Appliance and Equipment Efficiency Standards: History, Impacts, Current Status, and Future Directions

Steven Nadel
American Council for an Energy-Efficient Economy
David Goldstein
Natural Resources Defense Council

June, 1996

American Council for an Energy-Efficient Economy
1001 Connecticut Avenue, NW, Suite 801, Washington, DC 20036 (202)429-8873

ABSTRACT

It has been more than twenty years since the first appliance efficiency standards were enacted in the United States. In the initial years appliance standard discussions were marked by bitter debates but by the early 1990s a middle ground had been found in which manufacturers, states, and energy efficiency advocates often worked together to negotiate consensual national efficiency standards that preempted standards set by states. Standards set in this manner are producing substantial reductions in U.S. energy use (more than 2.5 percent of U.S. energy use, once existing standards are fully implemented) while maintaining a benefit-cost ratio of more than 3:1.

In 1994/1995, this apparent consensus broke down, due to some particularly controversial draft standards the U.S. Department of Energy (DOE) proposed in early 1994 and also due to the November 1994 election after which members opposed to regulation took hold of Congress. Equipment manufacturers sought to take advantage of this new state of affairs and incapacitate the standards program. As of early 1996, Congress had imposed a one-year moratorium on setting new standards, and DOE also had developed, with extensive stakeholder input, a series of reforms to improve the standard-setting process. Substantial savings are at stake—standards now under development could reduce projected U.S. energy use by more than 1.5 percent, raising total savings to more than 4 percent of U.S. energy use.

Over the short term, the future of the standards program is unclear, as some manufacturers are working to extend the moratorium on new standards while these and other manufacturers are negotiating with DOE and efficiency advocates on additional modifications to the program. At the same time, several states, frustrated by the hold-up at the federal level, are again considering setting state standards. In the long term, the future of the standards process appears brighter, as factors such as increased concern about global climate change, increased state and international standards activity, increased use of voluntary market-driven programs to lay the groundwork for new standards, and changes in the political winds from Washington are likely to combine to put the standards program back on track.

APPLIANCE AND EQUIPMENT EFFICIENCY STANDARDS—A BRIEF HISTORY

Initial Efforts at State and National Appliance Standards: the 1970s

The idea of appliance standards as a policy tool to reduce unnecessary consumption of energy predates the first energy crisis of 1973. Regional concerns of electric system reliability and environmental impacts were driving analysts and policymakers to look at energy efficiency standards beginning in the early 1970s. In the Northeast, the blackout of 1965 inspired a reexamination of the sustainability of rapid exponential growth in electricity demand; this activity led both to the development of building standards, such as ASHRAE 90-75, and to

consideration of appliance standards. A New York Public Service Commissioner testified before Congress in support of federal appliance efficiency standards in mid-1973 (Swidler 1973), before the oil embargo, and New York State had adopted standards for some products by 1976. On the West Coast, environmental concerns about power plant siting led to a major analysis of energy policy options during the first several years of the 1970s (RAND Corporation 1972; RAND Corporation 1975). This discussion, which included explicit mention of appliance efficiency standards, culminated in the passage of the Warren Alquist Act in 1974, establishing in California an Energy Commission with the authority to set appliance efficiency standards.

Momentum for doing something affirmative to improve appliance efficiency accelerated in the wake of the 1973 oil embargo. California's initial efforts to lay the foundations for energy efficiency standards also had impacts nationwide. As the Federal Energy Administration was working with President Ford to develop policy proposals for the 1975 State of the Union Address, that agency's staff was looking at the technical and policy analysis in California to provide guidance for their proposals. The chosen option was voluntary targets for appliance efficiency, producing on average a 20 percent reduction in new appliance energy use relative to then current levels. These goals were formalized in an executive order and then in the Energy Policy and Conservation Act of 1975.

Before the success of these voluntary targets could be evaluated, California and other states began to adopt mandatory energy efficiency standards. The proceedings were very contentious, with state officials arguing for significant energy savings and manufacturers uniformly opposing standards.

State efforts during the period 1975-1977 changed the dynamic at the federal level as well. When President Carter was elected, based in significant part on standards work by states, he proposed legislation that would replace the voluntary efficiency targets with mandatory standards to be set by DOE. The initial Carter Administration proposal did not mention state standards. The Carter proposal was debated for over a year in Congress. Manufacturers reacted negatively to the Carter Administration standards proposals and used the Congressional forum as a way to reduce the likelihood of state standards. To address manufacturer concerns, amendments to the Carter Administration's proposal, eventually incorporated into the National Energy Conservation and Policy Act (NECPA) of 1978, gave the DOE standards preemptive power over state standards.

Another amendment required DOE to evaluate and consider the impacts that proposed standards would have on manufacturers, a process that many in industry believed would prevent DOE from being able to issue standards, a belief that proved false. With these additions, manufacturers generally acquiesced to NECPA.

The Carter Administration proposed standards for a number of appliances in 1980 but failed to issue a final rule before the Reagan Administration took over.

Initial discussions on appliance standards at the state level involved dialogues between state officials and manufacturers. As time passed, public interest organizations began playing a larger role in advocacy to support appliance standards. Often public interest organizations such as the Natural Resources Defense Council (NRDC) and the American Council for an Energy-Efficient Economy (ACEEE) presented comments supporting stronger standards than those proposed by state or federal officials, while industry proposed weaker standards or none at all.

One company—Carrier—found that, despite its initial (1976) advocacy that market forces would produce gains in efficiency, high-efficiency models were in fact hard to sell in areas that did not have standards. This finding altered their position to one of general support for appliance efficiency standards, and of working collaboratively with regulators to ensure that standards were practical and technically sound from their perspective.

The 1980s: the Road to NAECA

The Reagan Administration had a completely different approach to appliance efficiency than its predecessors of either political party: the Reagan Administration opposed standards on ideological grounds. First, the Administration requested that Congress de-authorize appliance standards; when this effort was unsuccessful, it began to seek the same thing administratively. The Administration's first tactic was simply to delay issuing final rules. NRDC challenged this delay in court in 1982, and was successful in requiring DOE to issue standards. But when DOE published its standards in 1983, the Administration developed a novel argument to justify its refusal to adopt standards. The NECPA law provided that standards would not be adopted by DOE unless they saved a significant amount of energy. The Reagan DOE calculated large savings that it believed would occur due to market forces, and coupled these with relatively weak proposals for standards. It found that the difference in energy savings did not meet its newly proposed definition of "significant" savings. This "no-standard standard" was also challenged by NRDC litigation.

Over these first four years of the 1980s, many states became concerned about the lack of progress on appliance efficiency. Several of them considered the idea of adopting California standards, but found on analysis that these standards had effectively influenced efficiencies in their state as well, so that adoption of the California standards would produce limited additional energy savings. These states did not have the resources to conduct analyses to develop new standards, so for other states to adopt standards incorporating new technologies for efficiency, California would have to act first.

This action was precipitated by a 1983 petition by NRDC to the California Energy Commission (CEC) to establish new standards for refrigerators and central air conditioners. The California Energy Commission conducted extensive workshops and hearings throughout 1984, culminating in the adoption of stringent, two-tiered standards for both of these products.

These standards were vigorously opposed by the refrigerator industry, which was unwilling to accept virtually any level of energy standards, and by most of the air conditioner industry. Carrier supported the CEC air conditioner proposal.

Numerous other states became interested in adopting the California standards. Legislation was introduced in at least five other states in 1985 and 1986. These efforts, which were often reintroduced in the succeeding year if they failed the first year, were increasingly successful, and by 1986 Arizona, Florida, Kansas, Massachusetts and New York had adopted standards on one or more products. By this time, the court also agreed with NRDC that the DOE "no-standard standard" was illegal and directed DOE to develop substantive standards.

This situation, with the strong momentum toward standard setting at the state level, prompted the home appliance industry to reconsider its efforts. It offered to negotiate legislation with NRDC that would effectively trade off national standards for increased preemption of state efforts, a similar tradeoff to that which they had accepted in the 1970s. These negotiations led to an agreement by mid-1986 that incorporated an unusual result: adoption of the actual regulations setting efficiency levels in the legislation, as well as establishing a schedule of future DOE rulemakings until the year 2007 to consider strengthening the standards. The products covered by this law are listed in Table 1. In exchange, states and energy efficiency advocates agreed to strengthened language on pre-emption of state standards for covered products. Specifically, states desiring to set standards must petition DOE showing "unusual and compelling State or local energy interests," and DOE, in reviewing the petition, must determine that "State regulation will [not] significantly burden manufacturing, marketing, distribution, sale, or servicing of the covered product on a national basis." (U.S. Congress 1987).

The agreement between NRDC—working with state energy offices, ACEEE, and other environmental organizations, and consumer organizations—and manufacturers, along with related interested parties such as utilities (both gas and electric, and municipal and investor owned), retailers, home builders, mobile home producers, etc., was very attractive to Congress because of the broad and virtually unanimous stakeholder support. The legislation resulting from this negotiation, referred to as the National Appliance Energy Conservation Act (NAECA) passed Congress in less than three months. It was signed by President Reagan in the spring of 1987.

This agreement led stakeholders to seek opportunities for further consensual legislation. The first opportunity came in 1988 when efficiency advocates, led by ACEEE, negotiated with

ballast manufacturers for national standards that would include ballasts under the NAECA umbrella. These standards replaced ballast standards enforced by several states with national standards at the same efficiency level. The legislation, the National Appliance Energy Conservation Amendments of 1988, was adopted by Congress without controversy.

The coverage of further products under national efficiency standards was also initiated at the state level. In this case, Massachusetts passed legislation requiring its energy office to set standards for fluorescent and incandescent lamps. Massachusetts legislators also introduced legislation to enact standards on electric motors. The prospect of state standards on these products set the stage for negotiations over national standards between the same sorts of stakeholders: product manufacturers on the one hand and ACEEE (with assistance and support from several public interest organizations, utilities, and states) on the other. These negotiations were coupled with similar discussions for water efficiency standards, led by the National Wildlife Federation, on the public interest side, and plumbing manufacturers,. These negotiations, covering products also listed in Table 1 were incorporated into the efficiency provisions of the national Energy Policy Act of 1992 (EPAct). Enactment of the EPAct standards marked a significant expansion of the program into equipment largely used in commercial and industrial facilities, complementing the residential focus of the original NAECA standards. Overall, as discussed later in this paper, enactment of the EPAct standards approximately doubled the energy savings achieved by standards.

By the time the EPAct was enacted, some of the factors driving the development of standards had begun to change. While energy and economic savings remain important factors for pursuing standards, other factors increased in importance, including reducing the need for new electric generating plants and reducing emissions from the combustion of fossil fuels including compounds contributing to "acid rain," ground-level ozone, and global climate change.

Conflict and Consensus

Up until the negotiation of NAECA, discussions over appliance standards were highly polarized with manufacturers (except Carrier and, in some proceedings, Amana) vigorously opposing standards at virtually any efficiency level and in any forum, and public interest advocates arguing that state and federal officials had not gone far enough in proposing levels of efficiency. The two sides did not talk to each other informally, and did not particularly trust each other.

The negotiations over NAECA began to change that situation. The level of distrust and animosity began to decline and differences of opinion were more broadly recognized as representing legitimate differences in technical judgment. Whereas previous standards decisions at the state or federal level had generally culminated in industry-led court challenges, the 1989 refrigerator rulemaking by DOE was unchallenged by industry, despite the perceived high level of efficiency it demanded of manufacturers.

When DOE began to consider its next (1995 revision) of refrigerator standards in 1992, manufacturers contacted efficiency advocates and offered to try to negotiate consensual recommendations for standards levels.

This informal negotiation process was supported by DOE, which made its engineering and economic analysis available to the participants. The process—which took two years—was successful, leading to joint recommendations to DOE for a 1998 standard submitted in 1994. At this point the United States appeared to be on the verge a new era of consensus seeking in standards policy, with additional negotiations commencing on dishwasher standards. But several especially contentious standard proposals and a change in the political environment put these efforts on hold. These recent developments are discussed later in this paper.

ACHIEVEMENTS OF THE STANDARDS PROGRAM

Appliance and equipment efficiency standards have had a substantial impact on the efficiency of products that are regulated. This is illustrated by the case of refrigerator/freezers. The average annual electricity use of average new refrigerators increased rapidly during the period from the end of World War II to the early 1970s. Since 1972, average refrigerator energy use has decreased from 1726 kWh to 653 kWh in 1994, and will decrease further to an estimated 490 kWh in 2000 assuming consensual new refrigerator efficiency standards are finalized by the end of 1996. While other factors besides efficiency standards have contributed to these savings (e.g., rising electricity prices and utility rebate programs), the largest improvements in refrigerator efficiency have generally been in periods adjacent to the effective dates of new efficiency standards (see Figure 1). Similar results have been achieved for other products as is also illustrated in Figure 1. Interestingly, for all of the products shown in Figure 1, efficiency gains have been minimal since the last efficiency standards went into effect in the early 1990s, providing further evidence that standards are generally the most important driver for appliance efficiency improvements.

Overall, analyses by Lawrence Berkeley National Laboratory (LBNL) and ACEEE estimate that federal standards will save more than one quad of energy by 2000 and nearly three quads by 2015.[1] These estimates are net savings—they do not include efficiency improvements that would likely have occurred in the absence of standards. The LBNL and ACEEE analyses have also examined the costs and benefits of standards, comparing projected product price increases due to standards (which incorporate material, labor, and capital costs) to the value of consumer energy savings over the lifetime of affected products. These analyses have found that the benefits of standards are approximately three times greater than the costs. Actual results are likely to be even more favorable since realized cost increases appear to be smaller than

[1] A quad is a quadrillion (10^{15}) Btu. The United States consumed 87 Quads in 1995.

predicted by DOE during the rulemaking process (Greening et al. 1996). Savings, costs, and benefit-cost ratios for the different sets of standards are summarized in Table 2.

Appliance manufacturers are often concerned that meeting new standards requires significant investment, potentially drawing money away from other promising opportunities such as expansion in overseas markets. Manufacturers are also concerned that in today's highly competitive market, increases in production costs cannot be passed on to consumers and manufacturer profits will suffer. In addition, manufacturers worry that higher product prices may reduce demand for their products. Analyses by LBNL have generally predicted that new standards do require additional investments in the early years, which can result in small short-term decreases in return on equity, but in the longer term, return on equity generally increases because manufacturers can make some profit on the cost increment associated with higher-efficiency levels (see for example LBNL 1995). Support for these analytic results is provided by a review of data on refrigerators and clothes washers following imposition of new standards in 1993 and 1994. In the year these standards took effect, the consumer price indices for refrigerators and clothes washers increased more rapidly than the producers' price index for these products, and sales of these products increased (Appliance 1996a; Bureau of Labor Statistics 1995). The increase in product sales is largely due to a growing economy, but standards appear not to have hurt this trend. A review of manufacturer annual reports and financial analyst reports on 15 different appliance and ballast manufacturers covering the 1987-1993 period also supports the LBNL analytic results. This review found a substantial number of positive comments about standards including several comments that standards were increasing sales revenues and profits. None of the annual reports covered by this review mentioned any adverse impacts of standards (Chan & Webber 1995).

Furthermore, in some cases standards may be leading to the increased competitiveness of U.S. products in international markets. In many product categories, typical U.S. products are more efficient than products produced by foreign competitors. Conversely, regulated appliances are one of the few domestic U.S. markets that have seen minimal penetration by imports. For example, in the case of refrigerators, a recent international comparison found that U.S. refrigerators range in efficiency from 1.0 to 1.2 kWh per year per liter, substantially better than the 1.5 to 2.8 range for Japanese models and the 1.0 to 2.5 range for European models (Meier 1996). As other countries pursue policies to reduce the energy use of appliances and equipment, U.S. manufacturers are in a very good position. For example, in 1994 the Chief Executive Officer of Fedders Corp., the U.S.' largest room air conditioner manufacturer, urged DOE to set higher room air conditioner standards, arguing that these higher standards could serve "as a springboard to [allow U.S. firms] to regain the world's leadership in air conditioner technology" (Giordano 1994).

PENDING STANDARDS

Under the laws establishing initial federal standards, DOE is required to periodically review each standard and revise them if necessary in order to keep standards current with technical and economic developments. For most products, standards are reviewed every five years in a formal process that includes advanced notice of proposed rulemaking (ANOPR) that discusses the options to be analyzed and the proposed analysis process, notice of proposed rulemaking (NOPR) that discusses the results of the analyses and includes a draft standard level, and final rule that discusses the new standard and the rationale for this standard. For most products the new standard goes into effect three years after the publication of the final. DOE currently has pending rulemakings to develop new standards for all of the products covered by NAECA. The current status of these rulemakings is summarized in Table 3. Rulemakings have yet to begin for any of the products covered by EPAct. In general, the rulemaking process is proceeding very slowly—all of the rulemakings are behind schedule, some by as much as five years.

Some of the rulemakings have been very contentious. For example, in 1994 DOE proposed new standards for eight products including new or significantly strengthened standards for water heaters, fluorescent lamp ballasts, room air conditioners, kitchen ranges and ovens, microwave ovens, and televisions. Many of the proposed standards proved very controversial (e.g., a proposal that would essentially replace electric resistance water heaters with heat pump water heaters) and in some cases the analyses supporting these proposed standard levels proved faulty. To address these problems, in 1995 DOE announced that the rulemaking on televisions was being suspended, new draft rules would be developed for electric water heaters and ballasts, and analyses for other products would be revised before final rules would be published.

The potential energy savings from these pending rulemakings are dramatic. Based on a review of recent DOE analyses and manufacturer comments on DOE analyses, ACEEE estimated likely future standards and effective dates for many of the NAECA and EPAct products and projected the potential energy savings from these new standards. In general, the standards included in this analysis are modest and should avoid many of the controversies of the 1994 eight product rulemaking. Exceptions to this rule are the clothes washer and ballast standards, which remain controversial. Overall, by 2015 the new standards are projected to reduce U.S. energy use by 1.7 quads, increasing the savings in 2015 from existing standards (as shown in Table 2) by nearly 60 percent. Details of the analysis are summarized in Table 4. Combined savings from existing and projected new standards will total more than 4.5 quads in 2015, representing a reduction in projected U.S. energy use in that year of more than 4 percent.

CURRENT EVENTS: 1995-1996

The November 1994 elections produced the first Republican majority in over a generation in both the House of Representatives and the Senate. Many House freshman came from a strong ideological background that looked unfavorably on standards. This shift in the political winds apparently encouraged some companies who were still unhappy with the concept of efficiency standards to seek legislative relief.

Rather than challenging the underlying laws directly, anti-standards advocates attempted to stop the issuance of appliance efficiency standards through the budget process. In the House of Representatives, an amendment to the Appropriations Bill funding DOE was adopted that would have almost zeroed out DOE's budget for setting appliance efficiency standards. It also would have barred DOE explicitly from setting any new standards, remarkably including even the consensual refrigerator standards that had been supported by the refrigerator industry. These efforts were led by two subsets of industry: (1) ballast manufacturers, led by Philips and MagneTek, who were concerned about the possibility that DOE might set standards requiring electronic ballasts (thereby jeopardizing their profitable magnetic ballast operations), and (2) clothes washer manufacturers, including prominently General Electric and Maytag, who apparently were concerned that the significantly strengthened standards that DOE had suggested (in 1991) that it might adopt in 1996 could give a competitive advantage to Whirlpool. Whirlpool (and also Maytag and Frigidaire) had announced by 1994 the impeding introduction of products that would meet such projected DOE standard levels.

These efforts were opposed by historic standards advocates, but also by Whirlpool, which believed that advanced clothes washer standards could provide increased value to their customers and their company. Late in 1995, Carrier also announced its opposition to efforts to change appliance standards law. Many other companies have refrained from taking a position on the issue.

The resulting legislative battle was not resolved until April 1996. During the period of indecision, DOE acted as if the moratorium were already in place. The final resolution provides limited funding to DOE to continue to analyze potential standards, but prohibits DOE from issuing draft or final standards during the 1996 fiscal year (which ends September 30, 1996). However, the Congressional fight over standards is not over—the National Electrical Manufacturer Association (NEMA, which represents ballast manufacturers among other products) and the Association of Home Appliance Manufacturers (AHAM) have announced that they will seek Congressional action to extend the moratorium on new standards through the 1997 fiscal year.

When it became clear that DOE might not move forward with appliance efficiency standards, interest in standards rekindled at the state level. The California Energy Commission, responding to a NRDC/ACEEE petition, initiated an investigation into standards for ballasts

in August 1995 and is analyzing the potential for standards for other products as well, including refrigerators (based on the consensual standards negotiated by manufacturers and efficiency advocates including the California Energy Commission and several California utilities) and clothes washers. Florida and several other states are contemplating similar actions. A recent analysis discusses these and other possible targets for state action on efficiency standards (Nadel & Suozzo 1996). For products covered by existing federal standards, such as refrigerators, clothes washers, and some types of ballasts, states setting standards will need to petition DOE for exemption from preemption.

Finally, DOE recognized that some of the complaints about appliance standards it was receiving were due to weaknesses in DOE's internal processes for decision-making and processing standards. The Department convened an informal working group to discuss process changes for developing appliance standards within the context of existing law. This group included representatives of the primary stakeholders that have been active in debates in front of the agency, Congress, and the states. This informal process led to a formal public workshop in March 1996 and a draft DOE report on proposed changes to the standards program in April 1996. Recommendations proposed by DOE include soliciting stakeholder involvement earlier and more often in the decision-making process, devoting increased attention to energy consumption test procedures early in the process, concentrating limited resources on products with the greatest potential for cost-effective energy savings and on design options that are practical to manufacturers, improving the analysis of the impact of standards on manufacturers, and trying to speed up DOE processing of standards (DOE 1996). As of this writing, discussions are taking place among DOE, AHAM and efficiency advocates to determine whether the DOE proposed changes can be enhanced in exchange for AHAM agreeing not to promote further legislative moratoria on standards. NEMA, however, continues to pursue legislative action.

THE FUTURE OF APPLIANCE AND EQUIPMENT EFFICIENCY STANDARDS

In the short term, the future of appliance and equipment efficiency standards in the United States is uncertain. It is unlikely that Congress will change NAECA or EPAct in 1996, but de-authorizing or de-funding future rulemakings through the appropriations process is a possibility. While it is very difficult to predict what will happen in the short run, the most likely short run outcome is that the standards program will be allowed to continue but in a somewhat scaled-back form, e.g., concentrating on products with the largest potential savings. To the extent the federal government does not proceed with standards, it is likely that some states will begin setting standards, and that states and DOE will need to grapple with the exemption from preemption issue. State standards in turn will apply pressure on manufacturers and Congress to support renewed federal standards, as past experience has shown that manufacturers prefer uniform national standards to a patchwork of state standards.

In addition to work on standards themselves, work on voluntary market-driven programs that complement standards is likely to increase. Current examples of these programs include the EPA Green Lights program, the DOE motor challenge program, the EPA and DOE Energy Star program, utility market transformation programs, and labeling programs for lighting products included in EPAct. These voluntary programs often rely on test procedures developed for standards. These programs can also help build the market share of high-efficiency products, making new standards less controversial. However, the market penetration of voluntary programs is almost always substantially less than mandatory standards and thus voluntary programs are unlikely to be a replacement for standards (Nadel 1996).

Interestingly, just as standards activity is stalled in the U.S., activity is increasing in other countries. Among the countries that have recently finalized appliance standards or are likely to finalize standards soon are Australia, Brazil, Canada, China, European Union, Japan, Korea, Mexico, and the Phillippines. Except for Canada, standards in other countries do not apply to nearly as many products as do U.S. standards (Nadel 1996).

In the longer term the outlook for standards appears clearer: in the face of the proven effectiveness of standards, continued state and international activity in developing standards, and increased domestic and international concern with global climate change, and as the political winds in Washington shift again, national U.S. efficiency standards will likely continue with renewed vigor.

ACKNOWLEDGMENTS

Funding for the preparation of this paper was provided by grants from the Energy Foundation to ACEEE and NRDC. Invaluable assistance in reconstructing and documenting the early history of the appliance standards process was provided by a number of people who were lead figures at that time and who generously provided oral and written materials to the authors. These include Gerald Groff of Marquardt Switches, Maxine Savitz of Garrett Ceramic Components, Mark Friedrichs of the U.S. Department of Energy, Dan Quigley of Pacific Gas & Electric, and R. Michael Martin and John Wilson of the California Energy Commission.

Table 1. Products Covered by NAECA and EPAct

Products Included in NAECA:

Refrigerator/freezers
Freezers
Clothes washers
Clothes dryers
Dishwashers
Ranges and ovens
Room air conditioners
Central air conditioners and heat pumps
Furnaces and boilers
Water heaters
Direct-fired space heaters
Pool heaters
Televisions *

Products Included in EPAct:

Fluorescent lamps
Incandescent reflector lamps
Electric motors (1-200 hp)
Commercial packaged air conditioners and heat pumps
Commercial furnaces and boilers
Commercial water heaters
Showerheads
Faucets and faucet aerators
Toilets
Distribution transformers
Small electric motors (< 1 hp) *
High-intensity discharge lamps *

* Specific standards were not set in the legislation but instead DOE was instructed to investigate whether standards are technically feasible and economically justified and to set standards where feasibility and justification are shown.

Table 2. Savings and Cost-Effectiveness of Standards

Standard	Electricity Saved (TWh/yr)		Peak Capacity Saved (GW)		Primary Energy Saved (Quads/yr)		Cost	Gross Benefit	Benefit-Cost Ratio
	2000	2015	2000	2015	2000	2015	(billions,1990$)		
NAECA	8	43	1.4	15.7	0.21	0.58	28.3	67.9	2.4
Ballasts	18	24	5.7	7.5	0.21	0.28	2.7	10.3	3.8
NAECA updates	20	39	3.6	7.3	0.23	0.45	6.0	19.0	3.2
EPAct lamps	35	90	7.0	18.0	0.40	1.04	17.0	73.0	4.3
EPAct other	7	26	3.1	9.5	0.19	0.55	5.0	21.0	4.2
TOTAL	88	222	20.8	58.0	1.24	2.90	59.0	191.2	3.2

Source: Geller 1995.

Table 3. Status of Standard Updates by Product

Product	Effective Date(s) of Standards	Last Official Action	Scheduled/ Earliest Possible Effective Date for Next Standard	Notes
Refrig-erators and freezers	1990, 1993	NOPR 7/95	1998/1999	Manufacturers and efficiency advocates reached agreement in 10/94 on new standards that would reduce energy use in major product classes by nearly 30 percent.
Clothes washers and dryers	1988, 1994	ANOPR 3/95	1999/2001	Widespread support for a washer standard that addresses water extraction in the wash cycle and allows dryer standard to be unchanged. Standard for the rest of the wash cycle is controversial with efficiency advocates and some manufacturers supporting performance levels based on horizontal axis washer designs.
Dish-washers	1988, 1994	ANOPR 3/95	1999/2001	Work on dishwasher standards likely to be postponed so that resources can be concentrated on the clothes washer rulemaking.
Ranges and ovens	1990	NOPR 3/94	1995/1999	AHAM proposed prescriptive standard to ban pilot lights in all ranges and ovens; final rule nearly completed prior to 1996 moratorium.
Water heaters	1990	1/95 announce-ment will redo NOPR	1995/2000	NOPR proposed modest improvements in gas and oil standard but effectively requiring new electric water heaters to be heat pump units. This latter proposal was very controversial and DOE formally announced that they will reanalyze electric water heaters and publish a new NOPR.
Room air condi-tioners	1990	NOPR 3/94	1995/1999	Analyses by AHAM, FEMP, and DOE all suggest possible standard level of ~10 EER for most common product classes; final rule nearly completed prior to 1996 moratorium.
Central A/C & heat pumps	1994	ANOPR 8/93	1999-2002/2003	DOE has conducted initial analysis on possible standard levels, which has some problems but shows that very strong standards may be feasible; DOE now considering how to proceed.
Furnaces & boilers	1992	ANOPR 8/93	2002/2006	DOE conducted initial analysis but due to shortage of funding this analysis has been put on hold.

Ballasts for fluores-cent lamps	1990	1/95 announce-ment will redo NOPR	1995/2000	NOPR essentially required electronic ballasts but contained some technical errors; DOE released draft of new analysis in 2/96 that found that for most product classes electronic ballasts have lowest life-cycle costs.

Notes: Where a range of dates is shown, standards for different classes of products take effect on different dates. Where two dates are separated by a comma, the second date is the effective date of revised standards. Earliest possible effective dates of new standards are ACEEE estimates and assume aggressive efforts by DOE to complete rulemakings as soon as possible. These dates incorporate the legislated phase-in period between publication of a final rule and the effective date of that standard.

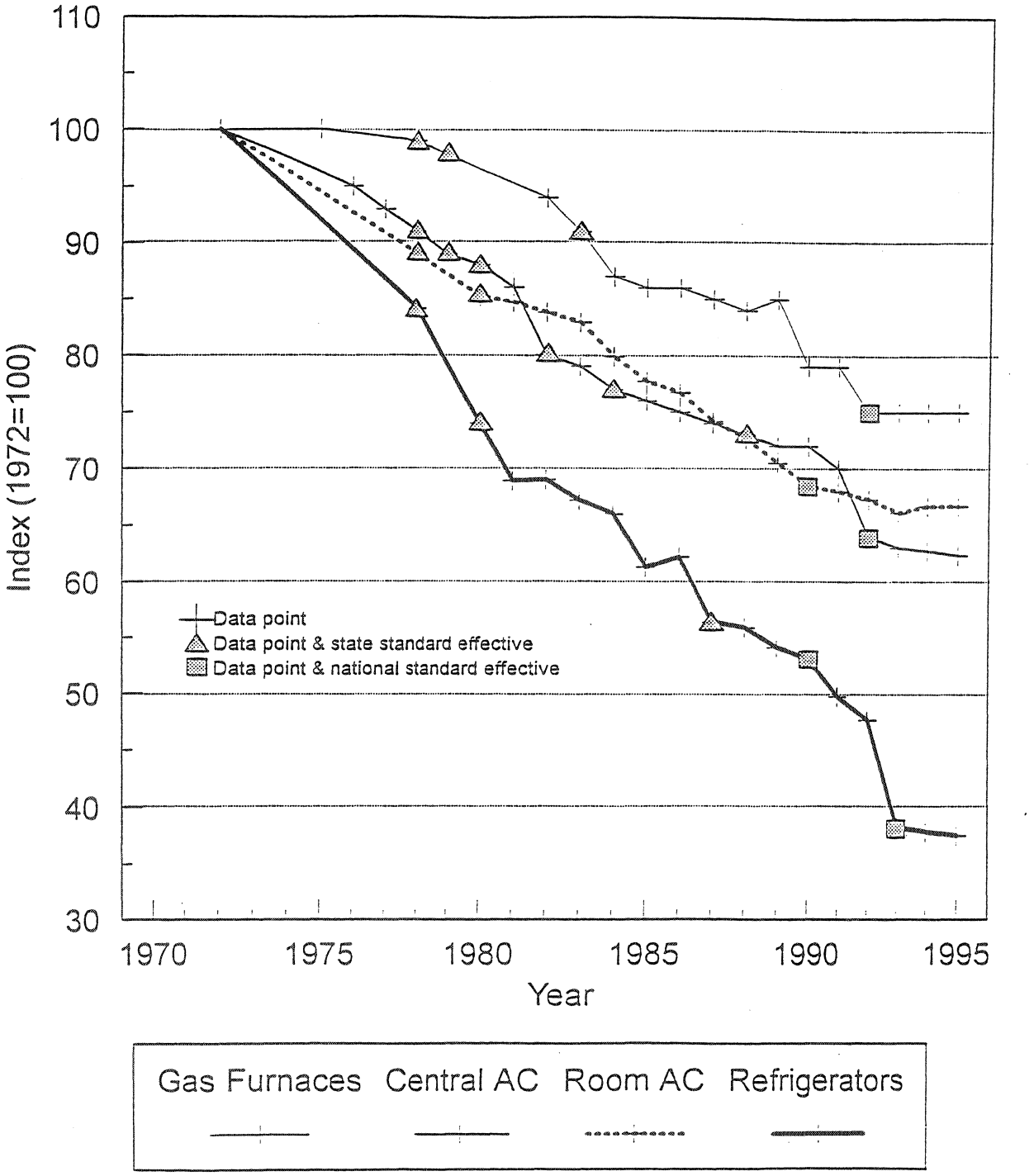
Table 4.
Estimated National Savings from Future Equipment Efficiency Standards

Product	1995 Sales (10^6)	Old Standard	New Standard	Basis for New Standard	Effective Date	Average Life (years)	Savings/ Unit (kWh)	GWh Savings in Year Listed 2005	2010	2015	Savings (Gross Quads in 2015)	CO2 Savings in 2015 (MMT)
Refrigerators (full-size)	8.7	681	496	Negot. agreemnt	2000	19	176	8,381	15,999	23,618	0.25	14.3
Freezers (full-size)	1.7	510	440	Negot. agreemnt	2000	21	67	622	1,187	1,752	0.02	1.1
Clothes washers (elec dhw)	2.7	702	251	3.5 EF	2002	14	428	4,115	9,995	15,874	0.17	9.6
Electric clothes dryers	4.0	604	478	50% RMC	2002	14	119	1,668	4,052	6,435	0.07	3.9
Dishwashers (elec dhw)	1.7	498	423	15% savings	2001	13	71	558	1,178	1,612	0.02	1.0
Electric water heaters	3.9	2671	2363	.93 EF (50 gal)	2001	10	308	5,400	11,401	12,001	0.12	7.3
Room air conditioners	4.3	679	611	10 EER (louver)	2000	15	64	1,525	2,911	4,158	0.04	2.5
Central air conditioners	4.1	2400	2000	12 SEER	2003	12	380	3,857	11,572	18,516	0.19	11.2
Central heat pumps	1.0	4377	4252	7.0 HSPF	2003	12	119	303	909	1,454	0.02	0.9
Fluorescent ballasts	71	256	217	Elec ballast	2002	12	21	5,262	12,779	18,041	0.19	11.0
R/BR reflector lamps	67	245	175	Halogen lamp	2002	0.57	63	2,406	2,406	2,406	0.03	1.5
Comm'l packaged A/C and HP	0.6	8494	7340	ASHRAE 90.1R	2001	15	1097	2,961	6,252	9,543	0.10	5.8
Transformers -- dry type	29	70	46	ORNL 2 yr PB	2002	30	24	2,364	5,741	9,119	0.09	5.5
Transformers -- liquid type	66	31	25	ORNL avg loss	2002	30	5	1,226	2,978	4,729	0.05	2.9
Subtotal								40,649	89,360	129,258	1.34	78.5
							(therms)		(mm therms)			
Furnaces	2.6	653	637	80% AFUE	2006	23	16	0	182	383	0.04	2.1
Clothes washers (gas dhw)	4.0	28	7	3.5 EF	2002	14	20	279	678	1,076	0.11	5.8
Gas clothes dryers	1.2	23	18	50% RMC	2002	14	5	20	48	77	0.01	0.4
Dishwashers (gas dhw)	2.5	18	15	15% savings	2001	13	3	29	62	85	0.01	0.5
Gas water heaters	4.5	226	211	.60 EF (40 gal)	2001	14	15	302	637	939	0.09	5.0
Gas ranges	2.5	60	56	No pilot	2000	19	3	46	88	130	0.01	0.7
Subtotal								676	1,695	2,690	0.27	14.4
TOTAL											1.61	92.9

Notes:

* In general, 1995 sales from Appliance 1996b. Ballast sales from LBNL 1996. Transformer sales (in kVA) from ORNL 1995. Lamp sales for 1994 from Department of Commerce data. Commercial HVAC sales based on data in Appliance 1996a and The News 1995.
* Effective dates are ACEEE estimates and assume that DOE moves on a fairly rapid schedule in FY97 and FY98 to finish on-going standard rulemakings. For ballasts and clothes washers, a 4-year phase-in period is assumed given the controversies these standards have raised.
* Average equipment life from various DOE and other sources. Ballast and commercial a/c life from analyses conducted for ASHRAE 90.1. Reflector lamp life based on 2,000 hour rated life.
* Average equipment energy use under the old and new standards is based on data in EIA 1995 and technical support documents developed for DOE (e.g., LBNL 1995), and adjusted for efficiency differences between stock and new units. For lighting products, annual energy use assumes 3,500 operating hours per year.
* Clothes dryer savings are from high-spin speeds in the clothes washer. Electric water heater savings from reduced standby losses. Range savings assume pilot lights are eliminated from the ~10% of new ranges that now use pilot lights. Reflector lamp analysis assumes that 90% of R lamp sales take advantage of BR lamp exemption.
* Analysis generally assumes new equipment exceeds standards by an average of 5%. For electric/gas water heaters, current efficiencies of .86/.56 and future efficiencies of .93/.60 are estimated. For ballasts/reflector lamps, analysis assumes products meeting standards have a 45%/10% market penetration in the basecase based on LBNL 1996/ACEEE estimate.
* Analysis generally assumes equipment sales remain static at 1995 levels. Analysis also generally assumes that efficiency levels in absence of standards remain at 1995 levels. Ballasts are an exception -- LBNL long-range sales projections are used (showing a small decline in future ballast sales) and the market share of efficient products is assumed to grow by ~50% from the 31% market penetration in 1995.
* Savings = (sales) x (savings/unit) x (# of years standard has been in effect).
* GWh converted to gross Quads using a conversion factor of 10,400 Btu/kWh.
* CO2 factors of 607 MMT/GWh and 5,357 MMT/million therms from DOE National Energy Modeling System model.

Figure 1
U.S. Residential Equipment Energy Intensity: 1972-1995



REFERENCES

Appliance. 1996a. "Statistical Review." *Appliance* 53(4): 43-46.

Appliance. 1996b. "1996: A Soft Landing." *Appliance* 53(1): 42-52.

Bureau of Labor Statistics. 1995. "Monthly Consumer Price Index" and "Monthly Producer Price Index." *Consumer Price Indexes Home Page.* Washington, DC: U.S. Bureau of Labor Statistics.

Chan, T., and C. Webber. 1995. Retrospective on Appliance Standards. October 11 memorandum. Berkeley, Calif.: Lawrence Berkeley Laboratory.

DOE (U.S. Department of Energy). 1996. *Results of the Appliance Rulemaking Process Improvement Effort, Preliminary Draft for Review.* Washington, D.C.: U.S. Department of Energy.

EIA (Energy Information Administration, U.S. Department of Energy). 1995. *Household Energy Consumption and Expenditures 1993.* DOE/EIA-032(93). Washington, D.C.: Energy Information Administration, U.S. Department of Energy.

Geller, Howard. 1995. *National Appliance Efficiency Standards: Cost-Effective Federal Regulations.* Washington, D.C.: American Council for an Energy-Efficient Economy.

Giordano, Sal. 1994. March 28 letter to Robert Holding. Peacack, N.J.: Fedders Corp.

Greening, L., A. Sanstad, J.E. McMahon, T. Wenzel, and S. Pickle. 1996. "Retrospective Analysis of National Energy-Efficiency Standards for Refrigerators." In *Proceedings of the ACEEE 1996 Summer Study on Energy Efficiency in Buildings.* Washington, D.C.: American Council for an Energy-Efficient Economy.

LBNL (Lawrence Berkeley National Laboratory). 1995. *Technical Support Document: Energy Efficiency Standards for Consumer Products: Refrigerators, Refrigerator-Freezers, & Freezers.* DOE/EE-0064. Washington, D.C.: Office of Codes and Standards, U.S. Department of Energy.

LBNL (Lawrence Berkeley National Laboratory). 1996. *Draft Report on Potential Impact of Possible Energy Efficiency Levels for Fluorescent Lamp Ballasts.* Berkeley, Calif.: Lawrence Berkeley National Laboratory.

Meier, Alan. 1996. "United States Leads in Refrigerator Efficiency." *Home Energy* 13(1): 8.

Nadel, S., and M. Suozzo. 1996. *The Need and Opportunities for State Action on Equipment Efficiency Standards.* Washington, D.C.: American Council for an Energy-Efficient Economy.

Nadel, S. 1996. "The Future of Standards." *Energy and Buildings* (forthcoming).

News, The. 1995. "Statistical Panorama." *The Air Conditioning, Heating and Refrigeration News.* April 10: 8.

ORNL (Oak Ridge National Laboratory). 1995. *Determination Analysis of Energy Conservation Standards for Distribution Transformers (Draft).* ORNL-6847. Oak Ridge, Tenn.: Oak Ridge National Laboratory.

RAND Corporation. 1972. *California's Electricity Quandary: III. Slowing the Growth Rate.* R-1116-NSF/CSA. Santa Monica, Calif.: RAND Corporation.

RAND Corporation. 1975. *Energy Alternatives for California's Path to the Future.* R-1793/1-CSA/RF. Santa Monica, Calif.: RAND Corporation.

Swidler, Joseph. 1973. "Statement of Joseph C. Swidler, Chair, New York Public Service Commission, before House Subcommittees on Conservation and Natural Resources and on Energy." In *Conservation and Efficient Use of Energy.* Washington, D.C.: U.S. House of Representatives.

U.S. Congress. 1987. *National Appliance Energy Conservation Act of 1987.* P.L. 100-12.