

# Turning the appliance market around towards A++

Jørgen S. Nørgård  
Department of Civil Engineering  
Technical University of Denmark  
Denmark  
jsn@byg.dtu.dk

Peter Karbo  
Elsparefonden  
Denmark  
peter@peterkarbo.dk

Birgitte Brange  
Elsparefonden  
Denmark  
bbr@elsparefonden.dk

Tom Guldbrandsen  
Department of Civil Engineering  
Technical University of Denmark  
Denmark  
birtheogtom@mail.dk

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## Abstract

In an effort to exploit better the labelling schemes for appliances the Danish Electricity Saving Trust has run some campaigns on cold appliances. In 1999 focus was on getting people to choose A-rated models, the 2004 campaign focussed on A+, and in 2005 on A++. These campaigns and their results are described in the paper and some conclusions are drawn.

The campaigns have consisted of various elements, namely 1) a general information about the campaigns, 2) a subsidy offered temporarily during some months to people buying the A, A+ and A++ models, 3) a website where people can easily find the most energy efficient model within their specification, and 4) in the website are also listed the shops, where consumers can get the appliances at lowest prices. The latter was the most innovative and maybe also the most effective measure in the package.

Results showed up as a permanent U-turn of the market in the course of a few years. Where models C, D, E earlier dominated the market, the A, A+ and A++, came to dominate as the standard models in stock. Consequently, their prices dropped significantly.

The theory of a rational market behavior is based on some assumptions, one being that full information is available to all actors. The website identifying to the consumers the shops with the lowest priced efficient models was a step in that direction, and the result did not fail to turn up.

## Introduction

Electricity is only one form of energy ware, but an important one, and the one we will focus on in this paper. It should be well known that the technology converting electricity into energy services, that is, the end-use technology, holds substantial potentials for higher efficiency. For three decades it has repeatedly been proven how roughly two thirds of the electricity consumption in a country could be saved, simply by making the end-use equipment like pumps, ventilation systems, light systems, etc. more efficient (Weizsäcker et.al. 1998, Jochen 2004, Goldemberg et al. 1988, Nørgård 1979, Nørgård, 1989). Although some of these options have by now been implemented, far the most of them remain to be harvested, and more technologies in this field have been invented.

These studies also state that making the end-use technologies more efficient is very cost effective, since the *extra* investment is low (or zero) and compared with the annual savings on the electricity bill they are very profitable for society as well as for consumers. We are facing a market “mystery” or rather we are getting exposed to the “imperfections” of the market. Why do people not make the most cost-effective choices when purchasing new electric appliances and other equipment?

There are many reasons why it is ridiculous to base an environmental protection policy on a strong belief in market theory, and it is not surprising that the Stern report stated that “Climate change presents a unique challenge for economics: it is the greatest and widest-ranging market failure ever seen” (Stern 2006, p. i).

One way out of this problem is to let governments bypass the market economy by introducing mandatory regulations, requiring a certain minimum energy efficiency standard for

appliances, similar to the energy regulation in the buildings sector. Based on the labelling scheme this option has actually been used to sort out the most inefficient appliances in Europe. In principle this could be taken to the point where only the most efficient appliances were allowed. But still, it is a political wish to leave space for the market to operate, and a great variety of energy efficiencies are found in the appliance models on the European market, in 2003 deviating by a factor close to three, see later Figure 2.

On the market no correlation is clear between an appliance's efficiency and its price. On this background, it is very cost effective to buy the most energy efficient models. What still remains, however, is to get the consumer to act economically more rational in this respect, - to get the market work better.

Harming and protecting the environment is a matter of *collective* cost and benefits. This is not immediately caught by the market mechanism, which at the best is based on *individual* cost-benefit perception. To make the market work better, the external collective cost, such as environmental damage, can be included in the consumer prices as taxes, as for example energy taxes, CO<sub>2</sub> taxes, etc, just as the benefits can be increased by subsidies and rebates. For private consumers, public institutions and liberal trades in Denmark the external environmental cost is to some extent included in the consumer's price of electricity, 1.95 DKK or around 0.26 EURO per kWh, out of which 60 % is government taxes. The export oriented businesses, however, are exempted from most of this tax burden, since it would distort their international competitiveness in an ever more globalized market. International agreements on a common energy tax are politically difficult to reach, even within the EU. Still, even with the high energy taxes, consumers were not behaving as the Danish government found it collectively rational, and other measures should be used.

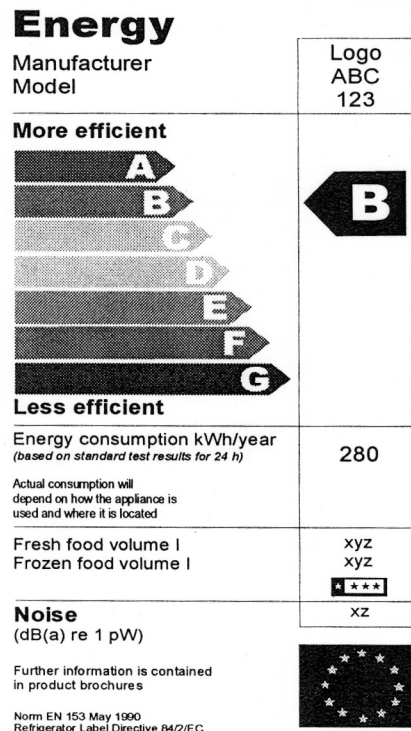
Information is the basis for behaviour. Market theory is based on the assumption that full information is available to both parts in the market, the buyers and the sellers. This criterion is clearly not fulfilled in the retail market, and it probably never will be completely. But as this paper illustrates with experiences from Denmark, there are good options for eliminating some of these information shortcomings, using today's information technology properly.

## Energy Labelling

It could be considered a general consumer right to have consumer goods labelled with information about the features the buyer cannot see immediately, such as the cost of running the technology, which can be even more relevant than the purchasing price. Labelling appliances and other equipment with their *electricity consumption* has, however, mainly been introduced when it was also recognized as a means for achieving the politically desirable collective goal of saving electricity and hence protecting the environment.

### HISTORIC DEVELOPMENT IN LABELLING

It has been characteristic that the early initiatives to implement mandatory energy labelling of appliances has come about, not on a national level, like the USA, Australia, Canada, Brazil, etc., but rather from single states or provinces within these nations.



**Figure 1. EU Energy Label was implemented in 1995.** Its design has turned out to be quite durable, and has been copied in many countries outside EU.

The reason is that it is easier to agree in a smaller community to take action.

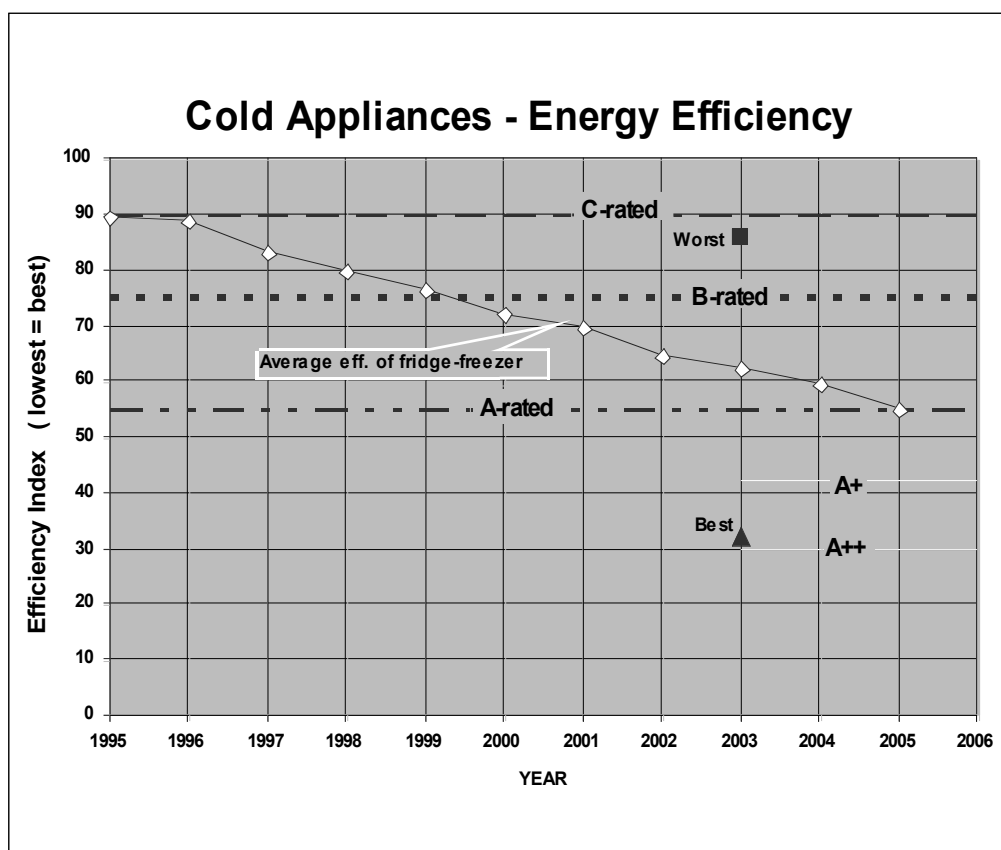
In USA, California and Florida were in 1978 first to implement mandatory labelling, and the Californian scheme was later extended to the whole of the USA. A similar pattern of development was found in Canada, Australia and Brazil, where a single province or state pioneered. In all these cases, the whole nation has gradually accepted mandatory labelling schemes.

In recent years in Japan, the Metropolis of Tokyo has taken the initiative to implement energy labels on a number of appliances hoping to inspire the whole country to follow.

By 2005 around 73 nations had implemented energy labels for appliances (Egan and Waide 2005).

### LABELLING IN THE EU

EU was slow in implementing labelling, although it was debated in 1979, resulting in a voluntary framework. Differences in the technical measurement standards delayed a mandatory directive. After years of debate only for electric cooking ovens a directive was implemented for this one appliance. As environmental concern developed, however, some Member States, including France, UK, The Netherlands and Denmark, begun to set up their own independent labelling schemes. To prevent this from causing trade barriers, which would be in direct conflict with the EU's primary purpose, the Energy Council in 1989 adopted a *Community action programme for improving the efficiency of electricity end use* (Winward et al. 1998). One of the actions was to establish a common EU scheme for labelling, and by 1995 it came into effect for cold appliances with 7 efficiency classes ranging from A for the most efficient models to G for the least efficient ones (EU Directive 2003), see Figure 1.



**Figure 2. Efficiency development for cold appliances in EU.** Horizontal lines indicates the various efficiencies required for the top classes, including the two newly implemented A+ and A++. The improvements in average efficiency for combined fridge-freezers sold in Denmark is demonstrated by the declining index. Also shown are the worst and the best efficiency available in 2003. (Source: FEHA).

There are actually some advantages from being slow, namely that you can learn from other's mistakes and successes, and the design of the EU labels has turned out to be reasonably durable and has been a model for many countries around the world (Egan and Waide 2005).

#### EFFICIENCY INDEX

The ranking in classes A to G is based on an index by comparing with average efficiencies in late 1992. For a certain cold appliance, its specific energy consumption is defined as its electricity consumption measured under standard conditions, divided by the unit's total *adjusted* volume, that is for a combined unit the refrigerated volume plus the freezer volume multiplied by 2.15. The efficiency index is defined as the ratio of this measured specific energy consumption and that of the average European models on the market by the end of 1992 (Winward et al. 1998). This average efficiency has been maintained constant over time.

For labelling the models are as mentioned divided into 7 efficiency classes with A for the most efficient models to G for the least efficient ones. For qualifying for an A, for instance, the efficiency index must be 55 % or less, as shown in Figure 2. The index 100 % is equal to the average base at the end of 1992, and constitutes the boundary between D and E. Those exceeding index 125 % are in class G.

#### EFFICIENCY DEVELOPMENT IN EU

In the wake of the oil crisis in 1973, energy efficiency of cold appliances has gradually been improved as shown by the curve in Figure 2 for the average efficiency index of combined fridge-freezers sold in Denmark. At first improvements were slow, and especially the intrusion of efficiency as a market feature was slow. This was the background for the labelling scheme introduced in 1995 for EU. Figure 2 shows the requirement for being rated in the best end of the scale with A, B, and C.

As appliances grew better with respect to energy efficiency, and most of the sale had moved to the upper end of the rating, where even quite a few were significantly better than what was required to qualify for A, EU realized that a new scale was needed. This need is illustrated by the fact that by 2005 the average efficiency of fridge-freezers was equal to the average A-requirement for cold appliances, see Figure 2. The original intention and plan of the Commission was to adjust the scale every 5 years or so by increasing the requirement for each step. So far this has not been given sufficiently high priority in the Commission to materialize. Instead it was decided in 2003 as a temporary solution to extend the scale with A+ and A++ as shown in Figure 2 until a total revision of the scheme could be done. The extended scheme with A+ and A++ can have a negative psychological effect because A-graded appliances now rank among the least efficient on the market. Hopefully a revised scale will soon be agreed upon.

Instead of insisting that as a criterion for class A, a certain selection of such models should be available on the market from

the start, another approach could have been pursued. From the beginning the scale on defining A could be based on what was proven possible to design in the years to come. Actually a low energy refrigerator, LER, which with an efficiency index around 35 % could qualify for an A+ or better rating, see Figure 2, was suggested already in 1979, developed and tested as prototypes in 1986, and reached the Danish market as Gram LER200 in 1988 (Nørgård 1979, 1989, Petersen et al. 2004). That was well before deciding the EU labelling classes. This approach of basing the scale on what was proven possible could be considered once the EU labelling scheme is to be revised. Also, it could be a model in countries outside the EU who have not yet established an energy labelling scheme and are following something like the EU model.

## Danish Electricity Saving Trust and its Campaigns

### ESTABLISHING A DANISH ELECTRICITY SAVING TRUST

In an effort to harvest more of the electricity savings options available, the Danish parliament in 1996 passed an act proposed by the Ministry of Energy, on establishing the Danish Electricity Saving Trust, DEST (Danish Energy Agency 1996). The sole objective of this trust was to promote electricity savings in private households as well as in public institutions, which together roughly accounts for half of the country's electricity consumption. Its board consisted of a chairman and 8 other members appointed by the Minister of Energy and Environment. Six of the members represent supply companies, other commercial activities, consumers, municipalities and county authorities, and energy and environmental organisations. The remaining 2 members plus the chairman shall be independent of the other interests represented.

The Trust was financed by a small extra tax, 0.006 DKK or less than 0.001 EURO per kWh, on electricity delivered to these sectors. This amounted to around 100 million DKK or 13 million EURO per year and corresponds to around a mere 2.5 EURO per capita per year.

The main task in the early years of the Trust, and the task that triggered its establishment, was to promote by subsidies, etc. the conversion of electrically space heated buildings to use more appropriate energy ware for heating, such as district heat (from combined heat and power production) and natural gas. The supply companies refused to contribute financially to this conversion, and the government then established this independent Trust. New installations of direct electric heating of buildings had already been banned.

Other activities by the Trust have included the development of low electricity appliances, and finally also the marketing of efficient appliances as dealt with in this paper.

### DEVELOPING EFFICIENT APPLIANCES

Following up on the earlier success of developing efficient cooling appliances, DEST undertook the task of subsidizing such further development in cooperation with Danish Technological Institute and manufacturers.

The first category to approach was the combined fridge-freezers. After development of two new versions in cooperation with the manufacturer Vestfrost, a pilot production provided

60 units to be tested at normal users. In 2001 Vestfrost started production of one of the versions, BSKF-875. With 191 litres refrigerated volume and 93 freezer volume, annual electricity consumption is 258 kWh. Energy efficiency index is 40 %, well below the 55 % required to qualify for A+ (Petersen et al. 2001).

Another project within technical development of efficient appliances, sponsored by DEST was a 277 litre refrigerator with no freezer compartment. It was an attempt to reintroduce a model like the so far most efficient model, Gram LER 200, mentioned earlier, which the manufacturer had stop producing, among other things due to poor marketing (Petersen et al. 2004). The new model has been built as prototypes and tested, showing that they have an efficiency index of 27.7 %, better than the 30 % qualifying for A++. So far this prototype has not been put into production.

### DEST'S PACKAGE OF MARKETING MEASURES

You don't usually gain much by introducing a rebate for efficient appliances, if you don't tell consumers about it through an information campaign. Similarly with the labelling of appliances, if you don't combine it with information about their existence and how to use them, not much will be gained. Measures have been applied separately without much success, and it is important to offer a proper package of measure like information campaigns, labels, rebates, etc. to trigger the changes.

One of the problems of getting consumers to make the right choice has been that even though the relevant information could be dug up from reports, etc. it was not easily available at the moment when needed. Which appliance models are the most energy efficient within the size and type the consumer is about to buy? Where are the best purchases of these models?, etc. When DEST in 1999 first decided to start a program to promote the sale of the most energy efficient refrigerators and freezers, these questions were taken into consideration in shaping the package of measures.

Minimum efficiency standards were not part of the package. Such standards had already been implemented by EU to eliminate the least efficient appliances from the market, but since the efficiency requirements were very weak, these models had already been pushed out of the market in Denmark. The purpose of the package presented in this paper was to pursue this success and eliminate more modestly efficient models from the market by utilizing the market mechanism.

While the campaigns were aiming directly towards the purchasing situation, that is the consumers and the dealers, also the manufacturers were asked before the campaign to have the efficient models ready and have them approved as qualified. Furthermore, it was the hope through the market campaigns to indirectly push the manufacturers to improve the efficiency of their products. In other words, instead of subsidizing directly the development of more efficient models, which as mentioned was also done by DEST, the hope was to achieve the same through the market mechanism.

### EU LABELLING SCHEME AS THE BASIS

As mentioned, the energy labelling system for refrigerator appliances had been established in 1995, rating them from A to G, with A as the most efficient. Already at the time when DEST launched its package in 1999, the labelling had shown some

effect on the sale, especially in the low efficiency end of the scale, almost wiping out the lowest rated models. B and C rated refrigerators conquered a larger part of the market, rising from 20 % in 1994 to 40 % in 1997, and the manufacturer's competition switched towards these products, rationalizing production and logistics, making it possible to lower prices. The basic selection in the shops came mainly to consist of these models, and B and C rated appliances dominated the market, and their prices dropped.

These were the early positive consequences of labelling. But the sale of the best rated, A-models, had not moved very much. From 1994 to 1999, the share of A-rated refrigerators only rose from 4 % in 1994 to 9-10 % in 1998. The Danish Electricity Saving Trust therefore decided to do something about bringing the A-rated appliances into the market place. By September 1999 the Trust launched the first campaign, consisting of the package described below. Later other campaigns followed.

### INFORMATION CAMPAIGN

Before the campaign started, various types of marketing materials were prepared by DEST, aimed at the retailers, consumer and the press.

A TV spot was shown in the days up to the campaign and this continued regularly during the campaign. The total number of contacts from this was estimated to be 6.3 million (Denmark's population is 5.3 million). Similarly radio spots were brought on two dominant radio stations, resulting in an estimated 5.2 million contacts.

Apart from the centrally controlled advertisements placed by DEST, there was enormous media pressure by retailers and manufacturers placing advertisements in national and local newspapers, flyers etc.

Analyses were conducted and random samples were taken to check energy consumption of the A-rated cold appliances for the Danish Energy Authority, and one model had to be withdrawn from the campaign when it proved unable to live up to the A-classification.

Unannounced visits were paid to the shops to check if they were living up to the requirements they had committed themselves to contractually, for instance concerning labelling.

All together DEST spent approximately 2.5 million DKK (0.33 million EURO) on the information campaign.

### TEMPORARY SUBSIDIES

For 95 days late in 1999, Danish Electricity Saving Trust, DEST, offered a direct subsidy to consumer's who bought certain common A-rated cold appliances. The subsidy was DKK 500 or around EURO 65 per unit of 2-door combined refrigerator-freezers, as well as for refrigerators with or without an internal frozen food compartment, and for upright freezers. Only chest freezers were not included. Besides the various cold appliances, a rebate twice as high was offered for A-rated tumble dryers, but their role was not significant and they are not considered in this paper.

The campaign was coordinated with the electricity utilities which were planning similar efforts. All retailers were offered to participate in the campaign and essentially all joined, amounting to some thousands shops, some independent retail shops, but most were chain stores. The subsidy was to be paid

directly to the consumers in the purchase situation, and later reimbursed by DEST.

Participating retailers had to sign a contract, for instance committing them to exhibit a reasonable selection of A-rated appliances during the campaign and in general inform consumers about the options. Also the retailers were at the end of the subsidy period obliged to report sales statistics for the four categories of appliances involved. Furthermore, the retailers were required not to raise the price of A-rated appliances during the campaign period so that they did not "take the top" off the subsidy scheme. On the contrary, they were urged to lower the prices during the campaign in order to ensure that it was successful.

In return retailers were given permission, on part of the Danish Electricity Saving Trust, to pay out the subsidy and to make use of the name and logo of the Trust in their marketing material: Every single advertisement, however, had to be approved by the Trust to ensure that its logo and name was not being used for appliances other than the A-rated cold appliances included in the deal. This was a wise control, since this message of government subsidy appeared very attractive to the consumers, who seem to perceive a 500 DKK subsidy was worth more than just 500 DKK in general. Maybe logo appeared attractive also because the government's subsidy gave a kind of guarantee for the product. The retailers were extremely positive about the subsidy campaign, as demonstrated by the large number who joined.

### WEBSITE ON THE BEST BUY

The most innovative part of the package was no doubt the establishment of a website to help people in their purchases ([www.elsparefonden.dk/hvidevarer](http://www.elsparefonden.dk/hvidevarer), or in English [www.elsparefonden.com](http://www.elsparefonden.com)). One example is shown in Figure 3.

The website contains lists of *all categories* of appliances on the Danish market - in this case cold appliances - showing the energy performance of each model, as well as its full product information. But not all *models* are listed. For each category only the most efficient models on the Danish market are shown. To begin with this included the A-rated models only. Later, in 2004, A+ and A++ were added.

But the information did not stop there. For these best models also the lowest prices in the country reported to the Trust are shown. By clicking on the price, a list appears over where the lowest priced units are available, including the retail shops' names, addresses and telephone numbers, see the example in Figure 4. By covering the full market, this website marks a breakthrough in making the market work in this area of energy policy, and it could well be extended to other fields in general.

### LATER CAMPAIGNS FOR A+ AND A++

When later, in 2003, the labelling scheme was extended to A+ and A++, see Figure 2, it was time to promote these classes. DEST included these classes in the websites, as seen in Figure 3, and, like in the first campaign, also ran general information campaigns in the media like TV and radio, and through providing campaign materials to the retailers.

Furthermore, during the last four months of 2004, DEST ran a new temporary subsidy campaign, paying in the same way as in 1999 a 500 DKK (65 EURO) subsidy for all A+ and A++ appliances. Contrary to the 1999 campaign, chest freezers

**Se andre oplysninger**

- Lyd dB(A)
- Antal døre
- Størrelse 0 °C-rum liter
- Vejl. pris kr.
- Fremstillingsland

**Viste oplysninger**

- Model
- Køl liter
- Sval liter
- Højde cm
- Bredde cm

**Vis**

Aktuelle apparater

Vis kun A+ og A++ **Sammenlign**

Søg apparater:

**Fritstående køleskabe (167)**

Resultatside: 1-20 21-40 41-60 61-80 81-100 101-120 121-140 141-160 161-167

Vælg	Model	Køl liter	Sval liter	Højde cm	Bredde cm	Dybde cm	KWh/år	Energimærke	Laveste pris
<input type="checkbox"/>	BEKO LRN 2880	248		144	54,5	60	127	A+	2375,00 Alle priser
<input type="checkbox"/>	EUROLINE L 288	248		144	54,5	60	127	A+	
<input type="checkbox"/>	BLOMBERG SSM 1450 X A+	256		145	54	60	127	A+	3395,00 Alle priser
<input type="checkbox"/>	BLOMBERG SSM 1450 A+	256		145	54	60	127	A+	3025,00 Alle priser
<input type="checkbox"/>	GRAM KS 290-00	280		155	59,5	60	128	A+	4254,00 Alle priser
<input type="checkbox"/>	VESTFROST SZ 277 R	277		156	60	60	128	A+	3445,00 Alle priser
<input type="checkbox"/>	VESTFROST FZ 277 P	202	75	156	60	60	128	A+	4745,04 Alle priser

**Figure 3. Sample of the website for A, A+ and A++-rated refrigerators.** Besides Danish, the basic website is available also in English, [www.elsparefonden.com](http://www.elsparefonden.com), but covering only what is on the market in Denmark. Information shown in the columns are: Model, refrigerated volume, chilled volume, height, width, depth, kWh/yr, rating, and lowest price in DKK. The user can choose information on other features like noise level, country of origin, etc. ([www.elsparefonden.dk/hvidevarer](http://www.elsparefonden.dk/hvidevarer))

17-01-2007

**Top 10**

**Køleskabe: VESTFROST SZ 277 R**

Resultatside: 1-5

Forhandler	Adresse	Postnr.	By	Telefon	Prisinformation	Laveste pris
Hvidevare-discount	Trekanten 17	6500	Vojens	66 12 66 18	Gælder til 28/2	<b>3445,0</b>
Isaksens Hvidevarer (mere info klik her)	Cikorievej 46	5220	Odense SØ	66185803	Gælder til 30/3	<b>3795,0</b>
<a href="http://www.Handelsgruppen.dk">www.Handelsgruppen.dk</a>	Magtenbøllevej	5492	Vissenbjerg	29 28 38 01	Gælder til 11/2	<b>3798,2</b>
El-Strøm onlinesalg	Arnold Nielsens Boulevard 73-75	2650	Hvidovre.	36770134	Gælder til 31/1	<b>3799,0</b>
Snøhvide.dk	Tømmergravsgade 25 A	2450	København SV	70250066	Gælder til 23/1	<b>4039,0</b>

**Figure 4. List of lowest prices.** Once the user has identified a model of interest in Figure 3, for instance model "Vestfrost SZ 277 R", a click at the price of that model will show a list of the up to ten retailers in the country with the lowest prices, shown to the right in DKK. (1 EURO=7.5 DKK). More information on some selected models can be obtained by ticking in the left column and clicking. (Source: [www.elsparefonden.dk](http://www.elsparefonden.dk)).

were now included. In this second campaign also close to all shops participated, around 50 of them independent retailers, but most of them were outlets for the around 20 chain stores.

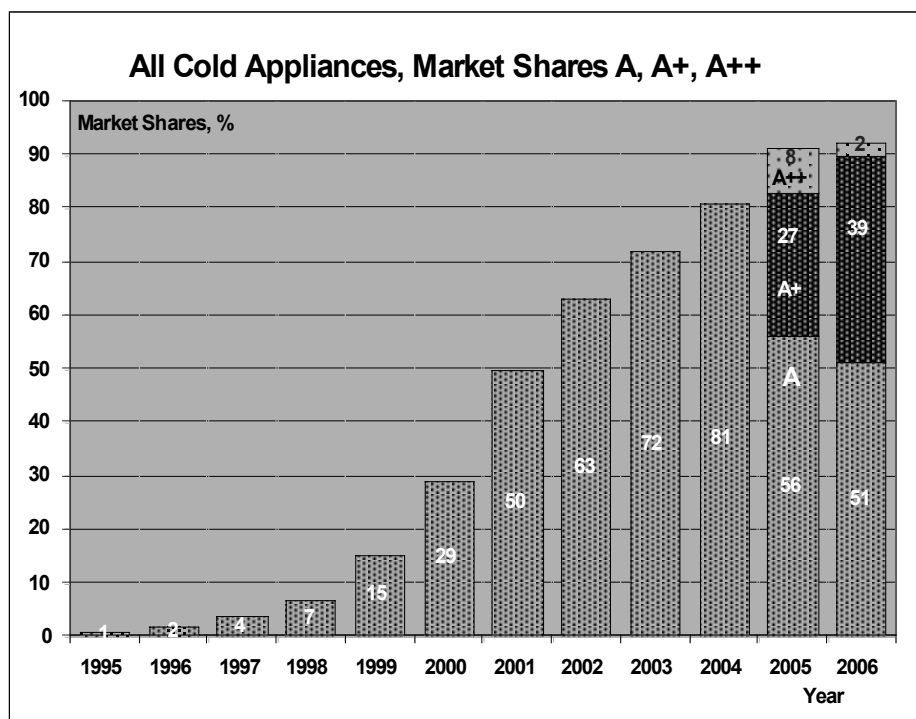
A similar campaign was run during October of 2005, but now directed only towards A++ and with double subsidy, namely 1000 DKK per unit. Fewer retailers than earlier participated this time, about 15 chain stores, probably because the campaign period was short and only included A++ units.

#### REACTION FROM APPLIANCE DEALERS

One would expect that business people in the market for appliances would subscribe to the market economy and be enthusiastic about this way to make the market work better – closer to the theory. Not every dealer applauded this initiative, however,

and some even refused to provide their prices to the website, but in the longer run, they could of course not keep the prices secret.

This negative reaction came from all the large chain stores, which had created an image of being the cheapest in town with the use of marketing tools as "price guarantee", etc. In the beginning only the independent shops participated by providing the prices to DEST, covering only around 15 % of the market. Later The Danish Electricity Saving Trust, with the assistance of the Danish Consumer Agency, called the shops of the big chains for prices, and included them in the published website to give a full picture of the prices in the market. In the few cases where the shops refused to tell price to the Agency, this reaction was published.



**Figure 5. Market share for all cold appliances sold in Denmark in the classes A, A+, and A++.** DEST's first campaign to promote A-rated started in Sept. 1999. Later with the extended scheme with A+ and A++, campaigns were launched to promote them in 2004 and 2005, respectively. The overall impact on the market is significant. (Data source: FEHA)

### Resulting Changes in Sale Patterns

It seems like the EU labelling schemes had already before DEST's first campaign in 1999 had some effect on the market, as mentioned, and the purpose of the campaign was to spur the process of getting A-rated appliances on the market. As described later, when the new A+ and A++ ratings were introduced in 2003, campaigns to promote these better appliances followed.

Obviously it is difficult to separate the results of the various elements in the package, since the whole idea of the package is that the elements are acting in synergy. In the following presentation of the results of the whole package campaign we will, nevertheless, ascribe the effect to especially the subsidy and the website.

#### EFFECT OF TEMPORARY SUBSIDIES

The Trust had budgeted with paying the subsidy of DKK 500 to close to 20,000 buyers of A-appliances in the roughly three month period this part of the campaign package ran in late 1999. For all cold appliances together (except chest freezers, which were not included in this first campaign), the development in market share for A-rated is shown in Figure 5. Only yearly sales data are available in the early phase, but as seen, the three month sale in 1999 had a significant impact on the market for this one year. All together, approximately 35,000 A-units of the various cold appliances were sold with subsidy during the campaign, or 15 % of all cooling appliances (except chest freezers) sold in the full year as shown in Figure 5. The success made it necessary to increase the anticipated budget for subsidy by 80 % to 18 million DKK or around 2.5 million EURO.

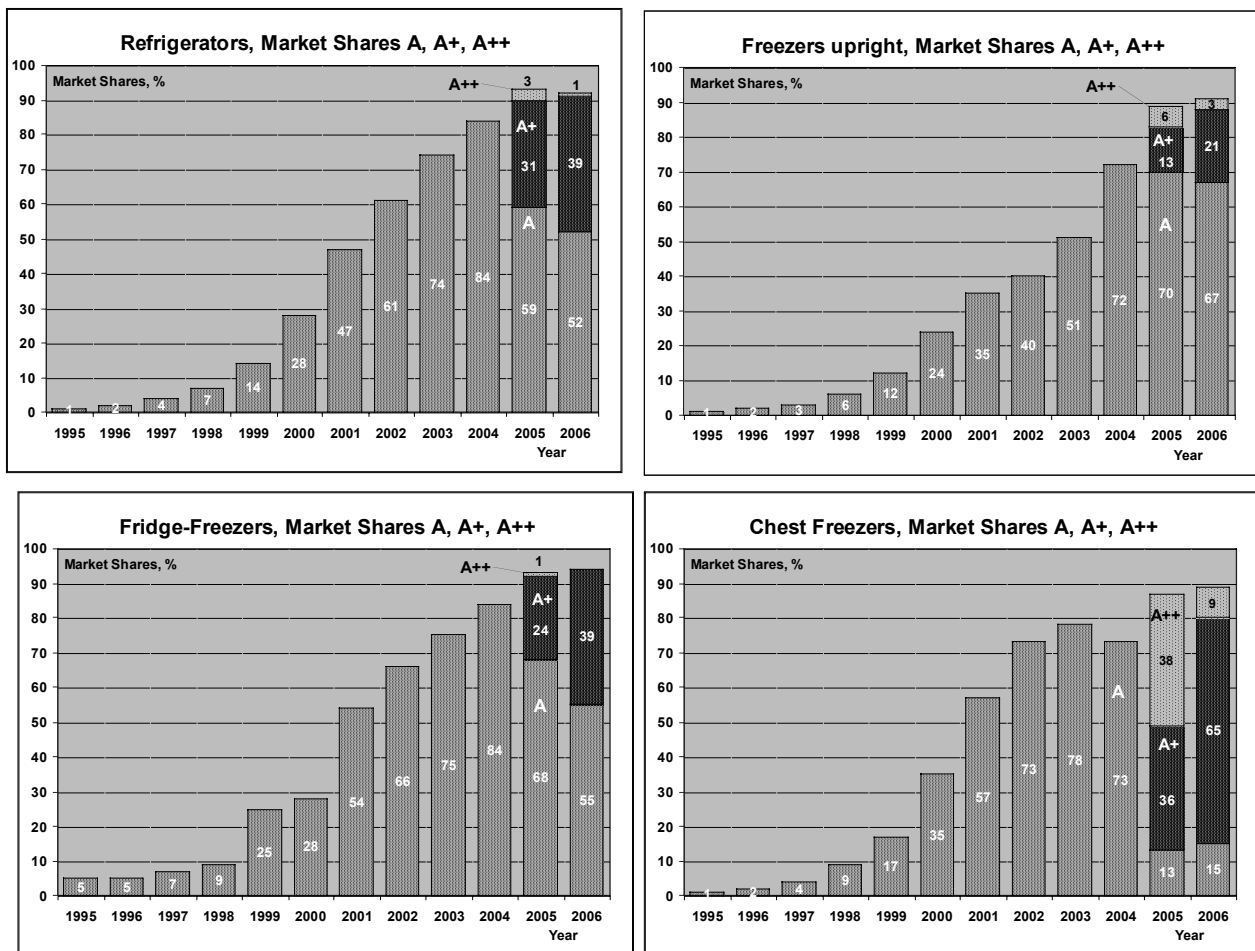
The doubling of the market share for A-appliances from 1998 to 1999 might not appear very impressive, but almost all the increase occurred during the three month subsidy campaign late in 1999. It is, however, easy to boost a sale by handing out a significant subsidy, but the strategy of a permanent subsidy did not appear politically sustainable in the longer run. So the goal of the subsidy campaign was to trigger a more permanent shift in consumers' choices, and it seemed to have succeeded, mainly through its impact on retailer's behaviour. From being able to deliver with a few days delay the A-units on request from people who insisted on it, the demand for A-rated models now made them the standard models in stock in the shops and showrooms. A derived consequence of it all was a reduction in prices of A-rated cold appliances of around 15-20 %. That is comparable or even larger than the subsidies paid.

In the following years the overall market share for A-rated cold appliances did not drop as could have been feared, considering that 35,000 consumers had replaced their units during the subsidy campaign, see Figure 5. On the contrary, an A-avalanche seems to have been released by the subsidies, but most likely maintained by the forces of the other campaign element, the Market Website.

#### EFFECT OF MARKET WEBSITE

The website makes it easy for consumers via internet to identify the appliances wanted on the list, and locate the retailers with the lowest prices. They can go there and buy it, or they can approach a more conveniently located dealer and bargain for a similar low price.

The impact of the website can be illustrated by the fact that in the couple of month after it was launched together with the subsidy campaign it was visited by 20,000 people per month on



**Figure 6. Development in market shares for the four categories of cold appliances.** The market for chest freezers, which were not included in the first subsidy campaign in 1999, but included in the 2004 and 2005 campaigns, has developed remarkably. A+ and A++ were not registered in the 2004 statistics. (Source: FEHA).

average. This can be compared with the total sale of all appliances in question, including B- and C-rated, which was around 50,000 per month in that period. So there is no doubt that the website can also take credit for a significant part of the effect in 1999. But since it probably took some time to dissipate and for the public to perceive how useful the website was, its impact is more in maintaining the growth in A-share of the market.

#### RESULTS OF RECENT FOLLOW-UP CAMPAIGNS

Compared to the first subsidy campaign in 1999 with 35,000 subsidies for A-units being paid, the later campaigns for A+ and A++ were even more successful. At the end of the A+ campaign in 2004, subsidy had been paid to a total of 86,000 A+ and A++ units, with the latter accounting for only 0.5 %. During the 2005 campaign which only involved A++, but a twice as high subsidy, 1000 DK, this was paid out to 35,000 consumers like in 1999, but in this case in just one month. The numbers should be compared to a relatively constant annual total sale of cooling appliances in Denmark in recent decade in the range of 350,000 units, plus-minus 10 %.

Figure 5 shows a sudden share of 27 % and 8 % respectively of A+ and A++ appliances in 2005. Obviously, this does not indicate a lot of new efficient models coming on the market and being sold in 2005 as compared with zero in 2004. It mainly

expresses that the best model in class A were now registered under their own classes A+ and A++.

But even when the A-share in 2004 was exceeding 80 % of the total sale, the new labels and the two new campaigns were able to push the market shares of all the A's together to an amazingly high 92 % in 2006. More important, however, is that the share of A+ and A++ models is approaching half. The decline in A++ share from 2005 to 2006 can maybe be explained by the market success of the extra large subsidy of 1000 DKK paid for A++ in 2004, which have led to an accelerated replacement followed by a slow down in demand.

#### MARKET DEVELOPMENT FOR THE VARIOUS COLD APPLIANCES

The cold appliances were in this study divided into just four categories, as seen in Figure 6, namely 1) Refrigerators (with or without a small internal freezer compartment), 2) Freezers, (upright), 3) Combined fridge-freezers (two doors), and 4) Chest Freezers. The latter were actually not included in the first campaign in 1999.

Figure 6 shows that roughly speaking the market trends are the same in all 4 categories of cold appliances. In all categories the market shares of A, A+ and A++ have grown from less than 10 % in 1998 to around 90 % in 2006.



The most remarkable deviation between the 4 categories is observed for the chest freezers, which were not included in the first 1999 campaign. They were, however, subsidised in the 2004 and 2005 campaigns. The latter was for A++ only and a double subsidy, 1000 DK (130 EURO) per unit was paid. This can explain the apparent marked effect on A++ chest freezers in 2005, seen in Figure 6, although we don't actually know their share in 2004, since the A+ and A++ classes were not registered separately, but was part of the A's.

### Future Policy Options for Energy Savings

Looking forward there are still tasks to be undertaken in the field of electricity consumption, especially considering that electricity consumption has not declined in the households despite the progress in marketing more efficient end-use technologies.

#### PUSHING FOR BETTER MODELS

It is characteristic that most analyses of potentials for using energy more efficiently is based on the data available on what are the most efficient *on the market*. Very few analysts look into the technological option of redesigning and bypassing the best models with even better ones. This shortage of publicly available technical analyses seems to imply that the initiatives for improving the appliances with respect to energy consumption, solely lies with the manufacturers. Consequently, decision makers are in the hands of the manufacturers as the only experts when it comes to setting realistic targets in energy saving policy. This development in energy savings by manufacturers has often turned out to be a slow or even negative process in the sense that some manufacturers other features have over-ridden the energy saving aspect. A general trend has been that environmental improvements of for instance refrigerators have actually been pushed by governments, environmental organizations and independent researchers. They have with reports and prototypes shown to consumers and policy makers what is possible and what can reasonably be demanded from the manufacturers.

Also DEST has realized how essential it is for independent organizations like this Danish Electricity Saving Trust to push further improvements towards A+ and A++, and even beyond. This has been carried out by financing development projects run by Danish Technological Institute in cooperation with manufacturers of more efficient refrigerators and freezers. Such projects have resulted in prototypes of new A++ models, as described earlier and should be pursued further.

#### SUFFICIENCY AND EFFICIENCY

Efficiency of the end-use technologies like for instance cold appliances, as discussed in this paper, is an important element in an energy policy aimed at environmental sustainability. But it would be a serious self-deception to equate efficiency with a reduction in energy consumption. The efficiency gains in cold appliances over the last decades - to a large extent due to the successful campaigns of DEST - are mostly eaten up by an expanding use of the "cold service". Future energy saving measures must therefore necessarily include measures to promote *sufficiency* in these fields together with *efficiency*.

A start in this direction is the latest message from the Trust in 2007 that an annual consumption of electricity in households of 1000 kWh per person is sufficient, compared to the present average in Denmark of around 2000 kWh.

Inspired by the labelling of single appliances a more radical suggestion could be to introduce an informative A to E ranking of households, where an annual electricity consumption of less than 250 kWh per person would qualify for an A, and D is for those exceeding 2000 kWh (Nørgård and Guldbrandsen 1998). Such ranking could be used for introducing progressive electricity taxes, where for instance the annual consumption of electricity below the A level of 250 kWh is tax free, while the rest is subjected to an increased tax. Also, the ranking could be used for setting low electricity consumption as a requirement to qualify for subsidies to buy renewable energy or to buy systems for utilizing renewable energy, such as photovoltaics, windpower, etc.

### Concluding Remarks

Results from the described package of measures implemented by the Danish Electricity Saving Trust point towards a significant energy saving effect from making the market more transparent. Supplementing the labelling system with easily accessible website information to consumers on which models are best and where they are available at the best price, must be given credit for a significant part of the dramatic market change in favor of energy saving models from 7 % to 92 % in 8 years. As a concrete action, the result presented here could be transferred to energy and environmental policies internationally as well as to other appliances and equipment.

Despite the fact that market economy cannot in itself resolve the environmental problems, the use of the market in energy policy should at least try to live up to the market theory axiom of full information to consumers. The importance of this aspect is supported by the example given here of using labelling effectively. Many other parts of the consumer economy in general could benefit from such independent website information to assist consumers to easily make those choices that are optimal, also in non-monetary terms.

If a more regulated market was politically accepted, the use of minimum efficiency standards could have achieved a similar result as presented in this paper. This would require the standards to be much tighter than those already introduced, for instance allowing only A+ and A++ to be on the market after a certain year. In the 1980s, such tight minimum efficiency standards in California lead to a conflict between the authorities and the manufacturers, but later resulted in significant efficiency improvements. In general, the use of tight minimum efficiency standards would immediately be easier and less costly for government than the campaigns used to make the "imperfect" market work, as described in this paper, and it would spare the consumers for some troubles.

It has taken about 30 years from the conception of A++ efficient refrigerators until such models are now dominating the market. This should make it worth investigating ways to speed up the process. Also it is worth to noticing the fact that many (maybe most) of the technological breakthroughs in these environmental fields are initiated, not by manufacturers themselves, but by outside independent actors like for instance environ-

mental organizations. Interdisciplinary research institutions, with a high degree of independence can be an important factor in resolving the delays in coping with the big problems mankind is facing.

Besides spreading the success of cold appliances to other countries and to other appliances, it is also time to look at the limitations of focussing on technological efficiency, since that can often be combined with an increase in energy consumption, because people take the opportunity to obtain more and larger appliances. The expansion in domestic stock of electrical equipment has so far eaten up the enormous savings achieved through more efficient technologies. Policy and campaigns shall focus more on combining efficiency with sufficiency, and rewarding not only the purchase of more efficient appliances but also penalising the purchase of excessive equipment.

## References

- Danish Energy Agency (1996): *Act on the Danish Electricity Saving Trust*, Act no 1209, 27 December 1996. Danish Energy Authorities, Copenhagen. [www.energistyrelsen.dk](http://www.energistyrelsen.dk).
- Egan, C. and Waide, P. (2005): "A multi-country comparative evaluation of labelling research". *ECEEE 2005 Summer Study Proceedings* (eds. Attali and Tillerson), European Council for an Energy Efficient Economy, ECEEE secretariat, Stockholm. [www.eceee.org](http://www.eceee.org).
- EU Directive (1992): 'Household appliances: energy consumption labelling', *Council Directive 92/75/EEC of 22 September 1992*. [www.europa.eu/int/](http://www.europa.eu/int/)
- Goldemberg, J., Johansson, T.B., Reddy, A.K.N. and Williams, R.H. (1988): *Energy for a Sustainable World*, Wiley Eastern Ltd., New Delhi.
- Jochen E., editor (2004): *Steps towards a sustainable development. A White Book for R&D of energy-efficient technologies*. A project of Novatlantis – Sustainability at the ETH-Domain, Switzerland. [www.cepe.ethz.ch](http://www.cepe.ethz.ch).
- Nørgård, J.S. (1979): 'Improved Efficiency in Domestic Electricity Use', *Energy Policy*, Vol. 7, pp. 43-56.
- Nørgård, J.S. (1989): 'Low Electricity Appliances – Options for the Future', pp. 125-172 in *Electricity*, (eds. Johansson et al), Lund University Press, Sweden.
- Nørgård, J.S. and Guldbrandsen, T. (1998): 'The next Generation of Appliances: Visions for Sustainability' in *Energy Efficiency in Household Appliances* (eds. Bertoldi, Ricci, Wajer). ISBN 3-540-65114-4, Springer Verlag, Berlin.
- Petersen, P.H., Marqvorsen, N., and Jepsen, K.U. (2001): *Udvikling af super lavenergi køle-fryseskab*. Final report of phase 2 to Danish Electricity Saving Trust (in Danish). Danish Technological Institute, Taastrup, Denmark. [www.danishtechnology.dk](http://www.danishtechnology.dk).
- Petersen, P.H., From, N., Poulsen, C.S., and Gundtoft, S. (2004): *Udvikling af konkurrencedygtigt lavenergi-køleskab (A++)*, Final report to Danish Electricity Saving Trust (in Danish). Danish Technological Institute, Taastrup, Denmark. [www.danishtechnology.dk](http://www.danishtechnology.dk).
- Stern (2006): "Stern Review: The Economics of Climate Change, Executive Summary". H M Treasury, [www.hm-treasury.gov.uk/independent\\_reviews/stern\\_review\\_economics\\_clima...](http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_clima...) Hard copy available from: Science Marketing, Freepost, Cambridge University, Edinburgh Building, Cambridge, CB2 1BR, UK. or [www.cambridge.org/9780521700801](http://www.cambridge.org/9780521700801).
- Weizsäcker, E. von, Lovins, A.B. and Lovins, L.H. (1998): *Factor Four – Doubling Wealth, Halving Resource Use*. Earthscan Publications Ltd., London
- Winward, J., Schiellerup, P., and Boardman, B. (1998): *Cool Labels, the first three years of the European Energy Label*, ISBN: 1 874370 21 4. Energy and Environment Programme, Environmental Change Unit, University of Oxford, 5 South Parks Road, Oxford OX1 3UB, UK.