Efficiency Standards for Household Appliances in the Nordic Countries and in EC

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Efficiency standards for electrical household appliances are on the agenda in the Nordic countries as well as in EC, where the SAVE programme stands as a central initiative. The NORDNORM work in the Nordic countries have been a valuable input to the European process. The energy saving potential is very large, and studies have shown that introducing efficiency standards could make the potential savings a reality. This paper describes the situation in Europe and points out some characteristics concerning cooperation between manufacturers and authorities, development of common initiatives in EC and the market of household appliances.

Introduction

The Brundtland Report from the World Commission on Environment and Development outlined global perspectives concerning energy consumption and the impact on the environment.

In the following years the Brundtland Report initiated different plans and programmes in different parts of the world.

In 1990 the Danish government presented their energy plan of action "Energy 2000 - A Plan of Action for Sustainable Development" with targets and initiatives to meet the objectives set forth in the Brundtland Report.

The Nordic countries adopted in 1990 an enlarged programme for Nordic energy cooperation with specific focus on increased energy efficiency. On this basis, the Nordic Ministers of Energy decided to appoint the NORDNORM Commission to present proposals for (1) labelling the electricity consumption of household appliances and (2) efficiency standards for the maximum electricity consumption of household appliances.

The SAVE programme (Specific Actions for Vigorous Energy Efficiency) was adopted by the EC Council in October 1991. The central objective is to increase the energy efficiency by 20% in the year 1995. The programme includes energy labelling and efficiency standards for household appliances. The EC Commission is now going to prepare proposals for directives with legal status for all member states.

EC member states have also pushed EC forward in the process by notification of national initiatives. In 1990 Denmark notified an Executive Order on labelling. At the end of 1991 The Netherlands notified a regulation for efficiency standards for household refrigerators, freezers and their combination. (In this paper these three appliance categories will be described as fridge/freezers). According to procedures EC has to respond on such initiatives. In both cases EC chose to make proposals for common regulations. The EC Commission should finish the common proposals within one year after the notification.

An EC frame directive on energy labelling is expected finally adopted in the EC Council in 1992. This directive will be followed by implementing directives for each category of appliances starting with fridge/freezers. The frame directive as well as the implementing directives must be followed by national legislation and implementation initiatives.

Energy labelling and standards in Europe seem to wait for and follow the EC context even in countries outside EC.

NORDNORM Proposal for Efficiency Standards

Efficiency standards have been highlighted in Europe in 1991 and 1992 through a series of seminars, workshops, and national and international initiatives. One of them is the NORDNORM Commission proposal of January 1992 titled "Principles for efficiency standards for the electricity consumption of household appliances."

The Nordic situation is that Denmark as a member of EC has to follow the EC regulations. The other Nordic countries, Norway, Finland and Sweden, are organized in the European Free Trade Association (EFTA). Last year

EC and EFTA finished the EEA talks concerning free trade conditions between EC and EFTA countries. The EEA agreements have now to be ratified in the single EFTA countries. Further Finland and Sweden have asked to become members of EC.

NORDNORM initiated a survey of the total supply of household appliances on the Nordic market. The result confirmed that this market is very European, see the Cooperation with the Manufacturers section. A large part of the supply is manufactured in EC countries and a large part of production is exported to EC countries. It seems reasonable to seek European standards instead of regional or national regulations.

Therefore the proposal is directed towards Europe even though it is formulated in a Nordic frame.

The NORDNORM Commission recognized that the recent years have brought improvements in the energy efficiency of appliances on the market. It is on the other hand obvious that market penetration of highefficient models has been rather low. A low market share of the refrigerator LER 200 can be seen on the Danish market. The very efficient models are often more expensive and are not purchased as special offers. The first cost is still a very important single factor of choice for the consumer.

Development of new highefficient models almost only occurs in connection with some kind of public funded programmes, as in Denmark with development of LER 200 refrigerator from Gram and in Sweden with innovative procurement of refrigerator/freezers.

Efficiency standards are initiated in recognition of the fact that the market alone will not be able quickly enough to secure the full achievement of efficiency gains that are either profitable for the buyers or which, over and above this, are necessary for ensuring that political objectives to reduce environmental impact are fulfilled.

Keypoints in the NORDNORM Proposal

The NORDNORM Commission finds it important that efficiency standards are introduced voluntarily. Voluntary agreements create the best basis for cooperation with the suppliers of the appliances which are considered as important for the scheme to function.

However, if voluntary agreements are not reached, the Commission proposed that making the efficiency standards compulsory should be considered. It is important to make this possibility of compulsory standards realistic from the beginning and determine the criteria of succes of the voluntary agreements.

The efficiency standards must be dynamic and graduated by means of updating the standards at regular intervals.

Sufficient lead time must be allowed for implementation from the time the standard has been announced until it comes into force to facilitate the necessary product development. As far as possible the next step in the efficiency standards should be announced as an interim target or at least an announcement of the time for updating.

Two methods to determine the level of standards were analyzed, (1) the technical analyses and (2) the empirical method. Both methods give valuable information and are necessary in the process. The empirical method is proposed to be carried out first. It creates a picture of the market situation and can form the background for the first level of standards. This method can give a quick start to the scheme.

The technical/economic method or engineering analysis provides more precise knowledge about technical and economic conditions. This is essential for getting knowledge about the impact on consumers costs for buying the appliances and for operation in the lifetime. The technical/economic analyses are used to set standards in the longer run.

Another important conclusion of the Commissions work was to point out that preparation and implementation and levels of standards should be coordinated between the Nordic countries and the rest of Europe in EC.

Methods of measurement must as far as possible be based on internationally recognized methods. As a main principle it is stated in the proposal that the authorities must rely on manufacturers' declaration of energy consumption. A system of control to spotcheck the given information must be established.

The question of how inspection should be organized and what kind of sanctions should be used must be determined in connection with implementation in member states.

As a final highlight of the proposal the necessity of an evaluation of both the initial phase and the operation phase is pointed out.

Effect of Efficiency Standards

In order to evaluate the extent of the efficiency potential in the Nordic countries from implementing efficiency standards for electrical household appliances, the NORDNORM Commission initiated a project conducted by DEFU, a Danish institute for research and development in the field of energy supply (DEFU 1992).

The aim of the project was to illustrate the effects of different scenarios for efficiency standards for fridge/ freezers.

The effects of three different scenarios A, B and C, each of which contains three levels of efficiency standards, have been analyzed. Time schedules for the different steps of efficiency standards are defined with dates that actually presuppose that an immediate decision to introduce efficiency standards is taken, in principle on January 1, 1992.

Scenario A. The empirical scenario is a "soft" scenario where all three levels of efficiency standards are defined on the basis of what is available on the market today.

	Into force	Description
Level 1	1.1.1994	The market is closed to the 25% of appliances that consume most electricity.
Level 2	1.1.1996	The market is closed to the 50% of appliances that consume most electricity.
Level 3	1.1.1999	The level as in a 1991 low-energy appliance

Scenario B. The technical-economic scenario is based on the above mentioned technical-economic analyses of the possibilities for making efficiency improvements.

	Into force	Description
Level 1	1.1.1996	A pay-back time for consumers of max. 2 years for the efficiency improvements carried out.
Level 2	1.1.1999	Life cycle costs are minimized.
Level 3	1.1.2002	The life cycle costs may not exceed the starting point (baseline).

Scenario C. The environmental scenario is an ambitious scenario where it is assumed that some of the efficiency improvements can only be realized if a number of technologies that are not of any immediate commercial interest today can be developed and made commercially interesting.

	Into force	Description
Level 1	1.1.1995	Life cycle costs are minimized (corresponds to level 2 of scenario B).
Level 2	1.1.1998	Electricity consumption is reduced by 25% in relation to level 1.
Level 3	1.1.2001	Electricity consumption is reduced by 50% in relation to level 1.

No assumptions are made about compulsory or voluntary efficiency standards in the scenarios. In this connection it is of minor importance whether the efficiency standards are achieved as a result of compulsory requirements or voluntary agreements. It is assumed that the standards will be fulfilled for all appliances that are sold.

The life cycle cost curves have been calculated by Pedersen (1992).

These scenarios are compared with a reference development determined as an extrapolation of the increase of efficiency in the latest 10 years.

Figure 1 shows the historic development in the electricity consumption for new appliances sold on the Danish market from 1970 to 1990 with regard to refrigerator without internal frostbox, combined fridge and freezer and chest freezer.

The extrapolation of the efficiency development is corrected with the assumption that it is approaching a minimum level. This is due to the fact that there is a physical limit of how low the electricity consumption of the appliance can reach and because further improvements will be very expensive, also seen in the long time perspective.

The development of the average consumption of new appliances is showed for combined refrigerator/freezers in Figure 2. It is important to note that the average consumption of new appliances is below the levels of standards. Introduction of efficiency standards does not mean, that all appliances will have a consumption exactly corresponding to the standard. Manufacturers will continue

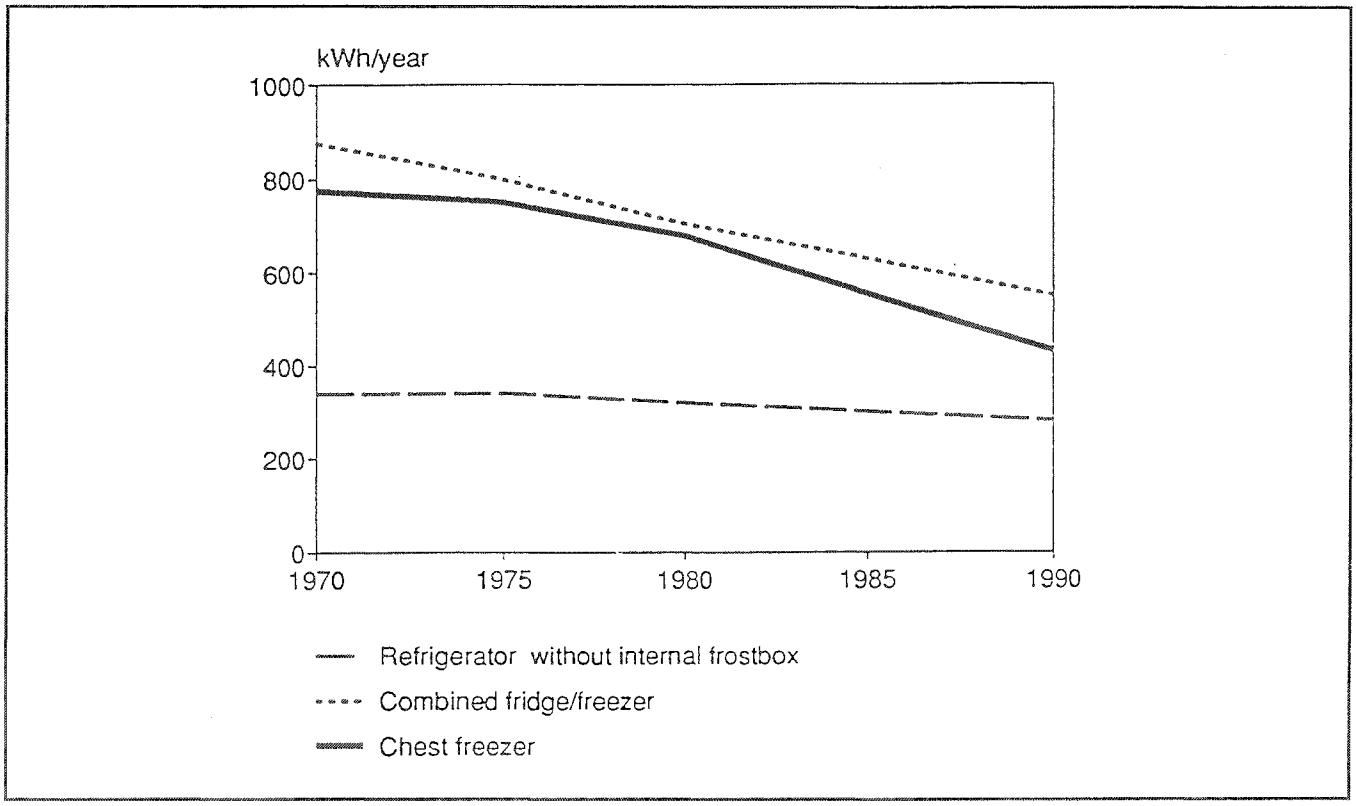

Figure 1. Electricity Consumption for New Appliances Sold 1970-1990

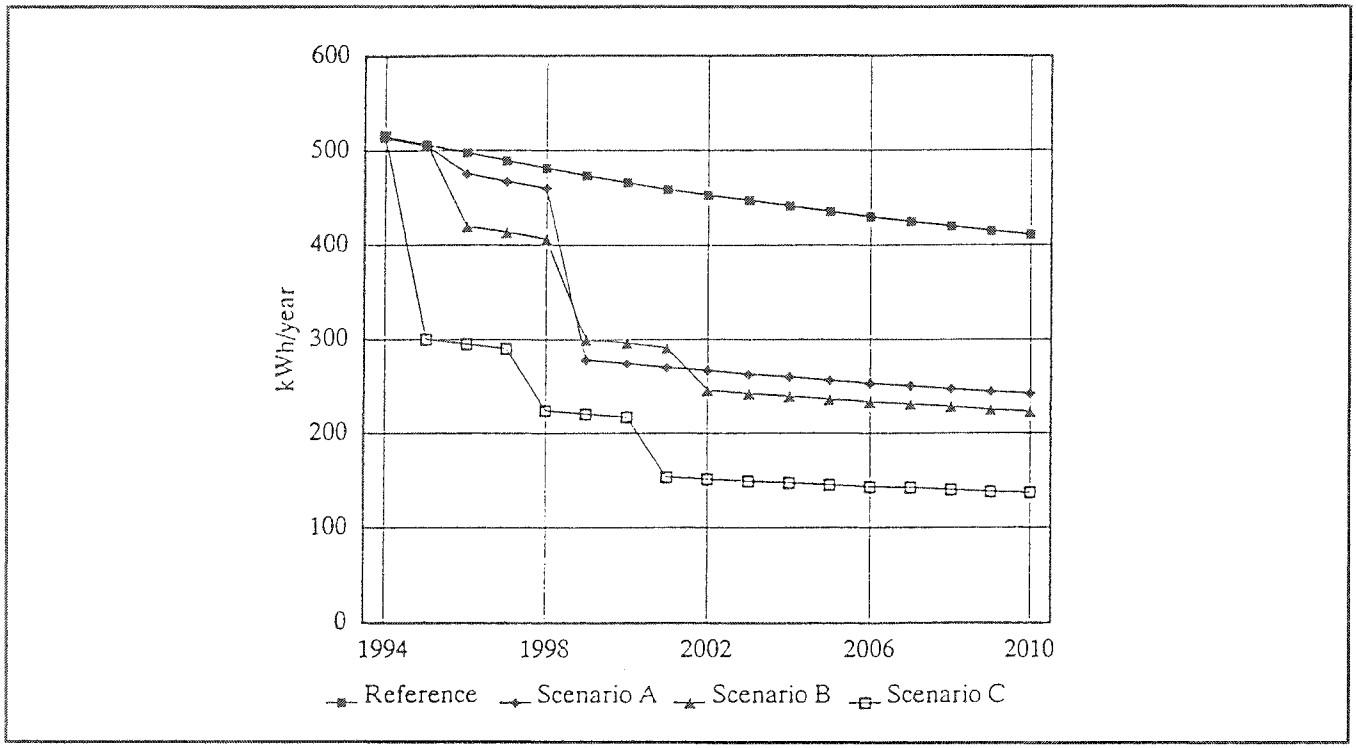

Figure 2. Electricity Consumption in New Combined Fridge/Freezers in Scenarios A, B and C

developing more efficient models for competition and in order to be ready for the next level of standards.

It is estimated that market supply will be within a range of ±10-15% of average. This estimate is confirmed by a presentation by James E. McMahon in Stockholm, Sweden in May 1991, of experiences from US efficiency standards. One of the conclusions was, that after introduction of standards there will still be a diversity on market. This spread will be smaller measured in absolute terms (kWh), but could be fairly described in percentages of average.

In the following calculations of the effect of efficiency standards it is assumed that average consumptions of new appliances follow the curves similar to Figure 2, which only concerns combined refrigerators and freezers. In principle this situation could be realized by mandatory or voluntary standards.

The total effect of the efficiency standards on the Nordic electricity consumption is shown in Figures 3 and 4.

Annual savings of between 2 and 4 TWh in the end of the period corresponding to 25-50 % of the total consumption for fridge/freezers in the year 2010 in the reference situation. Accumulated savings in the period between 15 and 35 TWh demonstrate a large potential.

It is important to note that if a first soft level of standard is not relatively quickly followed by a more stringent level, the standard can become "a sleeping pillow" where no resources are used to develop new efficient appliances.

The French energy agency (AFME) has carried out a similar study for the EC Commission, showing accumulated savings for fridge/freezers of around 300 TWh over a 15-year period see Figure 5.

The European Market

The NORDNORM Commission worked with a proposal concerning the Nordic countries, but its intent was to coordinate the efficiency standards with the rest of Europe, and especially with the EC. A major reason for this is that the market for hard white goods is European centered; that is the consumers in Europe buy almost the same types of appliances and use them in the same way.

There is on the other hand no reason to transfer the US standards to Europe. Besides the different methods of measurement there are a number of differences in the technology and in the consumer's choice of appliances that makes it no sense to adopt US standards to Europe.

There are around 123 million households in EC and aproximately 9 million in the Nordic countries. The market supplied by the European manufacturers is even bigger because they also serve the market in eastern Europe, Austria and Switzerland.

There are of course differences in the climate. Appliances used in northern Europe, with a temperate climate, may not be able to function in the south of Europe with a subtropical climate. This is especially a concern for fridges and freezers. The GEA (Group for Efficient Appliances) project mentioned below will analyze the differences in the use of the appliances in EC more deeply and take into account different categories according to the different climate zones.

The European Manufacturers

There are a number of manufacturers of hard white goods in Europe. Table 1 shows the market shares for electric household appliances in EC of the largest companies in 1988.

Electrolux has the largest share of the market for electric appliances in the household sector. In the Nordic countries they have an even higher market share, around 33%. Electrolux owns factories all over the world. In Europe they have factories e.g. in Sweden, Germany, Italy and Denmark. Germany and Italy are home to other important manufacturers.

In the Nordic countries the supply of appliances including fridge/freezers comes both from internal production and from import (Figure 6). Imports are around 50% of the supply to the Nordic Market.

Electric appliances imported come primarily from other EC countries (Figure 7).

Corresponding, the Nordic manufacturers export a large share of their production especially to the other EC countries (Figure 8).

For the above mentioned reasons there are great benefits of harmonizing standards in Europe just as has happened in the US with national consensus standards pre-empting state standards.

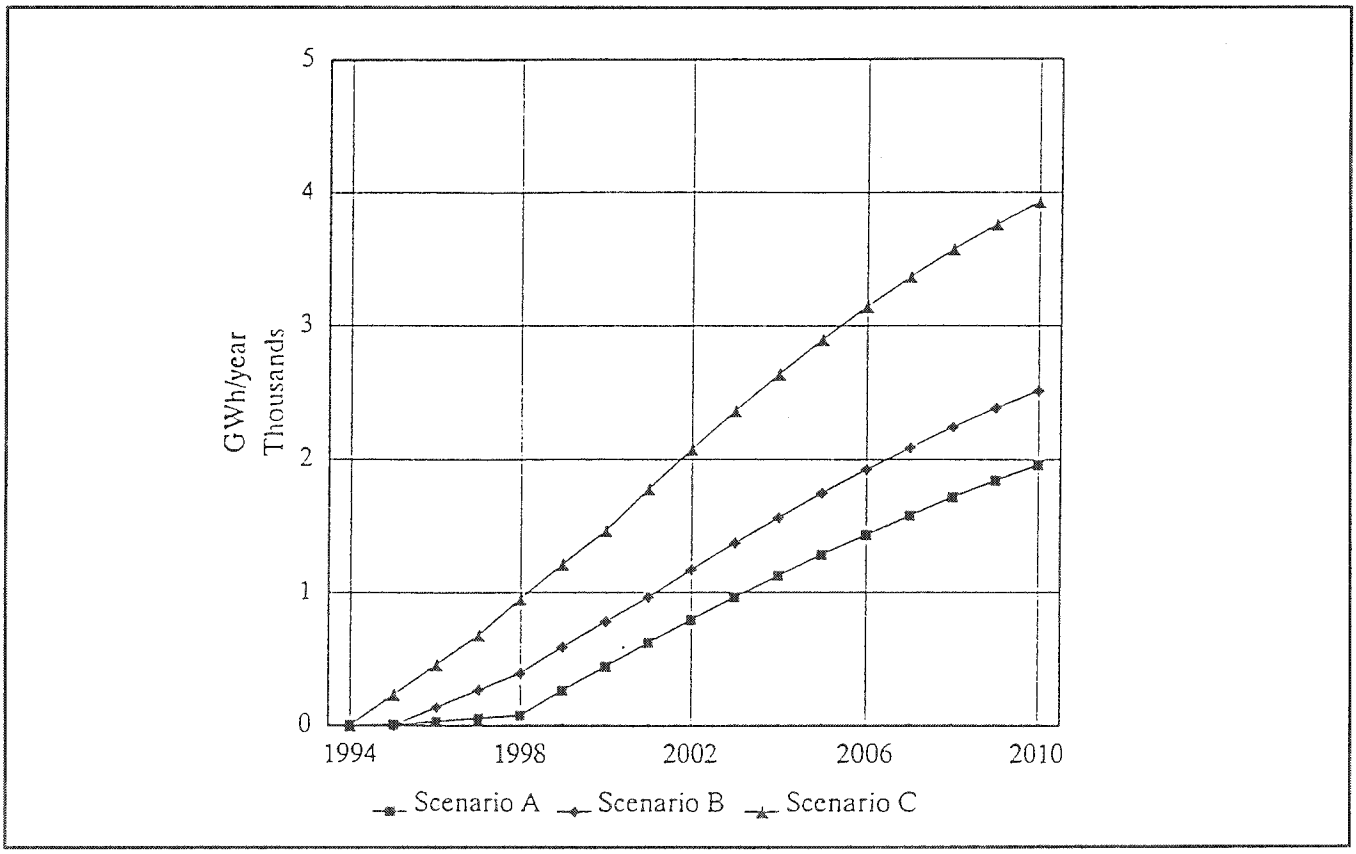

Figure 3. Annual Savings with Efficiency Standards for Fridge/Freezers in the Nordic Countries

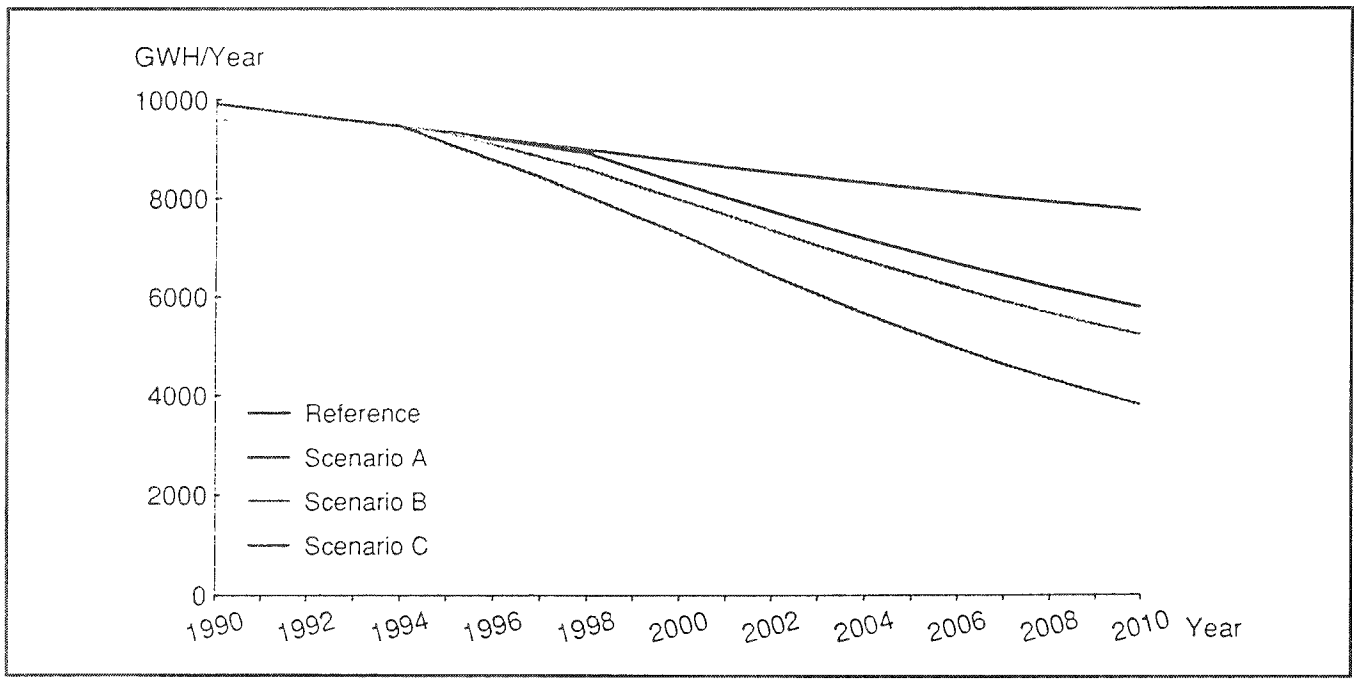

Figure 4. Effect of Efficiency Standards for Fridge/Freezers in the Nordic Countries

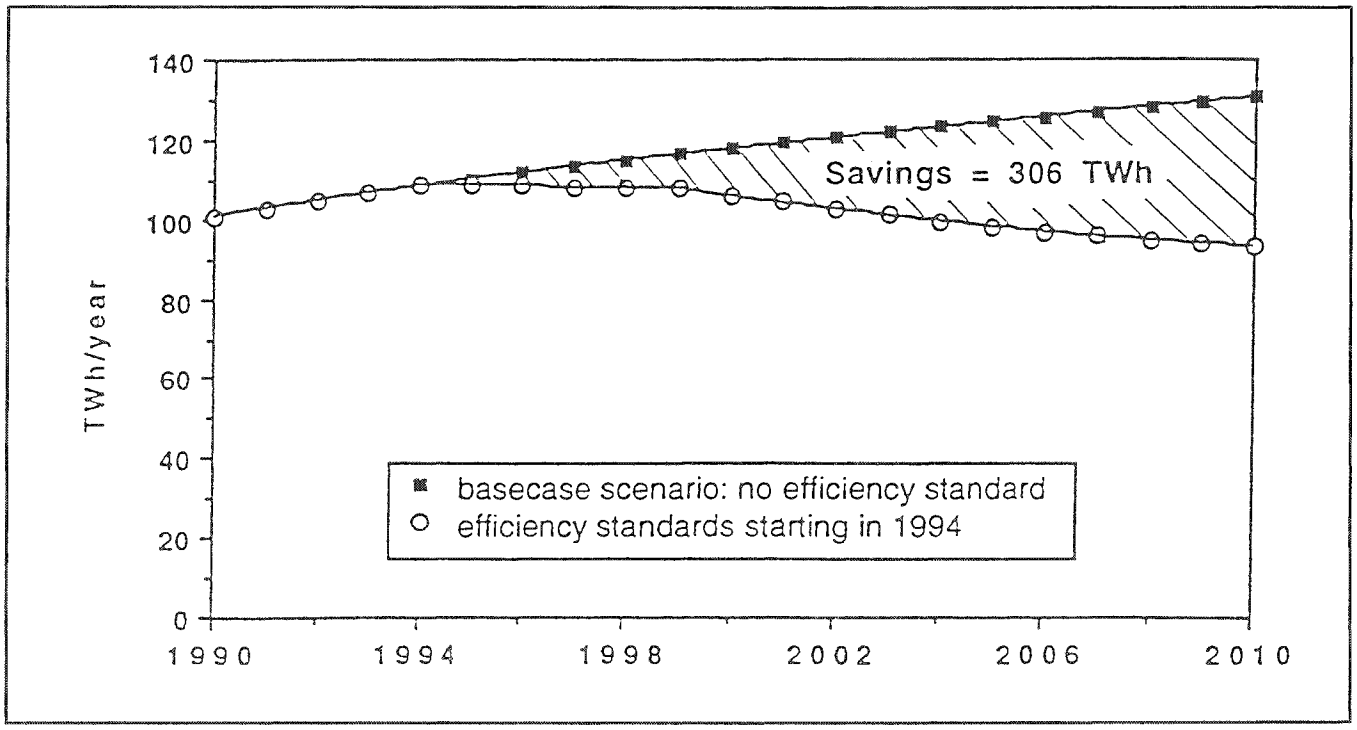

Figure 5. Effect of Efficiency Standards in the EC

Table 1. Marketshares in EC - the 10 Biggest Companies

Electrolux (Sweden)	20.5%
Whirlpool International (Netherlands/Italy)	11.5%
Bosch Siemens (Germany)	11.0%
Merloni (Italy)	10.0%
Candy (Italy)	5.5%
AEG (Germany)	5.0%
GEC Hotpoint (United Kingdom)	5.0%
Thomson (France)	5.0%
Miele (Germany)	4.0%
Ocean (Italy)	2.5%

Source: AFME (Euromonitor Publications)

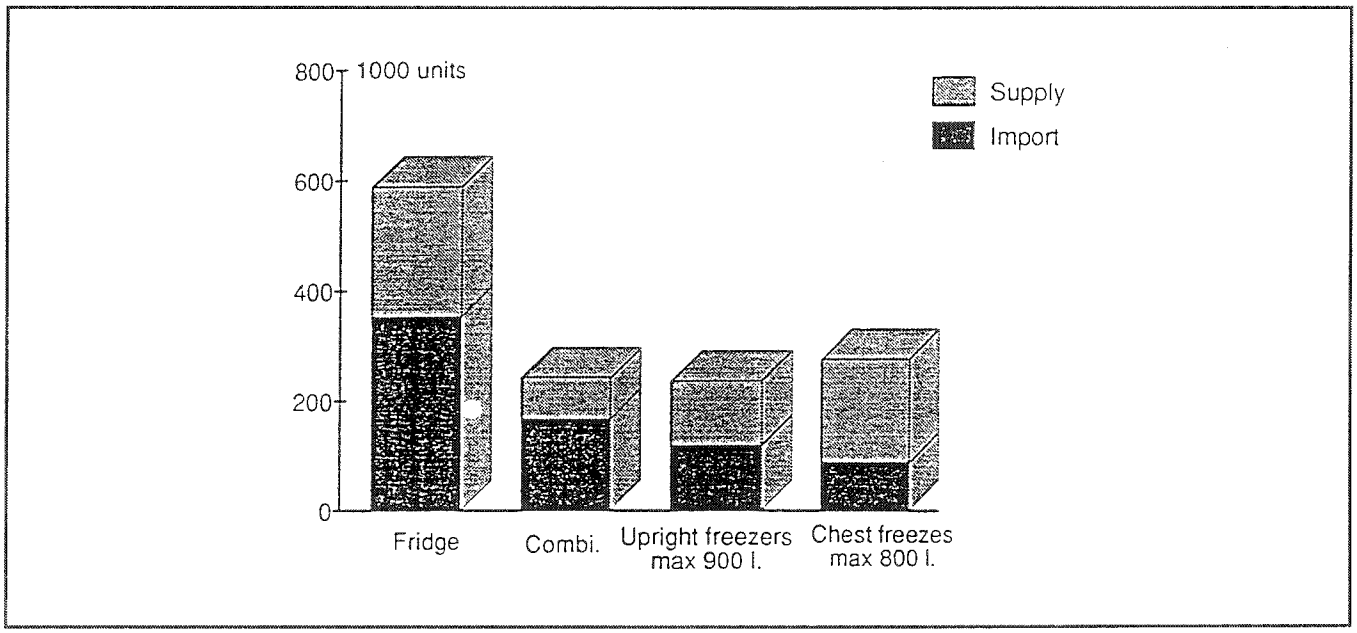

Figure 6. Supply of Fridge/Freezers to the Nordic Market 1989

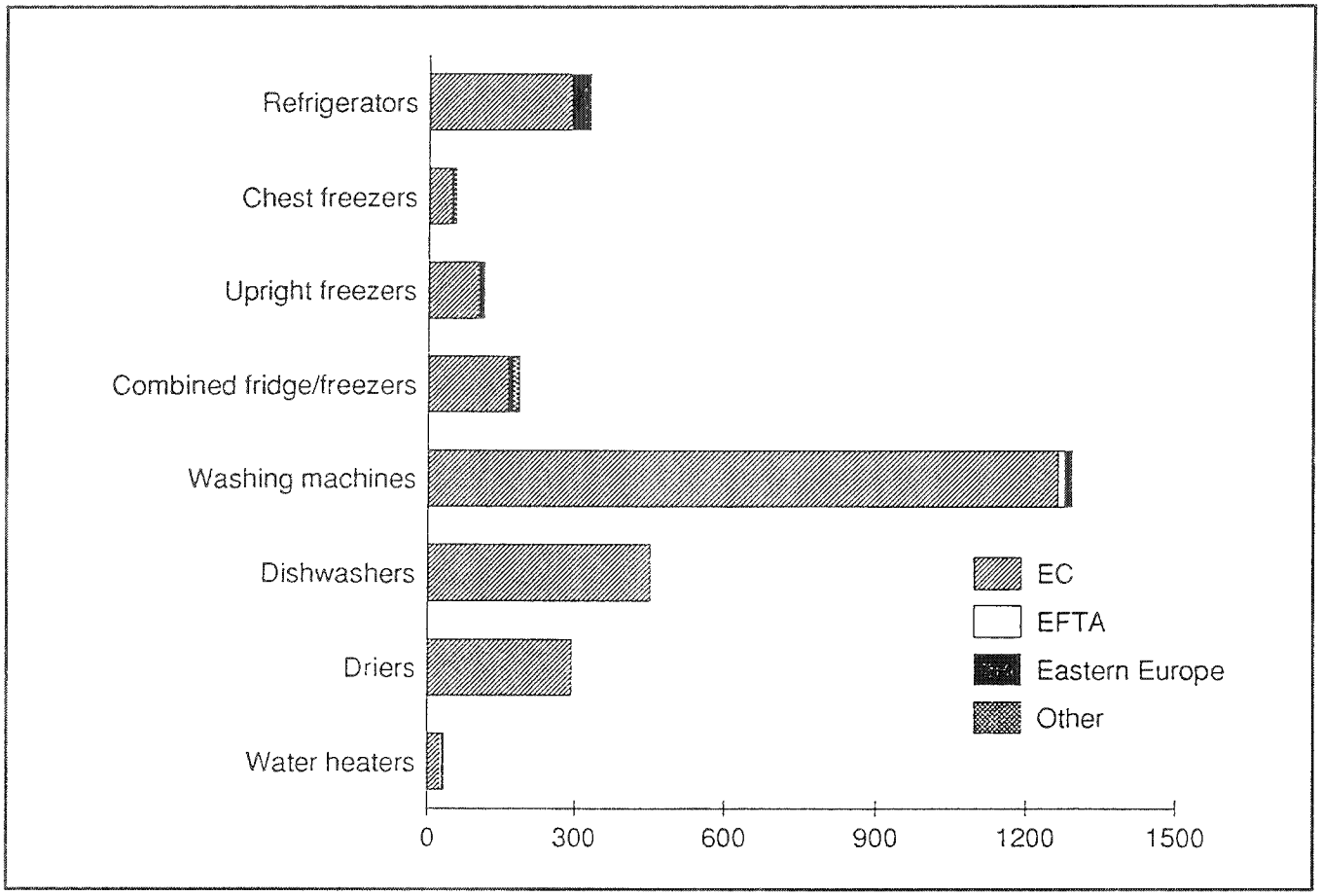

Figure 7. Imports to the Nordic Countries 1989, DKK millions

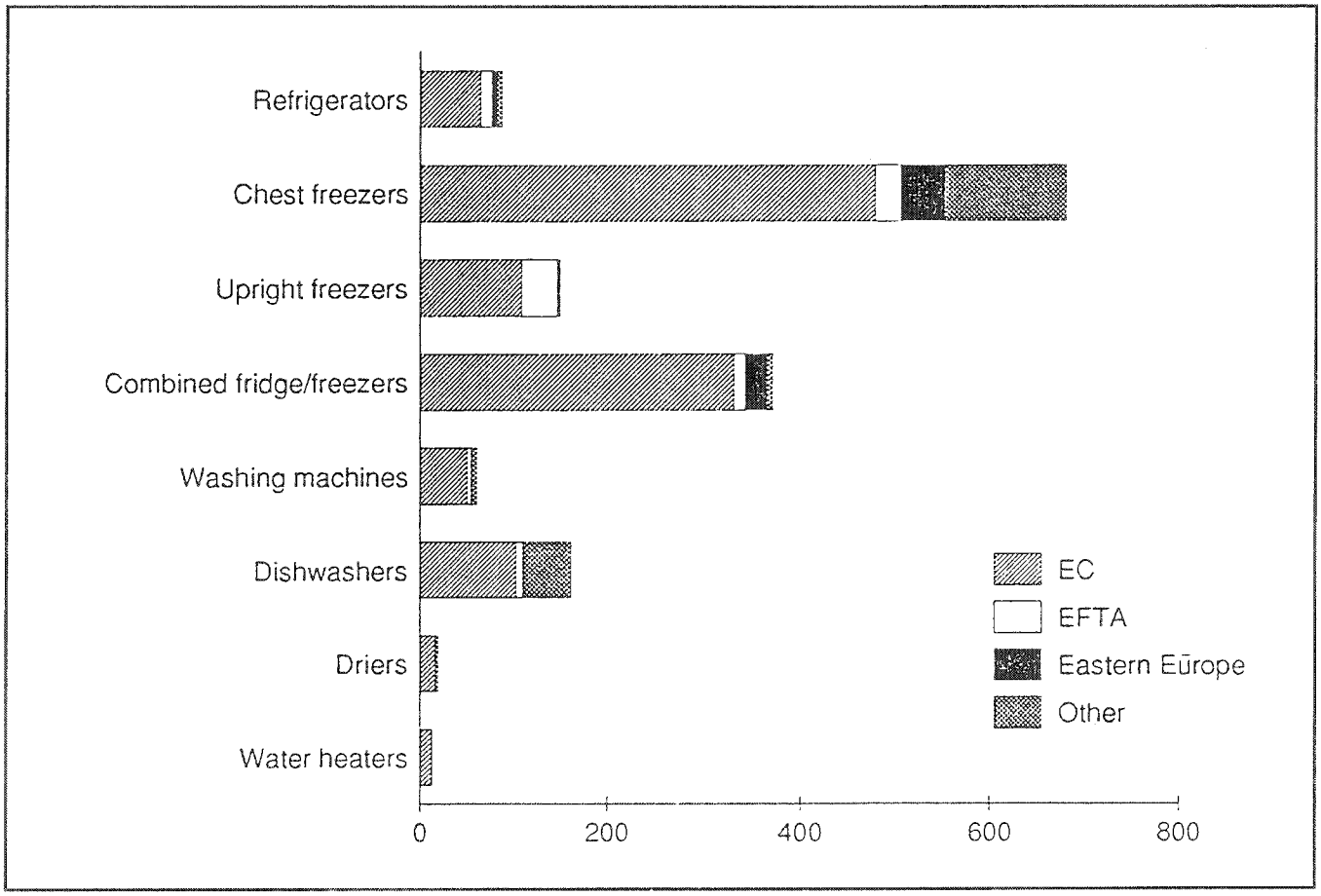

Figure 8. Exports from the Nordic Countries 1989, DKK millions

The Process of Setting the Standards

The Dutch notification of mandatory efficiency standards for refrigerators, freezers and their combination initiated the process.

The Dutch Proposal for Efficiency Standards

The Dutch proposal for efficiency standards concerns refrigerators, freezers and their combination used in the domestic sector.

The standards are mandatory and are therefore supposed to include all appliances sold on the Dutch market.

A model can only be marketed if it is certified i.e. if it has passed a test, which requires a certain minimum efficiency specified for each category of appliance.

The Dutch efficiency standards are set to reduce the average electricity consumption of the appliances sold on the market by 10 to 15%. At the same time it is important to keep a certain diversity of models and brands on the market, after the standards have been implemented. The standards have been set by using statistical analysis of the actual Dutch market of appliances.

The EC

The process of setting European efficiency standards is right now in the hands of the EC Commission. Whether the standards are going to be mandatory or voluntary is under consideration in EC. At the moment negotiations are carried out with the manufacturers to see if it is possible to implement an effective voluntary agreement.

Along with the negotiations for voluntary agreements the EC Commission is preparing a directive for a compulsory system to implement if the agreements are not a success.

Beside arranging a workshop in April 1992 for the manufacturers concerning methods to set standards, the EC Commission has asked the GEA-group to do both market and technical/economic analyses of fridge/freezers. GEA is the Group for Efficient Appliances and consists at the moment of the energy agencies in France, Netherland, Portugal and Denmark.

Cooperation with the Manufacturers - Foundation for the Scheme

A foundation for a scheme of standards is a succesful and positive cooperation with the industry of hard white goods both because they have to implement the requirements and because they hold the knowledge about the new and commercial technology.

In 1991 the Danish Energy Agency appointed a working group consisting of members from the Danish manufacturers of fridge and freezers for the domestic sector as well as members from the Danish manufacturers' association (FEHA) and the Danish Energy Agency. The aim of the working group is to exchange information about initiatives on the improvements of efficiency in appliances and to carry out joint projects. The group has achieved good working relations with members of the Danish industry.

One of the projects carried out in the group was on efficient fridge/freezers. Engineering and economic analyses were made with help from the group and a consulting firm (Pedersen, 1992). The manufacturers gave informations about their production costs for improving the efficiency by for example improving the compressor and improving the insulation. This information was used to analyze how far one could go taking into account the consumer cost to buy and operate the appliances - the life-cycle-cost analysis.

The fridge/freezers were divided into 5 categories: refrigerators, refrigerators with internal frostbox, combined refrigerators and freezers, cabinet freezers and chest freezers. For each category a baseline model was defined as the regression line for the market.

Different design options were outlined; all of them technical feasible today. The most cost-effective options were: optimized compressor and increased insulation of cabinet. For refrigerators increased evaporator surface was very cost effective.

In the optimum of the life-cycle-cost curve electricity savings were found to be possible of between 35 and 60% in relation to the baseline models. The life cycle costs were between 10 and 20% lower than the life-cycle-costs of the baseline models. The costs of reducing from the baseline to minimum of life cycle costs were between 0.11 and 0.34 DKK/kWh, which corresponds to between 64 and 88 % lower costs than the average electricity price in Denmark in 1990 (0.95 DKK/kWh incl. taxes and VAT).

The project is a good example of how succesful a cooperation can be with benefits for both sides.

In addition the AFME report mentioned above shows an example of benefits from a good relationship with the manufacturers. AFME worked together with the big French producer of electric appliances, Thomson.

As mentioned before the German manufacturers hold a large share of the market. It is therefore important to cooperate with them but unfortunately the German manufacturers represented by their organization (ZVEI) have been the most unwilling group. In Germany there has been a voluntary agreement with the German industry of reducing the average electricity consumption in appliances sold on the German market. The agreement covered from 1980 to 1985 but it has not been possible to renegotiate the agreements mainly because of the CFC problem and because of the competition with the appliances imported.

It is our opinion that the German industry will become more interested in joining the project when they recognize that the EC has started to implement the SAVE program and to react to the Netherlands's notification. It is also a benefit for the manufacturers to have uniform standards across different countries rather than meeting different standards in different countries.

The GEA Project

GEA started its work in September 1991. Different activities were going on at the same time in different EC and Nordic countries - the NORDNORM work, the Netherland's empirical market study of fridge/freezers, the French study for the EC Commission and the Danish project on the same subject. Also Switzerland was working to fulfil their energy plan by setting targets for minimum efficiency of appliances. There was a great need to coordinate the activities which GEA undertook.

The goal of GEA is to carry out technical/economic analyses necessary for the definition of efficiency standards for refrigerators and freezers in Europe. At first GEA works as a group of EC-members with other countries following the project with interest.

The GEA project is building on the AFME study and the Danish project on efficient fridge/freezers. As a first part of the project GEA will do empirical analyses to set the first step of standards. As a second part and for setting standards in the longer run GEA will do technical and economic analyses similar to the method used in US. The project will use EC electricity prices and mark-ups and will be carried out in cooperation of the European manufacturers. The definition of categories is important and numbers 8 categories. The question of the impact of two different climate zones will be analyzed separately.

In October 1991 around 60 questionnaires were sent out to the manufacturers to collect basic information and to establish contact with a broad representation of European manufacturers.

Another aspect of the project is to analyze the impacts on the electricity consumption, on the environment, on the manufacturers and the consumers. Important for the EC Commission is to find out to what extent manufacturers in the South and North are differently influenced. The Northern manufacturers is expected to produce more efficient appliances than their colleagues in the South. It is also very important for the EC Commission to look at the consequences of these standards for different consumers depending on where they live in EC.

The project will be carried out this year. The background analyses are not as extensive and detailed as those done at the Lawrence Berkeley Laboratory in California (DOE 1989). The project is however relying on the former projects mentioned above. The intention is to follow up with similar analyses for washers, dishwashers and driers in 1993.

The GEA study can be used both as background for negotiations with the manufacturers to make voluntary agreements and second, if necessary to set compulsory standards. GEA finds it very important to give the Commission a good input to negotiate with the manufacturers.

Conclusions

The process of setting efficiency standards in Europe is progressing with the view of capturing a large electricity savings.

The many initiatives set out in the different countries have been harmonized with the consequence that the EC and the Nordic countries are working together in the same direction - first trying to set voluntary agreements with the manufacturers and secondly if not a success to implement compulsory standards. It can also be concluded that this method will give the best background for cooperation with the manufacturers which is of great advantage for the scheme. The NORDNORM Commission has been an important input in this process.

It is our opinion that the process can proceed relatively quickly in Europe and also faster than it did in the US. First a basis for cooperation is already established, and second the different initiatives have been harmonized at an early stage. The already developed method of setting standards in US has in addition been very useful in the preparatory work in Europe.

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