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# Energy efficiency standards for equipment: Additional opportunities in the residential and commercial sectors

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**Abstract**

Energy efficiency standards for residential and commercial equipment have been a major source of energy conservation in the US This study estimated key national impacts of potential new and upgraded energy efficiency standards. These impacts approximate the opportunity for national benefits that may be lost if energy efficiency standards for residential and commercial equipment are not upgraded and expanded from current levels. The results suggest that national benefits from new and upgraded standards may be substantial. They also indicate that standards for currently unregulated products may yield more benefits than upgrading minimum efficiency standards for products that already have them. The majority of those currently unregulated products are in the commercial sector.
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*Keywords:* Energy conservation; Efficiency standards; Residential and commercial sector

## 1. Introduction

Energy efficiency standards set minimum levels of energy efficiency that must be met by new products. Depending on the dynamics of the market and the level of the standard, the effect on the market for a given product may be small, moderate, or large.

In the US, energy efficiency standards for consumer products were first implemented in California in 1977. National standards became effective starting in 1988. By 2004, national standards were in effect for over a dozen residential appliances, as well as for a number of commercial sector products. Updated standards will take effect in the next few years for several products. Outside the US, over 30 countries have adopted minimum energy performance standards (Wiel and McMahon, 2001).

Technologies and markets are dynamic and additional opportunities to improve energy efficiency exist. There are two main avenues for extending energy efficiency standards. One is upgrading standards that already exist for specific products. The other is adopting standards for products that are not covered by existing standards.

In the absence of new and upgraded energy efficiency standards, it is likely that many new products will enter the stock with lower levels of energy efficiency than would otherwise be the case. Once in the stock, it is either impossible or more costly to improve the energy efficiency. Therefore, by not expanding or upgrading energy efficiency standards, opportunities for saving energy would be lost.

In the past two decades, standards have significantly raised the level of energy efficiency for new products (Meyers et al., 2005). How much more might be gained by making standards more stringent on products already subject to them, or by extending standards to products not yet covered?

The main goal of this study is to estimate key national impacts of new and upgraded energy efficiency standards for residential and commercial equipment. These impacts approximate the opportunity for national benefits that may be lost if standards are not upgraded

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and expanded from current levels. This study also identifies the end uses where the largest opportunities exist.

This article is based on a longer report (Rosenquist et al., 2004) prepared for the National Commission on Energy Policy (NCEP). It uses an analytical approach that is similar in concept to that used by the US Department of Energy (DOE) to evaluate and set standard levels. It relies on much less data and uses more simplified assumptions than the detailed and complex formulations used in DOE's standard-setting process. The results of this analysis should thus be viewed as a first approximation of the impacts that would actually be achieved by new standards.

*Note*: All monetary values in this report are in 2002 dollars.

## 2. Products considered

Within each of the key end uses, we considered equipment standards for specific products, as shown in Table 1. For some of the products listed, we determined that additional standards would not be cost-effective on a national-average basis. These products are mentioned later.

Products that we did not consider include those listed below. The reasons for not considering them were one or more of the following: (1) recent studies indicate that a more stringent standard is probably not cost-effective; (2) the impact of a new standard would probably be low because the market for the product is small and shrinking; and (3) lack of adequate data. We also did not consider plumbing fixtures that can reduce hot water consumption in the residential and commercial sectors.

*Residential equipment not included*: Freezer, clothes dryer, oil furnace, boiler, cooking equipment, television, computers and related equipment.

*Commercial equipment not included*: Electric heat pump, gas unit heater, gas cooking equipment, commercial clothes washer, distribution transformer, miscellaneous (such as service station equipment, automated teller machines, telecommunications equipment, medical equipment, pumps, and emergency electricity generators).

Table 1
End uses and products considered for efficiency standards

| End use | Products considered |
|---|---|
| *Residential* | |
| Space heating | Gas furnace |
| | Heat pump |
| Air conditioning | Room air conditioner |
| | Central air conditioner and heat pump |
| Refrigeration | Refrigerator |
| Water heating | Electric and gas water heater |
| Clothes washing | Clothes washer |
| Dishwashing | Dishwasher |
| Lighting | Torchiere |
| Electric motors | Ceiling fan, pool pump, well pump, miscellaneous small motors |
| Household electronics | Audio, settop box, telephony, microwave oven, misc. |
| *Commercial* | |
| Space heating | Gas furnace and boiler |
| Air conditioning | Air-source and water-source air conditioner and heat pump |
| Ventilation | Air distribution |
| | Hot and chilled water circulation |
| | Cooling water circulation |
| | Heat rejection |
| Lighting | Fluorescent lamp |
| | HID lamp |
| Water heating | Gas-fired storage water heater |
| | Gas-fired instantaneous water heater |
| Refrigeration | Supermarket units |
| | Reach-in freezers and refrigerators |
| | Refrigerated vending machines |
| | Walk-in coolers and freezers |
| Office equipment | PCs and monitors |
| | Other equipment |

## 3. Technology cost-efficiency analysis

For each considered product, we estimated the incremental consumer cost of technologies providing higher energy efficiency relative to a specific baseline technology, as well as the associated reduction in annual energy use. We did not perform technology-specific engineering–economic analysis for this study, but instead used available recent studies. The main data sources are the technical analyses published by the DOE for its equipment standards rulemakings, and data from the analysis done by the Interlaboratory Working Group for the "Scenarios for a Clean Energy Future" study (Interlaboratory Working Group, 2000).

Box 1 provides an example of the key data inputs, sources and results for a product. In this and other cases, we selected the most common type of product to serve as a proxy for the product category. Appendix 1 in Rosenquist et al. (2004) provides a description of the cost and efficiency data and the assumptions for each of the several dozen considered products, as well as the sources of data used for each one. Most of the data-source reports were published in the late 1990s or the 2000–2003 period. The data vary among the products with respect to how recent they are. For most of the larger products, detailed engineering–economic analysis was performed in the cited studies. Many of the market projections were made for the present study by the authors.

Our estimates of technology costs in 2010 and 2020 assume that a decline occurs from current costs due to a