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# Efficiency of Appliance Models on the Market Before and After DOE Standards

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## Introduction

Energy efficiency standards for appliances mandate that appliance manufacturers not manufacture or import models that have a test energy efficiency below a specified level after the standard effective date. Thus, appliance standards set a floor for energy efficiency. But do they also induce more significant changes in the efficiencies that manufacturers offer after the standard becomes effective? To address this question, we undertook an examination of before-standard and after-standard efficiency of models on the market for three products:

- Refrigerators (1990, 1993, and 2001 standards)
- Room air conditioners (1990 and 2000 standards)
- Gas furnaces (1992 standard).

## Method

We created a database of models listed in selected product directories published by the Association of Home Appliance Manufacturers (AHAM) and the Gas Appliance Manufacturers Association (GAMA). For each product, we first identified the most popular product class or category, which are:

- Refrigerators: Top-mount freezer with auto defrost, no through-the-door ice;
- Room air conditioners: Residential models with louvers, 8,000-14,000 kBtu/hour;
- Gas furnaces: non-condensing.

For each model, we collated listed data for the size and the energy efficiency per the DOE test procedure. We collated data for the models in a selected directory that was published several years before the standard effective date. The reason for going back several years before the standard effective date is that the standards were announced well before the effective date, and

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manufacturers may have begun to modify their offerings before that date. For after-standard models, we chose directories published at least one year after the standard effective date. The reason for this is that sometimes models are listed for a while even if they are no longer being manufactured.

The table below shows the directories used. For the sake of making the results charts readable, we used the same models (June 1994) to represent the after-1993 standard market and the before-2001 standard market for refrigerators, and the same models (March 1991) to represent after-1990 standard and before 2000-standard markets for room air conditioners. Data from AHAM Factbooks on annual sales-weighted average efficiency for all standard refrigerator models show that efficiency in 2000 was 10% less than in 1994.<sup>1</sup> Since some of this apparent decline was likely due to higher market share of larger, more energy-intensive refrigerators, we believe that the average efficiency of refrigerators with top-mount freezer with auto defrost was similar in 2000 as in 1994. Similar data for room air conditioners indicate that 1999 models were 3% more efficient than 1991 models. Thus, the simplification we adopted has only a small effect.

#### Directories Used to Represent Before-Standard and After-Standard Models

Product	Directory for Before-Standard Models (# of models used)	Directory for After-Standard Models (# of models used)
Refrigerators		
1990 standard	June 1986 (540)	June 1991 (810)
1993 standard	June 1991 (810)	June 1994 (850)
2001 standard	June 1994 (850)	July 2002 (450)
Room air conditioners		
1990 standard	October 1987 (275)	March 1991 (325)
2000 standard	March 1991 (325)	September 2001 (205)
Gas furnaces		
1992 standard	October 1988 (3700)	April 1995 (2500)

## Results

Figures 1-6 show the efficiency distribution of models by size before and after the standards effective dates. The solid lines show the minimum energy efficiency (expressed as maximum energy use in the case of refrigerators) that would meet each standard. Note that in some cases there are numerous models on a single point.

For refrigerators, there was a major market shift after the effective date of each standard.<sup>2</sup> The same is true for non-condensing gas furnaces. For room air conditioners, the picture is somewhat less clear. There were many models on the market that were more efficient than required by the 1990 standard before the standard became effective. To a lesser extent, one sees a similar phenomenon with the 2000 standard for room air conditioners.

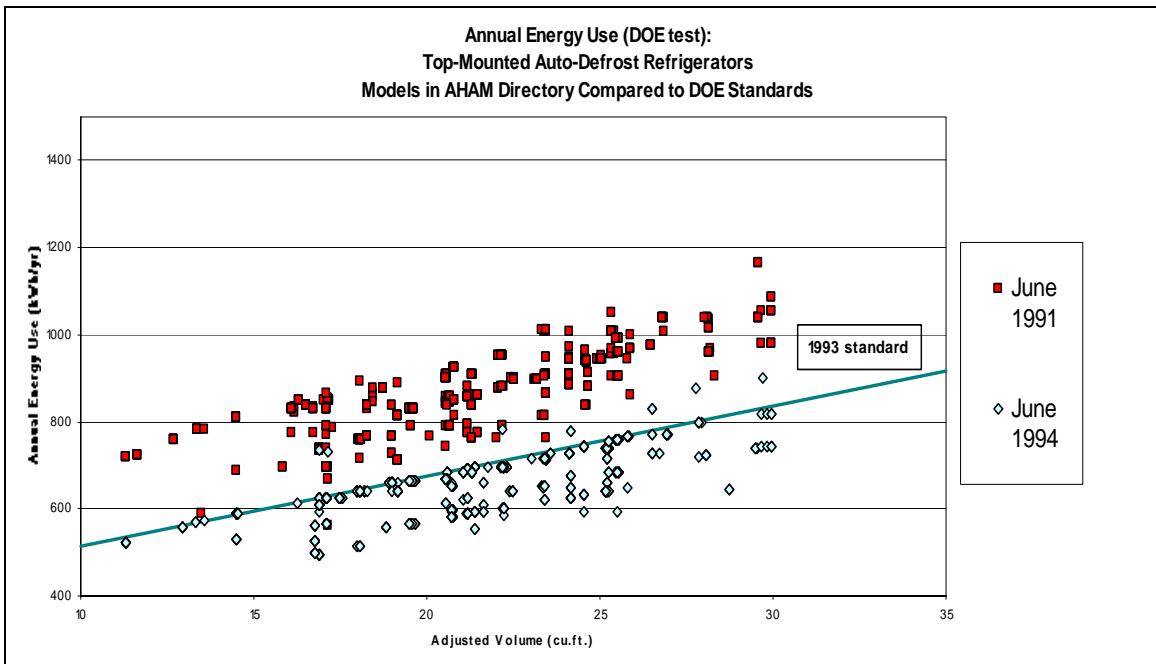
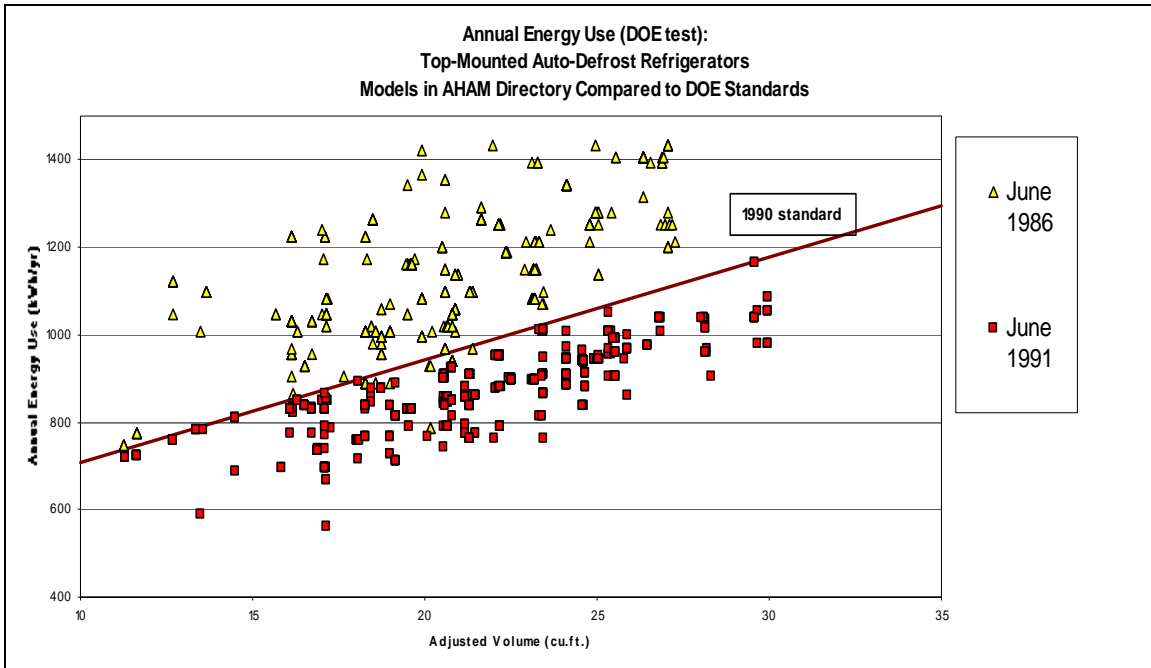
<sup>1</sup> Some of this apparent decline may have been due to higher market share of larger, more energy-intensive refrigerators.

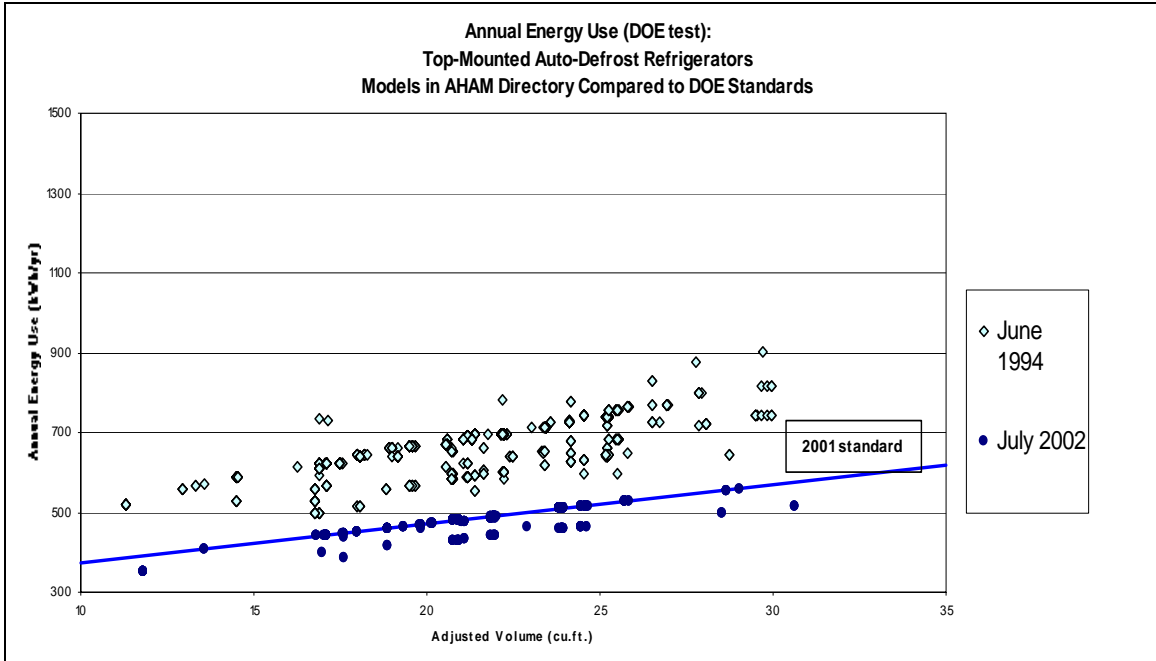
<sup>2</sup> In the case of the 1993 refrigerator standard, there were a few models in the June 1994 directory with energy use higher than allowed by the standard. It may be that these previously manufactured models were still listed even though they were not being manufactured in mid 1994.

**Discussion**

In interpreting the results, one must be aware of an important limitation of the data: they do not indicate the sales of each model, only its possible presence on the market. Even with this caveat in mind, it seems clear that all of the standards considered had a significant impact in moving the market toward higher efficiency. But why were so many models much more efficient than the standards required? Several factors could explain this phenomenon. One is the existence of utility DSM programs that offered incentives for purchase of high-efficiency models in the late-1980s and early 1990s. Another is EPA's Energy Star program, which promotes voluntary labels that highlight models in the top tier of efficiency. Another factor is the diversity of situations among consumers. Households in a hot climate with a long cooling season or high electricity prices are more motivated to purchase a high-efficiency air conditioner, while households in cold climates have incentive to seek out high-efficiency furnaces. A final factor is the marketing strategy of manufacturers, who seek to offer a diversity of models at different price points.

Figures 1 –3: Refrigerators





Figures 4 and 5: Room Air Conditioners

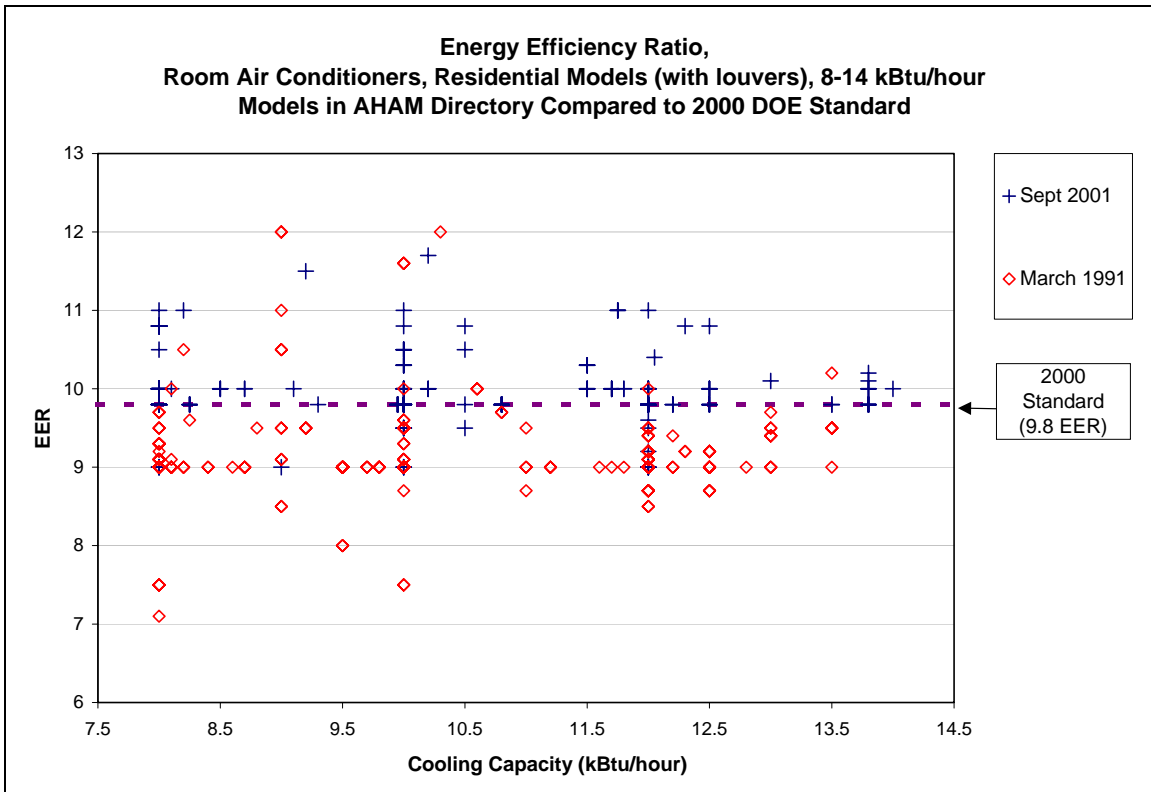
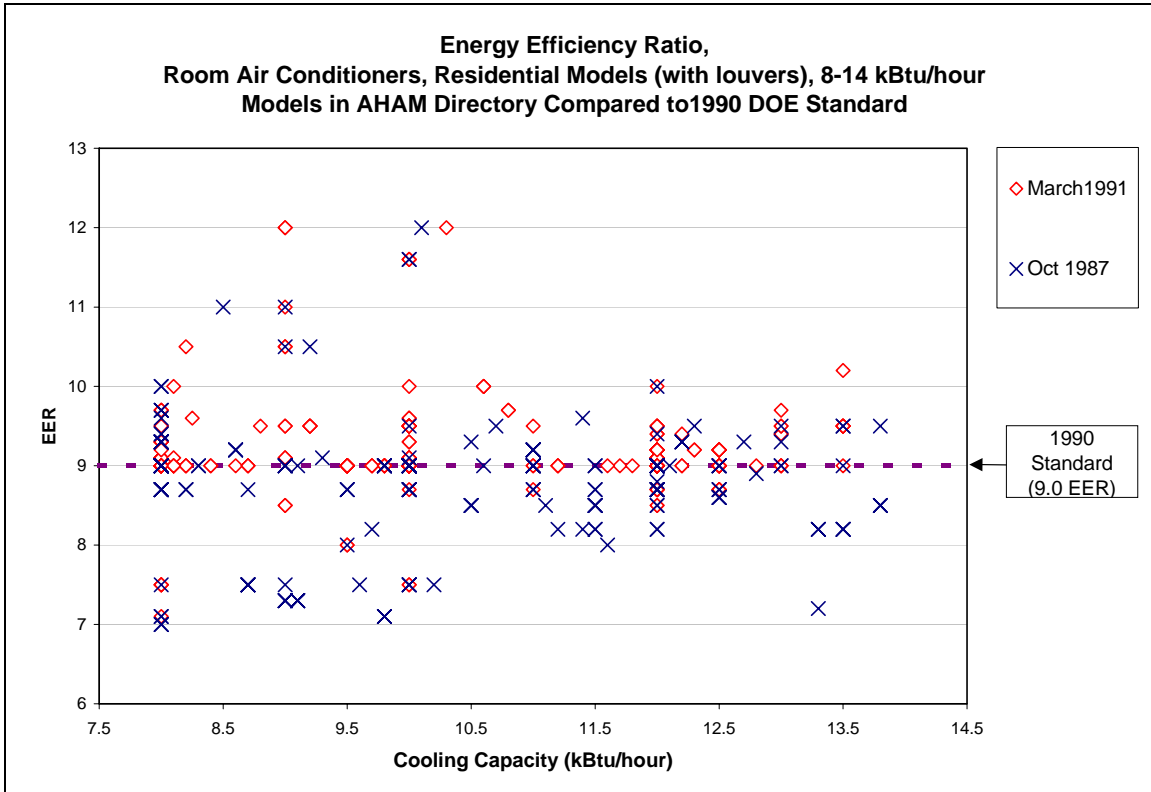


Figure 6: Gas Furnaces

