POLICIES FOR SPREADING EFFICIENT TECHNOLOGIES IN THE FIELD OF MASS MARKET APPLIANCES : STAKES AND METHODS

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1. SYNOPSIS

This paper analyses the relevant policy tools for spreading the dissemination of efficient appliances through specific case studies: CFLs, refrigerators and TV sets.

2. ABSTRACT

Efficient use of electricty has received since few years a great attention from public authorities, giving rise to different kind of actions in order to accelerate the diffusion of efficient energy technologies. These actions has been numerous in the consumer good sector in which buyer's criteria are often complex, but rarely include energy efficiency. Three specific technologies representatives of the different kind of goods that belong to the sector are considered here : compact fluorescent lamps, refrigerators and TV sets.

For each technologies, the technical opportunities for energy savings are presented with the barriers that limit the realisation of these potentials, and the behaviour of the main players (industrial firms, distributors, consumers) concerned by the dissemination of efficient appliances. Then, the main policy instruments that has been implemented in order to orientate the market in a sense more favorable to energy efficiency are presented.

The authors insist on the fact that public intervention should be adapted to the various institutional, cultural and socio-economic contexts that prevail in different countries and to the technologies that are considered. A great attention should be paid to the behaviour of players, in particular appliances manufacturers and distributors. Finaly, a decisive impact on efficient appliances dissemination may be obtained if coordinations between public instruments and commercial strategy of industrial firms are looked for.

3. INTRODUCTION

Changes in life styles in industrialized countries over the last thirty years have made the use of certain domestic appliances indispensable, amongst them refrigerators, washing machines and cookers, but also televisions, tape recorders, etc. In spite of fairly low unit consumption levels, the sheer number of such products leads to considerable overall power consumption levels. In France, almost 30% of electricity consumption in the domestic sector was in 1990 attributable to the power used by the 5 most electricity consuming domestic appliances[1]. Up until now, energy saving potentials in specific uses of electricity in the domestic sector has been relatively neglected, however they seem very significant of one considers best available technologies.

The diffusion of efficient technologies is limited because consumer choices call on complex criteria which are not confined to energy efficiency. Low consumer awareness of the energy/price factor, or of running costs in general, is characteristic of purchasing behaviour in which optimization as a function of the overall cost does not come into play. Moreover, the conditions governing the diffusion of efficient products are influenced by the existence of highly internationalized manufacturers and powerful distribution circuits in a context of comptetition-based dynamic driven by technical progress.

Our analysis will be centred on improving the understanding of the role of the players - both consumers and manufacturers - in coming up with and adopting innovations. The final objective is to update the effectiveness of the instruments put in place for speeding up the diffusion of them.

To do this, three mass market products reflecting very different behaviours either from consumers (utility products or entertainment products) and producers (white or brown products in different commercial contexts) has been choosen :

- compact fluorescent lamps (CFLs), which are basically a product to replace incandescent bulbs, having the same function, without being altogether identical. The investment cost for the household is the determining factor, but thinking in terms of running costs is not wholly ruled out where the consumer is concerned.
- the refrigerator, an item of "white goods" from the domestic appliance industry in which there are many models, with a wide range of energy efficiency. With possible variations in size, capacities, color, inside layout, ..., the principal function of refrigerators which consists of producing cold for food conservation may be considered as stabilized. In that sense, it is possible to envisage for the manufacturers the pursuit of energy efficiency as a criterion for differentiating their products.
- the television, an item of "brown goods" from the electronics industry, marked by strong oligopolistic competition with important stakes (risk of world domination). The functions of televisions are not stabilized, which drives company research and development activities towards priorities other than energy efficiency, such as high defi
nition, stereo sound, etc.

Each product is specific with regard to the approach to energy efficiency, depending on the industry it belongs to, the extent to which its functions are stabilized or even the growth rate of the technology on which it is based. Experiments already conducted outside France make it possible to determine the impact of the different means of action used, and to propose a tools typology as a function of the different kinds of product.

4. COMPACT FLUORESCENT LAMPS

4.1 Potentials and stakes

Lighting accounts for a considerable share of specific energy consumption in the residential (of the order of 10% of energy consumption in the sector) and tertiary sectors (40% in the IEA countries. In the tertiary sector, lighting needs are met partly by fluorescent tubes whose light efficacy is high (of the order of 100 lumen/W), but these are not widespread in the residential sector where incandescent bulbs still predominate. These lighting needs could be met by compact fluorescent lamps (CFLs) whose light efficacy is much higher than those of incandescent bulbs (60lumen/W) and which generate substantial energy savings. They also have the advantage of readily replacing traditional incandescent bulbs, of life spans 8 to 10 times longer, whilst using one fifth of the electricity for comparable lighting.

CFLs came on to the market in the late '70s, but sales remained relatively insignificant until the mid '80s. In the early '90s, sales reached almost 100 million units worldwide (E. Mills 1993) for an overall market in incandescent bulbs in the region of 9,000 million units).

4.2. Consumer behaviour patterns and diffusion constraints

A substantial part of the growth in sales seen in recent years is due to actions encouraging diffusion, without which the spontaneous distribution of CFLs would remain limited, in spite of their economic advantage. The life cycle cost of CFLs is in fact much lower than that of incandescent bulbs, in spite of a purchase price that can be 15 to 20 times higher. But the real penetration rate of the lighting market by CFLs shows that consumer behaviour is not determined by calculating life cycle costs. The constraints on the market penetration of CFLs are of different kinds :

- technical constraints : the inadaptability of some existing fixtures to CFLs, and the fact that it is impossible to modulate the power of the bulbs.
- behavioural constraints : a negative assessment of the quality of fluorescent lighting,
- financial constraints : the importance of selling prices, unknown or insufficient operating hours, which may make replacement financially worthwhile, low motivation because of the low expected savings.
- finally, traditional constraints on the diffusion of efficient technologies : insufficient consumer information, poor product availability, particularly on traditional distribution circuits for incandescent bulbs (hypermarkets) and caution where new technologies are concerned.

Being aware of these constraints, the lighting industry has made a great effort over recent years to improve product quality, by modifying the light quality, by reducing the time taken to light up, by encouraging miniaturization, and so on. The industry has also clearly adopted CFL promotion strategies in the form of mass market campaigns intended to make CFLs and their technical and economic characteristics better known, which contrasts with the more passive attitude taken by the domestic appliance industry.

These traditional marketing actions have not however had a decisive impact on CFL domestic market. It was only when the electricity utilities, obliged to embark upon Demand Side Management (DSM) activities, took over from manufacturers and distributors that sharp increase in sales were observed. The trigger in the domestic sector in fact came from incentive programmes put in place by these electricity companies (cf. item 7.1) which to a great extent made possible the initial growth of these markets, particularly in Sweden or Denmark. In parallel, marketing actions taken by producers were redirected towards more targeted programmes aimed at the distribution sector or certain activities in the tertiary sector.

5. REFRIGERATORS AND FREEZERS

5.1 A marked tendency towards improved energy efficiency

In spite of relatively low unit consumption levels, the overall power consumption of all the fridges / freezers (more than 100 million units in the European Community [2]) is very significant : 100 TWh (24% of consumption in the residential sector) for refrigeration appliances alone (Ademe 1991). Technological growth has appreciably improved the energy efficiency of refrigerators over the last 20 years : increasing the output of compressors, perfecting control systems, increasing the thickness of insulation materials in the fridge walls, improving the efficiency of the materials themselves, etc. These improvements have shown through in the form of a 35% reduction of unit energy consumption over the last 20 years (Greenwood 1992). They allow for the introduction of higher performing appliances on the market, even if part of the gains achieved are compensated by an increase of average size or the appearance of new functions (no frost, development of freezer compartments, etc) which lead to an increase of energy consumption.

Table 1. Electricity Consumption in the Residential Sector in European Community - Estimations, TWh -

	European Community	France
Electricity Consumption in residential sector - 1988 -	423,9	95,4
% of total electricity consumption	*26 %*	*28,6 %*
5 spécific uses* - estimations 1990 -	152,6	26,5
% of residential consumtion	*36 %*	*28 %*
Réfrigerators and freezers	100,1	17,9
% of residential consumption	*24 %*	*19 %*

Source Ademe

* *Réfrigerators, freezers, washing machines, tumble dryers, dish washing machines .*

5.2 Supply distinguished by a wide range of energy efficiency

The available supply is distinguished by extreme diversity from the energy efficiency point of view. For example, it is usual to observe, on a given market, differences of unit consumption ranging from the single to the triple for refrigerators having comparable characteristics. For 4-star refrigerators, the most common type, the unit

consumption levels of the models on the German, Dutch and French markets vary from 350 to 750 kWh/year (CEC 1993).

In addition, although the domestic appliance market in Europe is very competitive and international, the ranges available in the European countries are not comparable from the point of view of energy efficiency. In taking the English and German markets as an example, it will be noted that the energy efficiency levels of refrigerators available on the German market are much higher than those of equivalent products sold in the United Kingdom, that the most efficient equipments available in Germany are absent from the English market, and that certain products of identical size have different performance levels depending on whether they are marketed in Germany or the United Kingdom (H. Herring 1994).

Thus, without further technical progress, the mean energy efficiency of new equipments present on the European market could be appreciably improved by the adoption of those higher performance products already available on certain markets. These improvements are not achieved by manufacturers having little incentive to innovate in this direction because of the low apparent interest shown by consumers in energy saving criteria.

5.3. Consumers showing little awareness of energy efficiency

Traditional constraints on the diffusion of efficient technologies, absence of interest in energy savings, lack of information and sensitivity to purchase price, etc., are particularly influential in the case of domestic appliances. In the case of refrigerators in particular, energy efficiency is often considered only as a secondary criterion when purchasing a new equipment, after its internal layout, purchase price, brand or external appearance. Consumers prove that there is a strong preference for the present, to the detriment of potential future gains (Meier and Whittier 1983) : they are not very aware of running costs and rarely make up their minds as a function of the life cycle cost of the equipment. Most often, however, the problem is not even expressed in these terms in which the initial higher investment would be compared with future savings, since the energy efficiency of refrigerators is to a large extent independent of the selling price, without the most efficient ones being preferred to the others (Herring 1994; AIE 1991; Ademe 1991).

On these conditions, manufacturers have no incentive to produce more efficient appliances, even if the technologies are available and if the change is favourable to the consumer in terms of life cycle cost. In the absence of specific incentive programmes, manufacturers do not receive a clear signal from the market and do not direct their sales strategies towards energy efficiency criteria. The situation may be different in some European countries where awareness of energy efficiency criteria is judged by manufacturers to be more important for the consumers, particularly Germany, the Netherlands and Denmark.

It remains to be seen if, by allowing consumers to judge the energy efficiency of products marketed in a reliable and independent way, it would be possible to make them aware. It is already the case in certain countries where energy consumption rates are shown on the labels. Appropriate information, backed up by marketing campaigns on the part of the manufacturers could then encourage consumers to make more rational choices and lead to a dynamic favourable to the appearance and diffusion of more efficient models. Manufacturers should be given an incentive to take an active part in programmes of this kind, by running the risk of seeing more restrictive actions taken in the form of minimum energy efficiency standards, in the event of this strategy not having conclusive results.

6. TELEVISION SETS

Where televisions are concerned, energy saving potentials are relatively low in comparison with refrigerators or lighting, although they do exist and may increase in the light of changes affecting the audio-visual sector.

6.1.A limited energy saving potential

Efforts to reduce the energy consumption of television sets are not a priority for manufacturers, as this is not a selling point. The problem for the manufacturer is one of placing reliable products on the market and of reducing the failure rate of television sets. This concern may be exploited in order to interest producers in energy efficiency, as the main cause of failures comes from the heat given off by the set : a fall of 10° C in the inside temperature of the set would make it possible to halve the risk of failure by raising the reliability of the components.

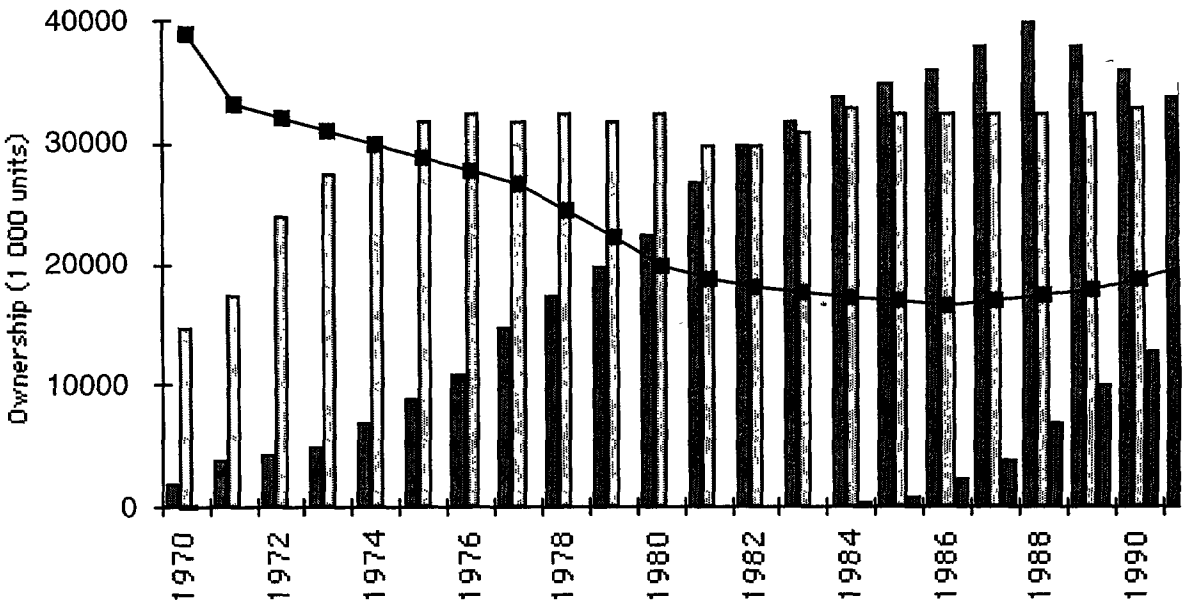
Very little work has been done in analysing the energy saving potential of television sets, with currently foreseeable improvements being slight. There seem to be very few technologies which make it possible to reduce the energy consumption of television sets, although there are many in the case of refrigerators and they allow for relatively substantial gains. The introduction of break technologies, such as liquid crystals display for example, could certainly have important consequences on the unit consumption levels of televisions, but only over a period of time that cannot yet be known with any accuracy.

According to the study conducted by the Lawrence Berkeley Laboratory (LBL) in 1988, three options may be considered : reducing standby power from 5 Watts to 2 Watts, reducing the white or black screen power by 5%, and increasing the efficiency of the display. In the case of television sets, the maximum efficiency gain would be 15%.

6.2.A potential that could be developed

The technology used in television sets is constantly evolving, leading to an increase of unit consumption. The functions introduced in to televisions are not stabilized, and their evolution leads to a change in the consumers behaviour which leads to an increase of watching time and energy consumption. This point throws light on a specific feature of "brown goods" in relation to "white goods" : the absence of clearly defined utility functions in the first case leaves open the possibility of changes in behaviour that could lead to an increase in overall power consumption.

The behaviour factor thus compensates those improvements resulting from the use of more efficient components. Because of this, the number of appliances increased, over the period 1970-85, with a product whose functions were stabilized, and this showed through in the form of unit power gains (cf fig. 1). On the other hand, since 1986, there has been an inflection on the curve showing the growth of this power, which is due to technological instability and the movement towards large screen sizes. This could result in an increase in power consumption of television sets as a whole over the coming years, which justifies taking account of achievable energy saving potential in this field.



6.3. The place of energy efficiency criteria.

- The effect surrounding technological progress in the field of "brown goods" has to do with the competitive dynamic of the electronics industry, and the energy criterion is entirely absent. This industry is a worldwide oligopoly in which electronic production is dominated by large firms that apply their strategies at an international level. At this level, the business strategies show through in the obligatory formation of alliance networks or agreements centred on

the development and diffusion of new products, strategies in which the energy efficiency attributes of these products are of virtually no importance.

The standard example of a strong strategic stake where energy efficiency appears not to come into the decision making process is the case of high definition television (HDTV) (Bakis 1992). Because of digitizing technology, the television appears as a display terminal that can be connected to different public or private networks. Confirmation of Japanese technological dominance of this product would have the consequence of industrial and commercial supremacy in the mass market electronics sector, with a market estimated at 650 billion Dollars (replacing television sets in general).

Because of this, the divergences observed between the energy efficiency levels of the sets on the market do not arise out of the deliberate wishes of the manufacturers to differentiate themselves by virtue of energy efficiency. They arise above all from the components used and the subcontracting and supply networks specific to each constructor.

Downstream, the routines associated with distribution circuits and salary structures in the sales system eliminate any incentive to promote energy efficient television sets as it is the general case for mass market products. Thus, the remuneration of sales staff is calculated on the basis of commission on sales, with sometimes a guaranteed basic determined, which encourages the salesmen to try and sell brands on which the commission is highest. Any objective involving sales staff in a process seeking to encourage the sale of energy efficient sets must take account of such rules governing the activity, in order to embrace or modify by them using other kinds of salary-based incentives.

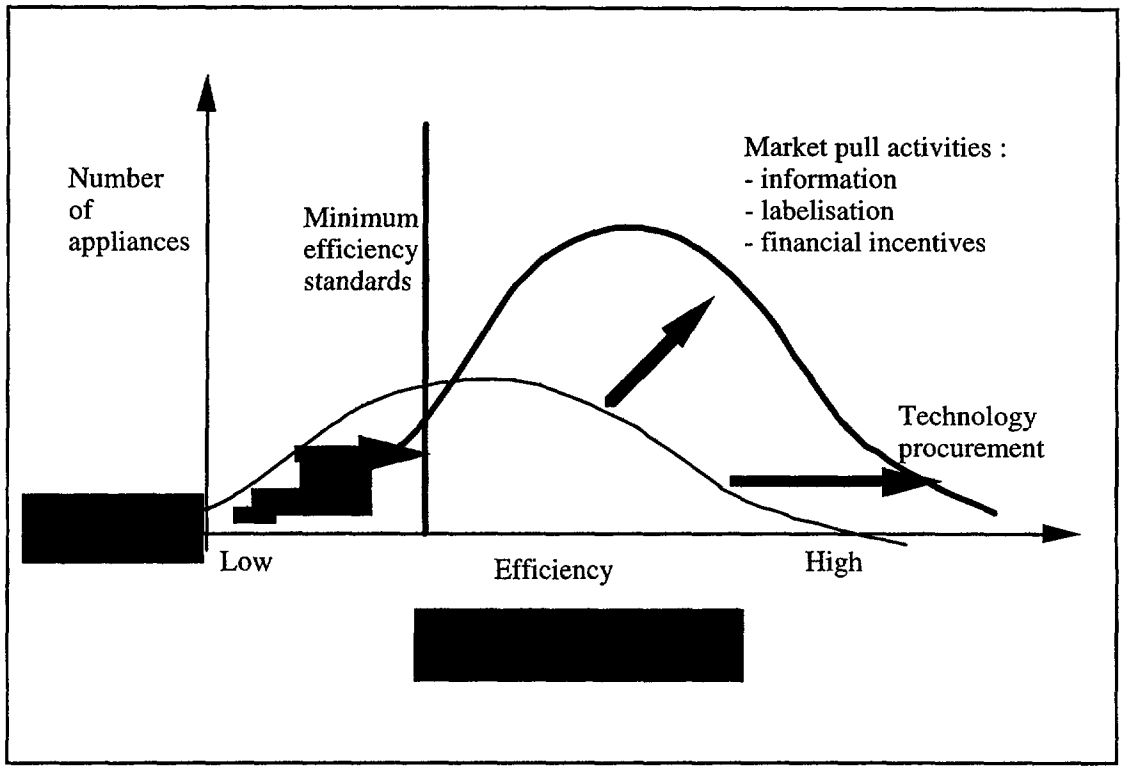
With regard to this analysis, the search for energy efficiency in the case of "brown goods" seems much more difficult to implement than is the case with refrigerators, because of their specific nature : non-stabilized functions, highly evolutive technologies, the importance of user behaviour and its status as a strategic sector. The promotion of energy efficiency by means of over rigid instrumentation is seen as something that must be avoided.

7. TOOLS FOR STIMULATING THE MARKET

A brief examination of the mechanisms for innovation and spreading more energy efficient mass market products demonstrates the low sensitivity of the market to the "energy efficiency" attribute. Lack of interest on the part of consumers in running costs in general, even more when linked energy costs are low, their hypersensitivity to selling prices, and the complexity of their choice criteria, etc constitute just as many constraints to the diffusion of energy efficient products.

For their part, manufacturers are not motivated to bring their research effort to bear on the development of more efficient sets, and rarely regard the energy efficiency of their products as something giving them a competitive edge.

Public policies have been put in place in many countries seeking to move the spontaneous working of the market in a direction more favourable to energy efficiency. These programmes may be divided into three main categories (the impacts of which are shown in fig. 2) : (i) actions intended to guide consumer choice towards the more efficient products by appropriate information (labelling) or financial incentives, (ii) actions seeking to remove the less energy efficient products from the market (standards or voluntary commitments), and finally (iii) actions directed at manufacturers to encourage them to develop and market more efficient sets. The balance sheet for policies of this kind introduced for CFLs, refrigerators and televisions enables us to obtain information on the various possibilities of stimulating the markets.



7.1. Stimulating consumer choice by information and financial incentives.

The aim of labelling programmes is to provide consumers with better information enabling them to compare the energy efficiency of certain products. The annual power consumption of each appliance is clearly shown, some times translated into running costs. It is then possible for the consumer to estimate the maximum acceptable extra initial cost as a function of expected savings in running costs. In addition, labelling also makes it possible to rate the model in question on an energy efficiency scale. This classification of products on an efficiency scale turns out in practice to be more effective than displaying the actual energy consumption of the appliance (Wilkenfeld, 1993).

Thus, labelling programmes exist in several countries (notably Canada, the United States and Australia), and a similar procedure is being introduced at European level, with an information sheet stating the annual energy consumption and the energy efficiency level of refrigerators and freezers. Some of these programmes have had a measurable impact on energy consumption : in Australia, for example, it is estimated that the total power consumption of the appliances sold in 1992 would have been 11% higher in the absence of labelling (Wilkenfeld 1993). However, the majority of the observers generally agree to recognize its limits (cf MacMahon 1991 on the American experience, for example). Labelling does not prevent the appearance on the market of low efficiency products that continue to be preferred by certain consumers who are mainly concerned with the selling price. It would moreover have a limited motivating effect on consumers in the case of "brown goods" where the act of buying is more subjective than objective and the energy efficiency attribute is of little, if any, influence.

In the case of CFLs, within the framework of DSM programmes, the electricity companies have carried out various activities to stimulate the market, centred mainly on consumers [3] : information campaigns, labelling actions or the provision of information about the reality of efficiency levels claimed by manufacturers, etc. However, financial motivations, in the form of subsidies on the prices of the bulbs, have been the most common.

In Europe more than 50 DSM programmes may be counted addressing improvements to the energy efficiency of lighting (Mills 1993). These programmes involved more than 7 million European households and made possible the distribution of 2.5 million bulbs. In Guadeloupe, in particular, the EDF-Ademe joigned project made it possible for 360,000 bulbs to be distributed in a few weeks, i.e. a participation rate of nearly 40% of households, with an average of 8 bulbs purchased per participating household.

In a much more marked way than in the case of refrigerators, market stimulation activities in the form of information campaigns (labelling) and financial incentives, have had an impact on the CFL market with knock-on effects on selling prices. The specific characteristics of CFLs, which mean that brand criteria or differences between models are of little importance, have certainly contributed to this. It should finally be noted that the involvement of other players apart from the electricity companies and their willingness to co-operate, lighting manufacturers and the distribution sector in particular, has been an important factor in the efficiency of the measures taken.

7.2. Energy efficiency standards and voluntary commitments

The aim of energy efficiency standards is to bring about the gradual disappearance from the market of the less efficient appliances by imposing a minimum level of energy efficiency. The possibility of defining the minimum energy efficiency threshold to be met, and therefore the radical impact of introducing the standard on to the market constitutes an important characteristic of the standard in relation to labelling programmes. It is also important to stress that the standard does not apply only to very high consuming appliances. On the contrary, it can apply to a very significant proportion of the market : in the United States, for example, only a very small percentage of the models marketed in 1989 were compatible with the future 1993 standards (Geller and Nadel 1994)

In the case of refrigerators, it is generally believed that the impact of energy efficiency standards could be very significant. In the United States, the impact of the 1990 and 1993 standards (not limited to refrigerators) on peak electricity demand could reach 7500 MW in 2015 (MacMahon et al 1990). According to a study conducted by the European Commission, the introduction of "long term" standards on refrigerators and freezers, using the "technical and economic" method[4] would lead to a reduction of 40% in the energy consumption of refrigerators and freezers in Europe in 2015, i.e. of the order of 50 to 60 TWh.

Manufacturers are not usually in favour of the introduction of standards of any kind, particularly energy efficiency standards. Their arguments, some of them acceptable, draw attention to the administrative costs involved, which would be very substantial, adaptation costs that cannot always be passed on to the selling price, the limiting of choice prospects for the consumer (eliminating bottom of the range models, suspending certain options that consume too much energy, etc), and problems of compatibility with other regulatory measures (e.g. the elimination of CFCs), etc. However, they are more favourable towards voluntary commitments by which they suggest energy efficiency targets and a timetable for meeting them, often negotiated with the public authorities. These commitments enable better account to be taken of the industrial constraints involved in adaptation and development of new products. Experience nonetheless shows that in order to be effective, they must often be associated with the threatened introduction of a standard if the targets are not reached or the negotiations are too difficult.

Whatever the case may be, with one approach or another, the setting of increasing energy performance levels spread over time today constitutes the most favoured strategy[5] for domestic appliances (white goods). However, regulatory actions are more difficult to envisage in the television sector except for stand-by systems. The manufacturers' argument, which stresses the risk of imposing constraints on the development of innovations in a strategic field in which each country seeks to maintain or extend its position in the race for technological supremacy, is particularly marked. Because of this, and taking account of the apparently limited prospects in terms of energy savings, the introduction of energy efficiency standards for television sets presents a constraints/advantages ratio which is unfavourable from the outset.

It is nonetheless possible to envisage voluntary commitments in this sector because there is already extensive co-operation between the various manufacturing players. Co-operation of this kind has become indispensable for taking account of the systemic nature of the technologies of electronics, and for forming sufficiently powerful networks to seek to impose a de facto technical standard. The existence of networks of this kind represents a favourable condition for reaching voluntary commitments. It is probably insufficient in the absence of particular motivation of manufacturers or a constraining outlook on the part of the public authorities.

7.3. Stimulating the supply of efficient products

The absence of incentives to manufacturers to develop and distribute products with performance levels appreciably higher than the standards is often invoked as a reproach in any move towards introducing a standard. No signal coming from the market would encourage manufacturers to seek a competitive advantage over their competitors by developing highly energy efficient products. For this to be the case, other means of stimulating the market must be

sought, seeking to speed up the appearance and distribution of more energy efficient products, the most significant of which are strategies of the "technology procurement" type.

The basic idea behind "technology procurement" consists of offering manufacturers sufficiently strong incentives to convince them to take part in development and diffusion of highly energy efficient products. This move generally enables the different manufacturers concerned to enter the competition on the basis of a requirements specification setting out the characteristics expected of the product and the maximum energy consumption threshold[6]. The incentive takes the form of a premium or a limit on the uncertainty surrounding outlets in the form of guarantees offered to the prize winner by electricity companies as in the United States or by purchaser groups as in Sweden[7].

This approach has been successfully used to increase the performance levels of the best refrigerators available on the market in Sweden, first of all, and then in the United States with the Californian "golden carrot" programme. In Sweden, the call for tenders launched in 1990 enabled the construction and marketing of a very highly energy efficient refrigerator whose energy consumption is 30% lower than that of the best product then available (350 kWh for a 350 litre refrigerator). As a prize, minimum sales of 500 units were guaranteed and purchasers then benefitted from reductions of the selling price. It is interesting to note that after the appearance of the new model on the market, the unit consumption of the 10 "best" refrigerators fell by 20% under the effect of the competition (Kaza 1993). The introduction of a new, very efficient model on to the market was not, therefore, the only result of this type of programme. Through a knock-on effect, it also led to a process of emulation on the part of manufacturers that appreciably contributed towards modifying supply in this market segment.

On the lighting market, the advantage of "procurement technology" is less clear, as it may be thought that an efficient product already exists, and that it is mainly a question of speeding up its distribution. This approach seems ill-suited to the specific nature of "brown goods". In this sector, in fact, manufacturers do not seek to differentiate their products, but to impose new technological standards. Given the importance of the role played by international competition, energy efficiency targets seem to be of secondary importance, and the "carrots" that could be held out by the public authorities or electricity companies seem to provide insufficient incentive to encourage research in new directions which do not complement well-trodden paths.

8. CONCLUSION : MAKING THE MEANS OF ACTION APPROPRIATE TO EACH TYPE OF TECHNOLOGY

The policies for promoting energy efficiency in the field of mass market products must be thought out as a function of the specific nature of each field. Because of the complexity and the diversity of each technological and manufacturing context, and the functional and symbolic nature of each product considered, an in-depth analysis cannot be avoided in order to define, in each case, the most suitable means of communication/information and incentives to be put in place.

Experience acquired in the industrialized countries over some fifteen years constitutes important empirical material. In the field dealt with here, it shows the novelty and variety of the new modes of co-ordination to be put in place between manufacturers (and component suppliers), distributors and purchasers. Some examples of these necessary co-ordinations follow :

- in the field of CFLs, co-ordination between manufacturers of fixtures and of bulbs, and further co-ordination between producers, distributors and purchasers within the framework of DSM programmes.
- in the field of refrigerators, co-ordination between manufacturers and the purchasers' market, through labelling and standards, or incentives and guaranteed outlets in "technology procurement" programmes.
- in the field of televisions, it is felt that relations between component manufacturers and constructors should be used to assist in the progressive incorporation of more efficient technologies.

Through the clear differences between CFLs, refrigerators and television sets, the preceding analysis shows up two main differentiation factors : consumer sensitivity to the energy efficiency attribute, and the competitive dynamic of the supplying industry. These factors clearly condition the possibilities for action and types of incentive to be put in place.

Thus, the diffusion of CFLs constitutes a stake for lighting manufacturers which arose from their willingness to be involved in DSM programmes, from substantial efforts made over several years to improve the characteristics of

CFLs, and from their own marketing strategies. This commitment is less clear in the case of domestic appliance manufacturers, with the "energy efficiency" attribute not seeming to be considered for the time being as likely to create a competitive edge. It is not at all likely to do so in the case of television sets.

Also, knowing that the main function of refrigerators may be regarded as stabilized[8] which is not the case with televisions, whose technology is evolving very quickly, domestic appliance manufacturers may be encouraged to seek to increase their market share by seeking out new possible ways of differentiating their products using the energy efficiency criterion. There is doubt that this could be the case with television sets, as the audio visual sector is one of competition centred on the possibility of imposing a new standard of high definition television.

The highly differentiated sensitivity of consumers, depending on products associated with the energy efficiency attribute, and the strategic behaviour of the industrial players have thus contributed towards shaping the principles of action for stimulating the diffusion of efficient products in each case, namely :

- an approach favouring demand in the case of CFLs: financial incentives and information campaigns, backed up by the manufacturers' own communication strategy.
- an approach centred more on supply in the case of refrigerators (standards or voluntary commitments and technology procurement) with complementary action on the demand side, with labelling being able to contribute towards developing receptiveness on the part of consumers to energy efficiency, and leading to efforts being brought to bear on the manufacturers' innovation strategies.
- on the other hand, no clear strategy emerges where television sets are concerned, insofar as labelling would probably be inoperative, and standards difficult to introduce for non-stabilized products.

Our understanding of the conditions on which public actions may be effective in relation to the specific features of each field, and on the particular conditions prevailing in each country is still limited and merits further research.

It is clear that the factors that lead consumers to purchase these mass market products are still poorly known. Experience with CFLs shows that it is important to analyse more thoroughly the different categories of purchaser and what motivates them to take advantage of product differentiation, to seek synergies with other attributes and to take advantage of demand dynamics.

On the supply side, our understanding of what motivates manufacturers to seek or not to seek a comparative advantage based on energy efficiency seems to constitute a central question. A clarifying of their perception of the factors and constraints imposed on them, by analysing the competitive environment, inter-company agreements, or anticipating market developments, is indispensable.

Finally, it is clear that the mechanisms inherent in the distribution of mass market products are very badly known, although they constitute a central rallying point of any incentive policy. Identifying the logics and practices involved, and earmarking the resources that would encourage distributors to take part in a market stimulation strategy constitute an important factor for improving the efficiency of public actions.

9. ENDNOTES

1. Refrigerators, freezers, washing machines, tumble dryers and dish washing machines. Source : Ademe, 1991.

2. The term European Community refers here to the Europe of the twelve.

3. In these programmes, priority has been given to CFLs, but some of them applied to refrigerators. In 1992, 28 US electricity companies offered subsidy programmes for the purchase of high energy efficiency refrigerators in the framework of DSM programmes.

4. This consists of defining the optimum energy efficiency levels from the technical and economic point of view, using the combination of possible technical improvements that minimize the life cycle cost. It is distinguished from the "statistical" method which consists of eliminating some of the appliances present on the market in order to achieve a given energy efficiency level.

5. Energy efficiency standards for lighting system components (ballast, bulbs, etc) or standards relating to the overall lighting energy current used in a room or building do exist, notably in the United States. The first ones impose insufficient constraints to limit incandescent lighting in particular. The second ones are mainly aimed at office buildings or commercial premises and are difficult to apply to the residential sector.

6. These specifications of energy consumption levels are also accompanied by requirements of an environmental nature, particularly regarding the absence of CFCs.

7. Housing co-operatives in Sweden represent a very powerful user group: they contribute to the purchase of 170,000 refrigerators / freezers per year, out of a total market of 520,000 units.

8. As could their technical configuration, even if certain options could come to be developed (no-frost, automatic defrosting, etc).

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