667	**11.31**	**10.05333**	**8.796667**	**7.54**	**6.283333**	**5.026667**	**3.77**	**2.513333**	**1.256667**	**69.12**
							Total Savings(Millions of Dollars)					**3,451.59**

Addendum to the
2001 Update, AB 970 Appliance Efficiency Standards
Life Cycle Cost Analysis, Publication #P400-01-028
February 1, 2002

Additional Data Related to
Commercial Air Conditioners and Heat Pumps, 135,000-240,000 Btu/h

The Consortium for Energy Efficiency in conjunction with the American Council for an Energy Efficient Economy conducted a cost effectiveness analysis for this range of equipment. Their study compares the current federal standard of 8.5 EER and 2.9 COP with the Commission's proposed levels of 10.8 EER and 3.3 COP. This analysis shows that, for the California marketplace, the added first cost (to go from current to proposed efficiency levels) would be $1,516, and would save 6,057 kWh/year. This equates to $697 per year in energy savings at 11.5 cents per kWh. At this rate of savings, the payback period would be 2.2 years, far less than the 15-year life span for this equipment. This study can be found at http://www.cee1.org/com/hecac/hecac-main.php3.

Subsection and Table	***Appliance***	***Added First Cost***	***Annual Unit Reduction in Energy Use***	***Annual Unit Reduction in Operating Cost @11.5 cents/kWh***	***Simple Payback (years)***
1605.2(c) Table C-6	Commercial air conditioners ≥135,000 and <240,000 Btu/hr EER 8.5 to 11.0	$1,516	6,057 kWh	$697	2.2

Summary of Cost Effectiveness Calculations

Table 13 in the original Life Cycle Cost Analysis was unclear. The following text shows the data in much greater detail and is thus more easily understood.

Tables 13A and 13B summarize the cost effectiveness data, explained in detail within the report.

Table 13A shows additional cost to the consumer related to the purchase and use of one single appliance of each type. The results confirm that the proposed standards do not result in added costs to the consumer over the design life of the appliance.

- The savings from the standards for emergency lighting and traffic signals are understated since not only is the energy use for these appliance types greatly reduced, but also the useable life of the appliance is greatly increased. The useful life of emergency lighting increases from 1-2 years to 10 years and the useful life of traffic signals increases from 3 years to 7 years.
- Since there is no change in the cost of maintenance due to the standards for any of the appliances, no mention of these costs appear in the table.
- The data related to residential air conditioners assumes an increase from 12.0 SEER to 13.0 SEER.
- The standard for commercial washing machines consists of two parts. The calculations take into account the energy factor standard, but not the water factor standard, which takes effect two years later.

Table 13B uses the same basic data as Table 13A, but displays results on a statewide basis, using expected annual sales numbers within the state for each appliance type. This table also lists the reduction of peak demand based on the first complete year that each newly designed appliance is in use. Since twice as many appliances will have been installed at the end of the second year, and three times as many by the end of the third year, this energy savings and peak reduction grow rapidly from year to year.

Table 13A – Cost Effectiveness for Individual Consumers

			Simple Payback Method								Present Worth Method		
			Lifetime	Energy Costs		Electricity Savings		Gas Savings		Simple Payback			
Appliance	Number of Units Sold per year	Added First Cost Dollars per unit	Years	Electricity Dollars per kWh	Gas Dollars per therm	kWh per year	Dollars per year	Therms per year	Dollars per year	Years	Total Added Costs $/Lifetime per consumer	Gross Dollar Savings Over Lifetime	Net Dollar Savings Over Lifetime
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Commercial Air Conditioner	26,000	160	15	0.115		2,790	321			0.5	160	2,739.78	2,579.78
Vending Machine	47,500	25	10	0.115		351	40			0.6	25	333.10	308.10
Commercial Refrigerator and Freezer with Transparent Door	33,750	382	9	0.115		1,504	173			2.2	382	976.10	594.10
Commercial Refrigerator and Freezers with Solid Door	11,250	382	9	0.115		2,064	237			1.6	382	1,339.54	957.54
Tub Spout Diverter	200,000	0	10	0.115	0.81	-	0	1.2	1.00	0.0	0	7.20	7.20
Emergency Lighting	160,000	20	10	0.115		315	36			0.6	20	223.34	203.34
Traffic Signal	1,000,000	142	7	0.115		300	35			4.1	142	157.80	15.80
Torchiere Fixture	1,300,000	20	12	0.115		394	45			0.4	20	423.55	403.55
Commercial Clothes Washer	50,000	300	8	0.115	0.81	340	39	70	56.70	3.1	300	572.79	272.79
Distribution Transfer	10,000	506	30	0.115		2,690	310			1.6	506	4,274.41	3,768.41

Table 13B – Cost Effectiveness - Statewide

			Simple Payback Method								Present Worth Method			
			Lifetime	Energy Costs		Electricity Savings		Gas Savings		Simple Payback				Peak Reduction
Appliance	Number of Units Sold per year	Added First Cost in Millions of Dollars	Years	Electricity Dollars per kWh	Gas Dollars per therm	Millions of kWh per year	Millions of Dollars per year	Millions of Therms per year	Millions of Dollars per year	Years	Total Added Costs in Millions of Dollars	Gross Dollar Savings Millions of Dollars	Net Savings Over Lifetime Millions of Dollars	Reduced Peak Demand* *MW
Residential Air Conditioner	205,000	24.8	18	0.115		42.8	4.9			5.0	24.8	62.6	37.8	9.6
Commercial Air Conditioner	26,000	4.2	15	0.115		72.5	8.3			0.5	4.2	71.2	67.1	8.7
Vending Machine	47,500	1.2	10	0.115		16.7	1.9			0.6	1.2	15.8	14.6	1.9
Commercial Refrigerator and Freezer with Transparent Door	33,750	12.9	9	0.115		50.8	5.8			2.2	12.9	32.9	20.1	6.9
Commercial Refrigerator and Freezers with Solid Door	11,250	4.3	9	0.115		23.2	2.7			1.6	4.3	15.1	10.8	2.3
Tub Spout Diverter	200,000	0.0	10	0.115	0.81		0.0	0.24	0.20	0.0	0.0	1.4	1.4	0.0
Emergency Lighting	160,000	3.2	10	0.115		50.4	5.8			0.6	3.2	35.7	32.5	5.8
Traffic Signal	1,000,000	142.0	7	0.115		300.0	34.5			4.1	142.0	157.8	15.8	34.0
Torchiere Fixture	1,300,000	26.0	12	0.115		512.2	58.9			0.4	26.0	550.6	524.6	58.5
Commercial Clothes Washer	50,000	15.0	8	0.115	0.81	17.0	2.0	3.50	2.84	3.1	15.0	28.6	13.6	2.9
Distribution Transfer	10,000	5.1	30	0.115		26.9	3.1			1.6	5.1	42.7	37.7	3.1
TOTALS											238.7	1,014.4	776.0	133.7

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2001 Update, AB 970 Appliance Efficiency Standards
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February 6, 2002

Table 13 in the original Life Cycle Cost Analysis was unclear. The following table augments the original data..

Tables 13C summarizes the dollar savings for all covered appliances during the first 10 years after the adoption of the appliance standards.

Table 13C - Net Dollar Savings: All Appliances Purchased During First 10 Years After Adoption of Standards
(10-Year Cost Effectiveness Calculations)
February 5, 2002

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Sub-Totals
Residential Air Conditioners					205000	410000	615000	820000	1025000	1230000	1435000	
					14.7	**12.6**	**10.5**	**8.4**	**6.3**	**4.2**	**2.1**	**58.80**
Commercial Air Conditioners		26000	52000	78000	104000	130000	156000	182000	208000	234000	260000	
		44.73333	**40.26**	**35.78667**	**31.31333**	**26.84**	**22.36667**	**17.89333**	**13.42**	**8.946667**	**4.473333**	**246.03**
Vending Machines		47500	95000	142500	190000	237500	285000	332500	380000	427500	475000	
		14.6	**13.14**	**11.68**	**10.22**	**8.76**	**7.3**	**5.84**	**4.38**	**2.92**	**1.46**	**80.30**
Commercial Refrigerators and Freezer with Transparent Door		33750	67500	101250	135000	168750	202500	236250	270000	303750	337500	
		22.33333	**20.1**	**17.86667**	**15.63333**	**13.4**	**11.16667**	**8.933333**	**6.7**	**4.466667**	**2.233333**	**122.83**
Commercial Refrigerators and Freezer with Solid Door		11250	22500	33750	45000	56250	67500	78750	90000	101250	112500	
		12	**10.8**	**9.6**	**8.4**	**7.2**	**6**	**4.8**	**3.6**	**2.4**	**1.2**	**66.00**
Tub Spout Diverters		200000	400000	600000	800000	1000000	1200000	1400000	1600000	1800000	2000000	
		1.4	**1.26**	**1.12**	**0.98**	**0.84**	**0.7**	**0.56**	**0.42**	**0.28**	**0.14**	**7.70**
Emergency Lighting		160000	320000	480000	640000	800000	960000	1120000	1280000	1440000	1600000	
		32.5	**29.25**	**26**	**22.75**	**19.5**	**16.25**	**13**	**9.75**	**6.5**	**3.25**	**178.75**
Traffic Signals		1000000	2000000	3000000	4000000	5000000	6000000	7000000	8000000	9000000	10000000	
		22.57143	**20.31429**	**18.05714**	**15.8**	**13.54286**	**11.28571**	**9.028571**	**6.771429**	**4.514286**	**2.257143**	**124.14**
Torchiere Fixture		13000000	26000000	39000000	52000000	65000000	78000000	91000000	1.04E+08	1.17E+08	1.3E+08	
		437.1667	**393.45**	**349.7333**	**306.0167**	**262.3**	**218.5833**	**174.8667**	**131.15**	**87.43333**	**43.71667**	**2404.42**
Commercial Clothes Washer		50000	100000	150000	200000	250000	300000	350000	400000	450000	500000	
		17	**15.3**	**13.6**	**11.9**	**10.2**	**8.5**	**6.8**	**5.1**	**3.4**	**1.7**	**93.50**
Distribution Transformer		10000	20000	30000	40000	50000	60000	70000	80000	90000	100000	
		12.56667	**11.31**	**10.05333**	**8.796667**	**7.54**	**6.283333**	**5.026667**	**3.77**	**2.513333**	**1.256667**	**69.12**
								Total Savings(Millions of Dollars)				**3,451.59**