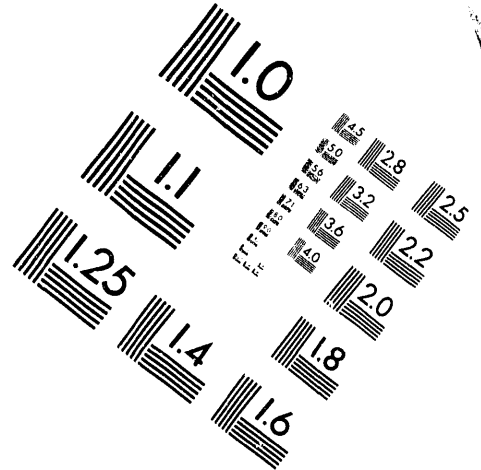
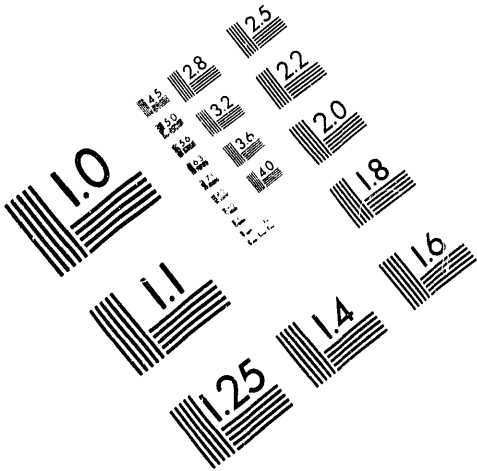




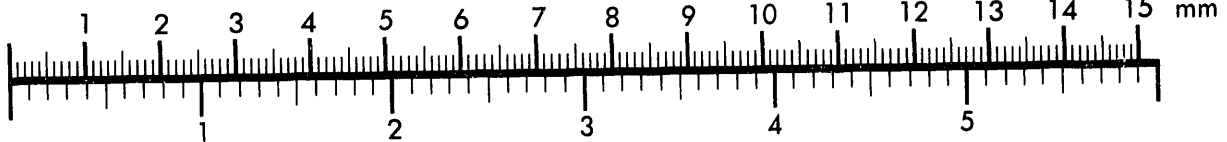
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**Association for Information and Image Management**

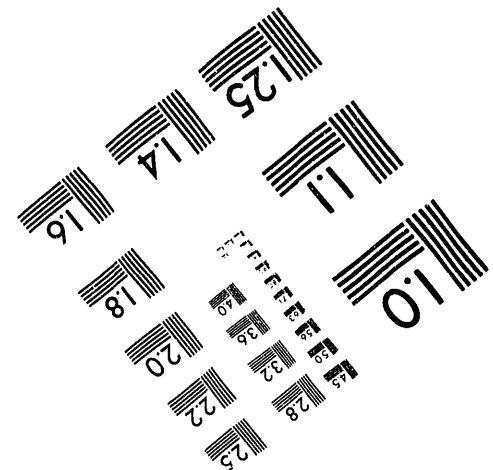
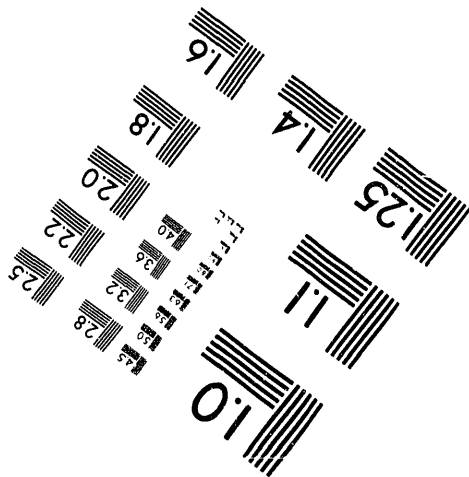
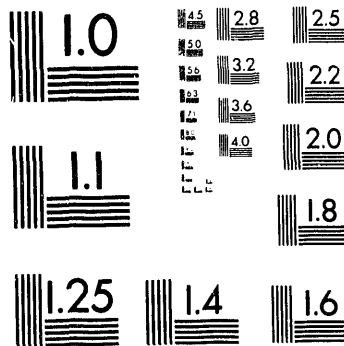
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**1 of 1**

## Electricity Savings from Residential Appliance Standards in Sweden

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## **Electricity Savings from Residential Appliance Standards in Sweden**

**Isaac Turiel, Lawrence Berkeley Laboratory**

**Benoit Lebot, Agence de l'Environnement & de la Maitrise de l'Energie**

**April 1993**

### **1. SYNOPSIS**

This paper discusses the energy savings that could be obtained in Sweden by instituting specific standards for five appliances: refrigerators, freezers, dishwashers, clothes washers, and clothes dryers.

### **2. ABSTRACT**

At the present time, Sweden has no minimum energy efficiency standards for residential appliances. This paper discusses the energy savings that could be obtained by instituting specific standards for five product types (refrigerators, freezers, dishwashers, clothes washers, and dryers) starting in 1995. A methodology similar to that used in analyses for the European Community was employed in this study.

In the Swedish study, we used appliance test data developed by the Swedish consumer agency, Konsument Verket, to estimate new unit energy consumption for each product type. Shipments, saturations, energy use, and demographic data were input to a spreadsheet model that sums energy consumption for each product type over the period 1990-2010. Both a base case and a standards case scenario are simulated for each of the five appliance types.

It was found that electricity use for these five products can be reduced by 12% over the time period from 1990-2010. Most of the energy savings come from instituting efficiency standards for refrigerators and freezers. For each product class type, the impact on manufacturer offerings is discussed. For example, for simple refrigerators, eleven 1990 models meet the 1995 standard and six models meet the 2000 standard

out of a total of 63 models.

### 3. INTRODUCTION

In Sweden, household electricity consumption by appliances (excluding space heating) accounted for 14 TWh in 1988 (40% of total household use). Refrigerators and freezers are the largest end use in households, accounting for about 4 TWh or 29% of the total. At the present time, there are no minimum efficiency standards for residential appliances sold in Sweden. In this report, electricity savings that may be derived from such standards are estimated for five appliance types; these are refrigerators, freezers, dishwashers, clothes washers, and clothes dryers. The methodology used for this analysis is similar to that employed in a European Commission (EC) study on the same subject (Lebot, Szabo, and Despretz, 1991). The EC study was carried out for the same five appliance types for the 12 members of the EC. Minimum efficiency standards were developed for each appliance type and used to forecast potential energy savings over the time period from 1990-2010.

### 4. METHODOLOGY

In this study for Sweden, we utilized test data developed by the Swedish Konsument Verket. These data included energy and water consumption of each model of the five appliance types sold in Sweden. Since shipment weighted data were not available, we made the simplifying assumption that sales were proportional to the number of models available. This assumption allowed us to calculate the average unit energy consumption of new models of each of the five appliance types. Future sales of each appliance type were estimated by calculating expected retirements and adding additional sales due to estimated increased saturations. The number of households are assumed to remain constant. For the base case scenario, it was assumed, as in the EC study, that unit energy consumption remains constant. Total energy use however, increases if saturations increase. Several other types of data were collected during this project. They include annual shipments and existing saturations. In order to forecast future household energy use it was also necessary to estimate the saturation of different product types in future years. A simplifying assumption was made that the number of households remains constant at 3.863 million over the study period from 1990 to 2010.

For each product class, we have collected data on unit energy consumption for all new 1990 models sold in Sweden. In Figure 1, we have plotted the Swedish energy use data for 1990 combination refrigerator-freezers. For typical capacities (350-400 liters adjusted volume), it can be seen that the average energy use is about 565 kWh/yr. The regression lines were chosen as the baselines for this study. That is, they represent the energy consumption as a function of adjusted volume<sup>1</sup> for average new units purchased in 1990. The trial standard levels are also shown in this Figure as a function of adjusted volume.

Trial standards levels were developed in two ways. For refrigerators and freezers, we used a fixed percentage decrease from the baseline energy use/adjusted volume equation. The percentage decreases were the same as derived in the EC study. The EC study decreases were based on engineering analyses carried out for typical models in the French marketplace. These analyses included estimates of manufacturer cost for improving the efficiency of refrigerators and freezers from the average EC baseline models. Additional research is needed to determine if these estimates of manufacturer cost are applicable to Sweden and other nations. For typical refrigerator-freezers, a reduction of 33% in 2000 results in an annual energy use of about 380 kWh. A Swedish manufacturer recently won a competition to deliver 500 very efficient refrigerator-freezers (of typical size) with an annual energy consumption of 315 kWh (Statens Energiverk, 1990). These new models (see Figure 1) will exceed the trial energy efficiency standard for 2000.

## 5. RESULTS

Table 1 shows the cumulative energy consumption for each of the five product types from 1990-2010 under the base case and standards case scenarios. From the results shown above, it appears that base case electricity use (site energy) can be reduced by 11.8% over the time period from 1990-2010. Most (80%) of the energy savings come from instituting efficiency standards for refrigerators and freezers.

For 1990 refrigerators, 11 models meet the 1995 trial standard and 6 meet the 2000 standard out of a total of 63 models. For refrigerator-freezers (see Figure 1), only 3 1990 models meet the 1995 standard and none meet the 2000 standard out of a total of 70 models. However, the new highly efficient unit mentioned above exceeds the 2000 standard. For upright freezers, 4 models (many additional models are very close

however) meet the 1995 standard and none meet the 2000 standard out of a total of 92 models. For chest freezers, 7 models meet the 1995 standard and 3 models meet the 2000 standard out of a total of 50 models.

## 6. CONCLUSIONS

Since there is a common test procedure for refrigerators and freezers throughout the European Community and Sweden, these products are prime candidates for the first uniform efficiency standards for Europe. Under the base case scenario, cumulative energy use for these two products is equal to 62.32 TWh. With efficiency standards, this total can be reduced to 53.51 TWh, a savings of 8.81 TWh, or 14% over the 1990-2010 time span. These standards will impact the number of models that may be offered in future years although, experience in the U.S. has indicated that manufacturers will tend to slowly improve the efficiency of their offerings in advance of a future standard.

## 7. ACKNOWLEDGEMENT

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## 8. ENDNOTES

1. Adjusted volume (AV) is a function of fresh food and freezer volumes and internal temperatures. AV equals fresh food volume plus a constant times the freezer volume. For one star refrigerators, the constant equals 1.55 and for refrigerator-freezers the constant equals 2.15.

## 9. REFERENCES

Lebot, B., A. Szabo, and H. Desprez, *Gisement des Economies d'Energie du Parc Europeen des Appareils Electromenagers obtenues par une Reglementation des Performances Energetiques*, October, 1991.

Statens Energiverk Press Release, *Electrolux Wins Fridge/Freezer Competition*, August, 24, 1990.

Table 1: Cumulative Energy Savings (TWh) From Efficiency Standards  
1990-2010

Product Type	Base Case	Standards Case	Energy Savings
Refrigerators	15,38	13,56	11,9%
Refrigerator-Freezers	20,67	17,38	16,0%
Freezers	26,27	22,57	14,1%
Dishwashers	7,73	6,98	9,7%
Clothes Dryers	10,99	10,64	3,2%
Clothes Washers	11,41	10,43	8,6%
Total	92,45	81,56	11,8%



# Energy use versus adjusted volume Swedish refrigerator/freezers 1990

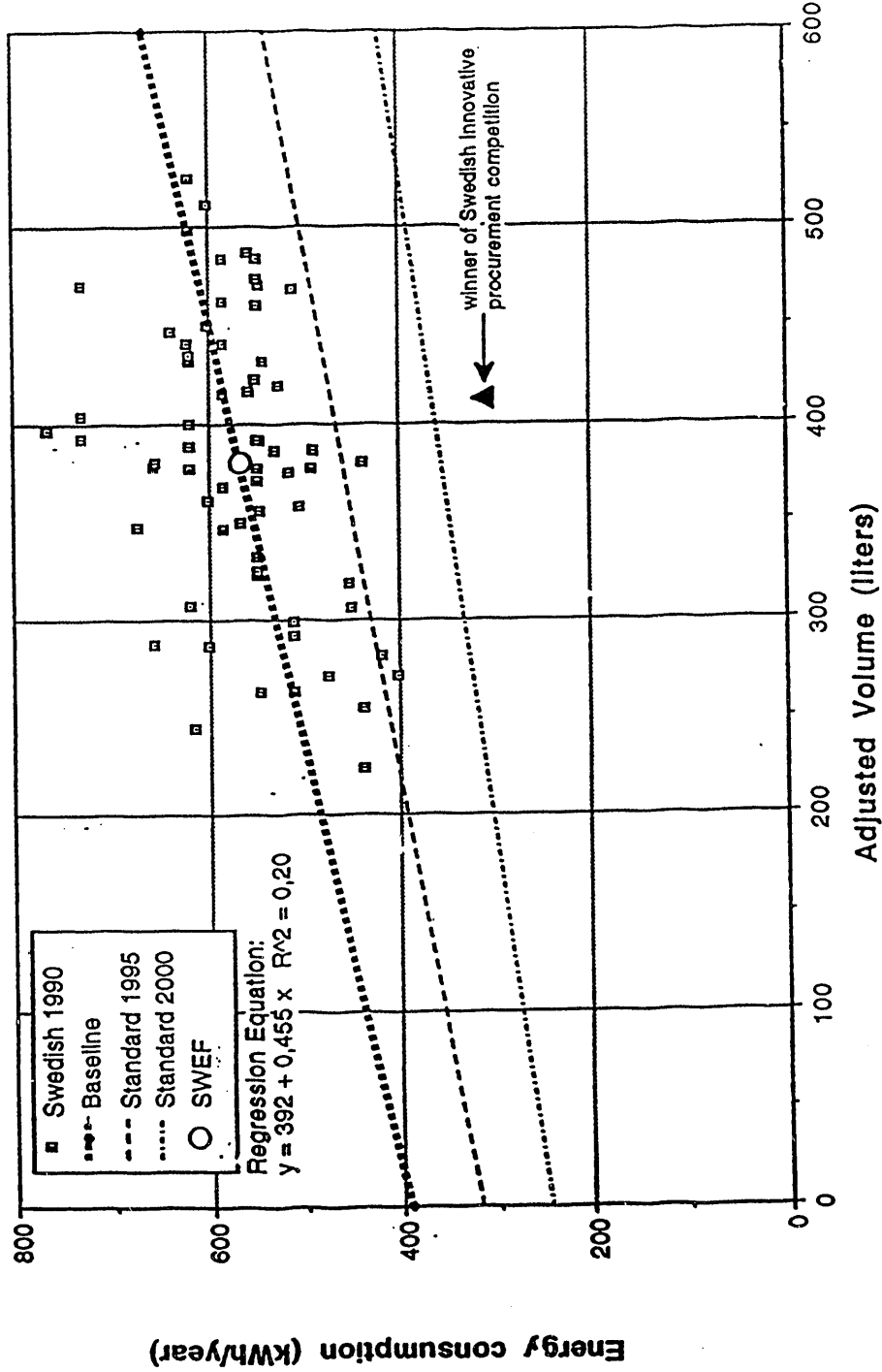


Figure 1: Impact of trial standards on new 1990 refrigerator-freezers. Note that the 1992 Electrolux model already meets the 2000 standard.

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