Energy efficient office appliances

A case study in the framework of the project 'Assessing innovation dynamics induced by environment policy'

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Contents

Abstract

The paper deals with the influence of public policy on innovations in energy efficiency of office appliances. It focuses in particular on the role of public procurement. There is strong evidence that public policy has played an important role in accelerating the introduction of energy efficient office equipment, especially in the USA and Japan. In the EU, energy efficient public procurement is still voluntary. Many public purchasers do not yet use energy efficiency criteria. Industry considers an obligation to do so an effective and acceptable instrument.The design of the instrument is an important issue, also in the case of public procurement. For example, criteria should be frequently updated. Furthermore, complementary measures (such as education) are needed to ensure that the potential efficiency gains are actually realised.

1. Introduction

Over the past decade, concern has been expressed about the rapidly growing energy use by personal computers (PCs) and other electronic office appliances. A landmark were the publications by Mills (1999) and Huber and Mills (1999), suggesting that as much as 8% of electricity demand in the United States was directly related to internet-linked computer use, and 13% if stand-alone computers and indirect energy use (e.g. to build the computers) are included. They stated that "half of the electric grid will be powering the digital-Internet economy within the next decade." Later estimates arrived at much lower figures. Kawamoto *et al.* (2002) conclude that energy use by office and network equipment is about 2% of total US electricity consumption.

Whatever the right figure might be, it is clear that the increase in the numbers of ICT appliances has been accompanied by a decrease in their specific energy use. For example, over the past two decades the performance of the PC has increased over 400 fold, while the energy consumed by the system is largely unchanged. A primary reason for the relatively low power usage of ICT products can be attributed to the introduction of technologies that 'manage' the power consumption of these devices (Intel, 2002).

The aim of the current case study is to look at the role of public policy in stimulating the development and diffusion of more energy efficient office appliances. In particular, it investigates the specific (actual and potential) contribution of public procurement to this market transformation.

Chapter 2 of this report briefly describes the development of energy efficiency in electr(on)ic office appliances, including the market penetration and prices of energy efficient models. The main part of Chapter 2 deals with the role of public policy, both in the EU and elsewhere. Chapter 3 focuses on public procurement as a specific policy instrument. In Chapter 4, the results of a small scale expert survey are presented and analysed. Chapter 5 summarizes and concludes.

2. Innovation dynamics in eletr(on)ic office appliances

2.1 Evolution of the technology

To some extent, energy efficiency (especially in PCs) may be a necessity for the functioning of the appliance. For example, the processing unit should not become too hot, and laptop batteries should not get exhausted too fast. Therefore, improvements in energy efficiency are partly 'autonomous' developments, without which improvements in performance would not be possible. In other respects, however, lower energy consumption is a feature that can be added to products that in principle might as well be 'electricity guzzlers'.

The first widely used power management technology for personal computers, advanced power management (APM), was introduced in the beginning of the 1990s. Intel, Microsoft and other leading IT manufacturers worked jointly to enable hardware and software interaction, resulting in powermanaged PCs. Since this time, many additions and revisions to this technology have occurred, including APM's successor — Advanced Configuration and Power Interface (ACPI) (Intel, 2002). Another important trend leading to improved energy efficiency of PCs is the shift from traditional cathode ray tube (CRT) monitors towards 'flat screens'.

For other products, such as copiers, energy efficiency improvements also have been achieved by reducing energy use during the time when the appliance is not in use. In the case of conventional copiers, more than 90% of the energy is consumed when they are not being used. Energy consumption can be decreased by reducing the amount of energy required to heat the roller (that applies the toner to the paper). Reducing warm-up times can take away the need to maintain the roller at a high temperature during the whole day. Copiers from Ricoh and Canon received the IEA DSM Award of Excellence. Both copiers consume 70-75% less energy than comparable copiers on the market and use new technologies to reduce warm-up times.[1]

2.2 Market penetration

PCs and other electronic office appliances have rather short lifetimes and the frequency of replacement is high. This implies that a rapid market penetration of innovative energy-efficient models will soon be reflected in the overall efficiency of the equipment in use.

In recent years, energy efficient office appliances have found their way to the market quickly. This is for instance illustrated by Figure 2.2, showing the market share of computers in Japan that met the energy efficiency requirements of the 'Top Runner Program' (see Section 2.4.3). The 100% market share was achieved for all computers in 2002, well ahead of the target year 2005. In the United States, 'Energy Star' compliant office equipment had achieved market shares of 90 to 99% in 1999 (see Section 2.4.2).

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[1] Source: IEA DSM website (http://dsm.iea.org/NewDSM/awards.asp, accessed 22 May 2006).

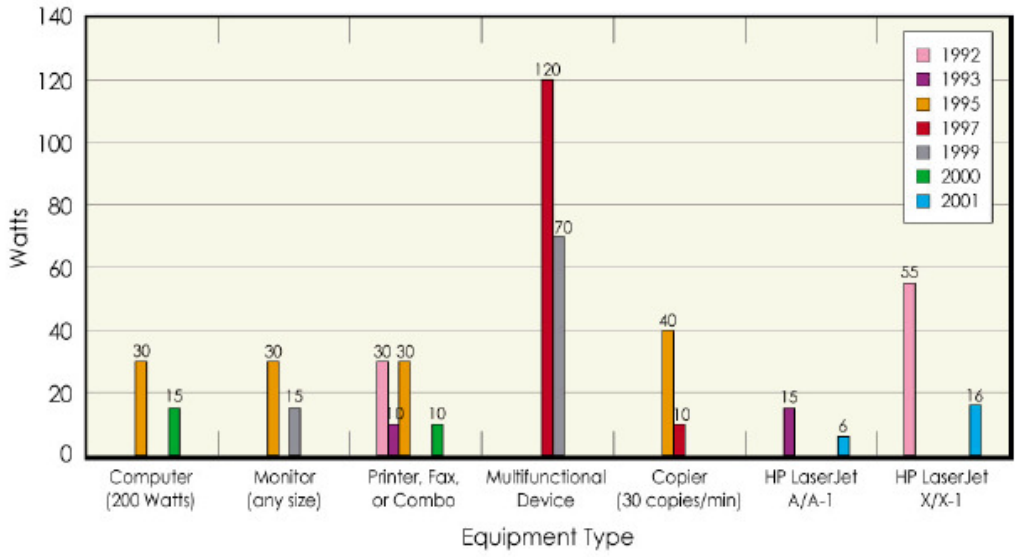

Figure 2.1 Efficiency as a function of product development (Source:Gehl et al., 2005; original source: American Electronics Association, Electronic Industries Alliance (EIA), and Information Technology Industry Council (ITI), 2002).

The rapid market penetration of energy efficient office appliances can also be observed in Europe. In its Communication on the implementation of the Energy Star programme in the EC[2] the European Commission concluded that to date the Energy Star technical specifications are being fulfilled by almost all the models of the five companies that had submitted data (through the EICTA).

The associated energy savings are significant (although small compared to total energy use). For example, the average annual primary energy savings over the period 2000-2010 in case of 100% market penetration for Energy Star compliant office appliances in the United States were estimated at 490 PJ, avoiding 6.7 million tonnes of carbon emissions per year.[3]

2.3 Development of costs and prices

Energy efficiency is usually embedded in a large 'package' of features that characterize a new type of office appliance. This makes it impossible to isolate the development of costs of energy efficient innovations in this area. Generally speaking, the market for office electronics is very dynamic and prices of innovative products tend to drop quickly. An example are the flat computer screens (liquid crystal and plasma displays), which are much more energy efficient than the traditional cathode ray tube (CRT) monitor on a PC. Flat screens now dominate the market and their prices are decreasing, even though they are still more expensive than CRT monitors.[4]

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2 COM(2006) 140 final.

3 Webber *et al.* (2000), table 6. For comparison: total gross energy consumption in the US amounted to almost 96,000 PJ in 2002, and CO_2 emissions from fuel combustion to 5,700 million tonnes (equivalent to 1,540 million tonnes of carbon) (calculated on the basis of IEA data).

4 Analyses of the market for 'flat screens' can be found at http://www.displaysearch.com.

Often the additional costs of incorporating energy efficient features in office appliances are close to zero. For example, the cost of achieving Energy Star efficiency levels was estimated by the manufacturers to be negligible (Koomey *et al.*, 1995).

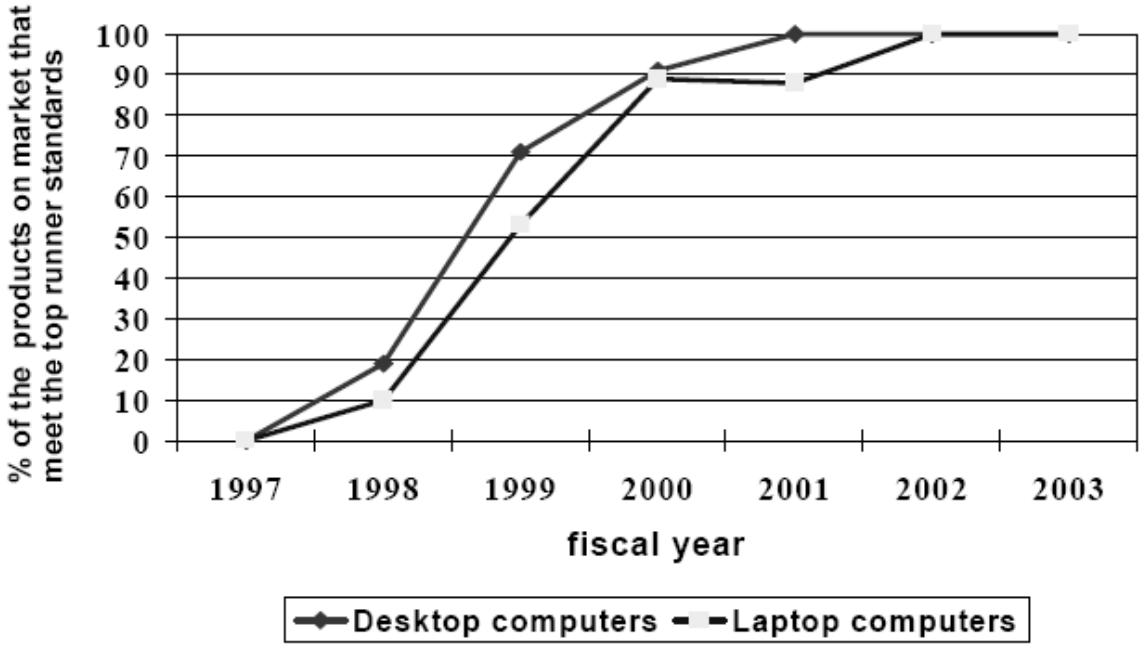

Figure 2.2 Change in the number of personal computers put on market that meet the Top Runner Standards. Source: Naturvårdsverket (2005); original source: JEITA (Japan Electronics & Information Technology Industries Association).

2.4 The role of public policy

2.4.1 General considerations

Public policy can play an important role in the development and diffusion of more energy efficient appliances. Different policy instruments may be relevant in the different stages of the innovation process and their specific function in transforming the market may vary.

Figure 2.3, taken from IEA (2000), shows the possible role of different policy instruments in the process of market transformation towards more energy efficient equipment:

a. Labels, fiscal incentives and other customer focus instruments increase the average efficiency of the market, increasing the market shares of efficient models at the expense of inefficient ones. Also, fleet average standards and voluntary programmes encourage manufacturers to increase the average efficiency of their product lines;

b. Minimum efficiency standards prevent the marketing of low-efficiency appliances. This process is facilitated on markets where labels have already reduced the market shares of the products;

c. Support for innovation and research and development enable new, more efficient, products to be introduced to the market.

Obviously, Figure 2.3 is a stylised representation of the market profile. The relative sizes of the market transformations (a), (b) and (c) can vary considerably. The market transformations also have time and cost elements, which are not shown.

In the following subsections, the applications of these three types of instruments to office appliances in the EU and elsewhere will be briefly described. In the next chapter, the focus is one one specific type of policy instrument for market transformation, namely public procurement.

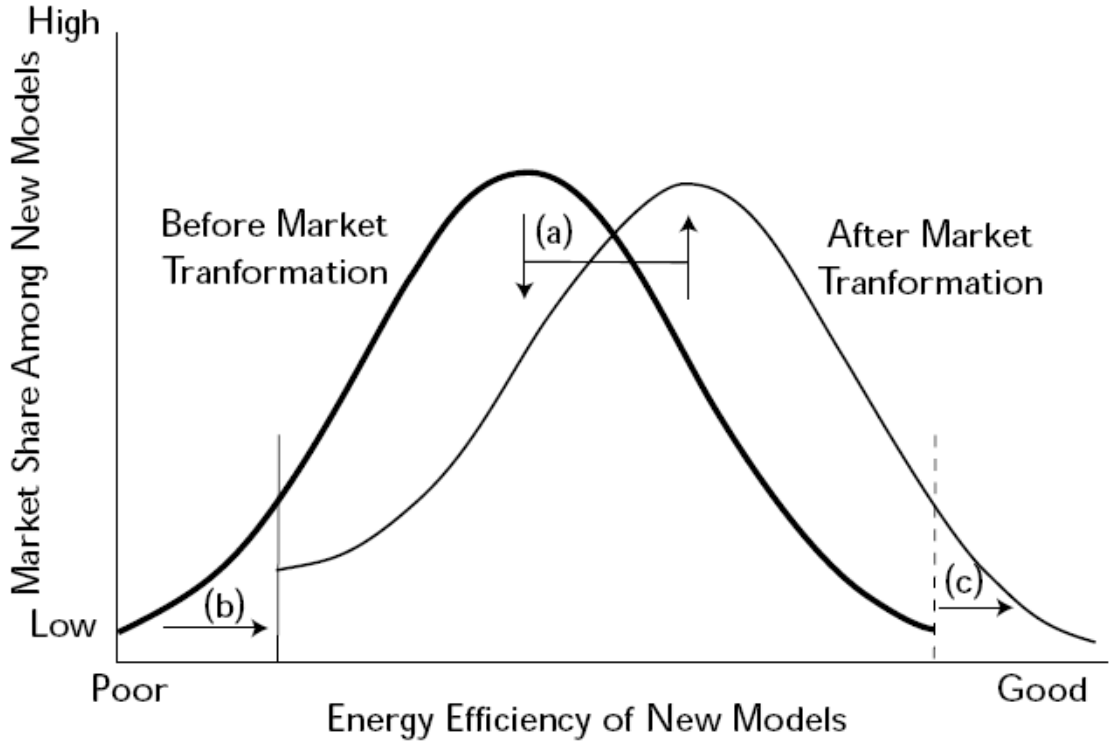

Figure 2.3 Impact of several market transformation instruments on the dissemination of energy efficient equipment (Source: IEA, 2000).

2.4.2 Labelling

The main labelling scheme in the area of energy efficient office appliances is the 'Energy Star'. This scheme was launched by the United States Environmental Protection Agency (EPA) in 1992, as a co-operative program with the manufacturing industry. Computers were the first product category under the scheme. By 2000, market penetration of Energy Star labelled office equipment computers, copiers and faxes had reached rates from 90 to 99% (EPA, 2003). In 2000 the EU joined the Energy Star programme. Revised technical specifications for computer monitors were established in 2004; for computers and imaging equipment (copiers, printers etc.) they are under development.

The EU contributes to these revisions through the European Community Energy Star Board (ECESB).

The European ecolabel ('the Flower') can be awarded to personal computers since 1999. The labelling criteria include requirements for maximum energy in different modes. The original criteria[5] have been revised in 2001[6] and 2005[7]. Table 2.1 shows the development of EU ecolabel and Energy Star energy consumption standards for PCs.

Table 2.1 Development of energy consumption criteria for the Energy Star and the EU ecolabel for personal (desktop) computers.

		Energy Star 1993	Energy Star 1999/2000	EU Eco-label 1999	EU Eco-label 2001	EU Eco-label 2005	Energy Star 2006
Operating mode (idle)	Monitor					23 W*	23 W*
Sleep mode	Monitor	30 W	15 W	10 W	10 W	2 W	2 W
	System unit	30 W	15-30 W**	27 W	5 W	4 W	
Deep sleep, standby or off-mode	Monitor		8 W	3 W	5 W	1 W	1 W
	System unit			5 W	2 W	2 W	

* Higher value allowed if monitor has 1 mega-pixels or more.

** Depending on Power Supply Output Rating (PSOR). If PSOR > 400 W, the criterion is 10% of maximum continuous PSOR.

In addition to the energy consumption criteria, ecolabelled PCs have to meet other energy related requirements, e.g. regarding the time of inactivity after which the computer automatically switches to the sleep mode, and the instructions on energy management that have to be given to the user.

Some national ecolabelling systems, such as the German Blue Angel and the Nordic Swan, have their own criteria for electronic office appliances.

There are also a number of non-public labels, such as the TCO label. Recently, ICT standardisation organisation ECMA launched an 'Eco Declaration Standard', which covers both the product's and the company's environmental performance.[8]

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5 Decision 1999/205/EC.

6 Decision 2001/686/EC.

7 Decision 2005/341/EC.

8 See presentation by Mr Silvio Weeren of IBM at the Green Public Procurement conference on 3-4 April 2006 in Graz (http://www.iclei-europe.org/fileadmin/user_upload/ITC/gpp_2006/presentations/Session_F_SilvioWeeren.pdf, accessed 24 May 2006).

2.4.3 Mandatory energy efficiency standards

Currently, neither the EU nor the US has legal obligations for electronic office appliances to meet certain energy efficiency requirements.[9] Such obligations do exist, however, in Japan and South Korea.

Under Japan's 'Top Runner Program' energy efficiency standards are formulated for various product groups, including copiers and computers. These standards have to be met within 3 to 12 years, depending on the product group, and they are based upon the most energy-efficient model on the current market: "today's best model sets tomorrow's standards" (IEA, 2003). Manufacturers and importers must make sure that the weighted average of energy efficiency of the products placed on the market in the target year meets the standard. In case of non-compliance, a 'name-and-shame' approach is followed and a fine of up to 1 million JPY (EUR 7,000) can be imposed (Naturvårdsverket, 2005).

The South Korean minimum energy performance standards apply to a larger range of office appliances than the Japanese Top Runner programme (in addition to computers and copiers also fax machines, printers and scanners). They are primarily aimed at eliminating the most inefficient models from the market (IEA, 2003).

2.4.4 Support for R&D

Obviously, public authorities can provide direct R&D support to companies to develop new, more energy efficient appliances. However, this would imply that these companies have to make their innovations available as a public good, and they might prefer to patent it or otherwise protect it against competitors. An alternative tool could be to provide incentives and challenges. An example of this approach is the 'Copier of the Future Competition' that took place within the framework of the IEA's Demand-Side Management programme (Westling, 2000).

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[9] In the EU, such binding standards would in principle be possible under the (framework) directive for the Eco-design of Energy Using Products (2005/32/EC).

3. Public procurement of energy efficient office appliances

3.1 Introduction

Public institutions are a major buying party on the market for office appliances. In principle, they can use their purchasing power to stimulate the development and market penetration of 'greener', more energy efficient models. By specifying stringent energy requirements, they can reinforce the position of products meeting those requirements on the market (the right hand part of Figure 2.2).[10]

A substantial demand by governmental and othe public bodies may make it worthwhile for suppliers to bring appliances with improved energy performance on the market. Moreover, the cumulative volume of sales to public purchasers implies a movement towards the right hand side of the 'learning curve': the new product will benefit from economies of scale and learning effects, and prices will tend to decrease. This will in turn make the low-energy appliance more attractive for buyers in the private sphere. In this way the government can act as a 'launching customer' and initiate market transformation.[11]

This chapter presents information on the practice of public procurement of energy efficient office appliances in Europe as well as in the United States and Japan.

3.2 Europe

The European Union supports the use of energy efficiency criteria in public tenders. For example, the recent Directive on energy end-use efficiency and energy services[12] includes an article (5) obliging Member States to 'ensure that energy efficiency improvement measures are taken by the public sector, focussing on cost-effective measures which generate the largest energy savings in the shortest span of time.' They should use at least two out of a list of six measures (set out in Annex VI of the Directive), one of which is the requirement 'to purchase equipment that has efficient energy consumption in all modes, including in standby mode, using, where applicable, minimised life-cycle cost analysis or comparable methods to ensure cost-effectiveness.' In other words, there is no obligation to require the procurement of energy efficient office equipment if other

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[10] Under the prevailing EU public procurement rules, there is considerable scope for incorporating 'green' criteria in public tenders, as long as they do not have protectionist or trade barrier impacts. For a discussion of the issues, see e.g. Erdmenger (ed., 2003), Oosterhuis (2003a,b) and Oosterhuis *et al.* (2003).

[11] Obviously, there are also costs involved in using public procurement as an instrument to stimulate environmental innovations. These costs include not only the possibly higher price of the innovative 'green' product or service, but also the risks involved (including the risk of 'backing the wrong horse'). A cost-benefit analysis of sustainable public procurement has been carried out for DEFRA; see http://www.defra.gov.uk/environment/business/scp/pdf/scp008-final.pdf.

[12] 2006/32/EC.

measures are considered to be more cost-effective. Nevertheless, the option of mandatory public procurement is still being discussed in the framework of the revision of the Energy Star regulation.[13]

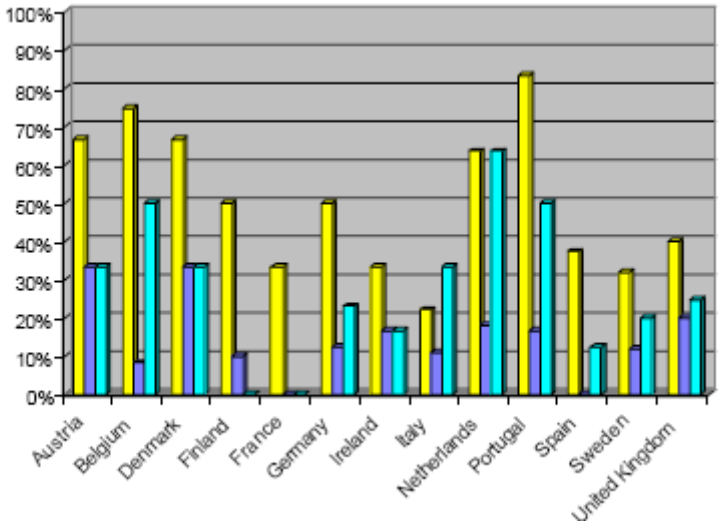

Figure 3.1 Share of administrations requiring energy efficiency standards when purchasing personal computers (yellow column: stand-by mode exists; dark blue column: < 5 W in stand-by mode; light blue column: only flat screen monitors). Source: Ochoa and Erdmenger (2003).

A survey carried out by ICLEI in 2003 (Ochoa and Erdmenger, 2003) revealed that there are wide differences between EU countries as far as the use of 'green' criteria in public procurement is concerned. For personal computers, a commonly applied criterion was the existence of an automatic shift to 'stand by' mode. Other criteria, such as a maximum energy consumption of 5 W in 'stand by' mode or the presence of a flat screen monitor were less frequently applied, and their application varied strongly between Member States (see Figure 3.1).

Bouwer *et al.* (2005) conducted a large survey among public purchasers in the EU-25 on the inclusion of green criteria in public tenders. In the product category 'office machinery' 30% of the respondents claimed that they used environmental criteria (including, but not limited to, energy efficiency) in their tenders 'often' or 'nearly always' (i.e. in 50-100% of the tenders). Another 22% did so 'sometimes' or 'quite often' (i.e. in 10-50% of the tenders), whereas 42% did it 'very seldom' or 'never' (in 0-10% of the tenders). The remaining 6% did not know. An analysis of public tender documents in the same study showed that 44% of the tenders for office machinery were 'not green' (i.e. no green specifications); 6% were 'grey' (attempts for green specifications, but not leading to a greener product), 40% 'light green' (1 to 3 clear specifications) and 10% 'solid green' (more than 3 specifications).

Within the framework of the present study, a small scale additional survey was done to get some more information on the current use of energy efficiency criteria in public purchasing in the European Economic Area. Public institutions who had published tenders

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[13] 2422/2001/EC. See Draft Minutes of the European Community Energy Star Boeard (ECESB), 2 December 2005, Brussels (on http://www.eu-energystar.org/).

for office equipment (computers, printers and/or copiers) in the EU's Official Journal Supplement during March and April 2006 were contacted and asked for their use of such criteria and their motives if they had not applied any. The results are summarized in Table 3.1. The numbers are by no means representative, as only 18 out of the 249 institutions that were approached actually responded, with a strong 'North West European bias'. Nevertheless, it is clear that energy requirements are not yet included in all public tender specifications for office equipment, especially since it is likely that the tenderers that did specify such requirements are overrepresented among the respondents.

The main reason given for not using energy requirements was that other criteria were more important. Apparently, the purchasers involved were afraid that they would restrict their options unduly by excluding energy-inefficient ones. In one case, it was mentioned that before launching the tender the purchasing authorities had already verified that all new computer models on the market were meeting energy efficiency requirements.

Those respondents who did include energy requirements referred mainly to Energy Star or national ecolabel criteria (Blauer Engel or Nordic Swan; the EU Flower was not mentioned at all). Four of them used more general requirements, e.g. the presence of an energy management system, or simply to provide information on energy use.

Table 3.1 Use of energy efficiency criteria in public tenders for PCs, printers and/or copiers, March-April 2006.

Country	***Number of respondents***	***Use of energy efficiency requirements***			
		Referring to Energy Star	***Referring to Ecolabel***	***Other***	***None***
Belgium	3	1		1	1
Germany	2		1		1
Denmark	1		1		
Spain	1				1
Finland	2			1	1
France	2			1	1
UK	1	1			
Norway	4	2	1		1
Poland	1				1
Sweden	1			1	
Total	***18***	***4***	***3***	***4***	***7***

3.3 United States

In 1993, President Clinton signed Executive Order 12845 requiring Federal agencies to purchase computer equipment, specifically personal computers, monitors and printers that met the Energy Star requirements. Largely due to this, Energy Star labeled products soon came to dominate the market. Already in 1999 it was estimated that 95% of monitors, 85% of computers and 99% of printers sold were Energy Star compliant (Webber *et al.*, 2000). According to Siemens (2001), the Executive Order was crucial in creating awareness and the public market for Energy Star products, particularly office equipment. Moreover, extensive promotion efforts to all government levels, tools to demonstrate cost and greenhous gas emission savings, and integration within government procure-

ment catalogues, appear also to have been effective in promoting Energy Star procurement.

3.4 Japan

Japan can be considered to be the international forerunner in green purchasing of office equipment and electronics. Führ (2001) considers this to be one reason for the advanced position Japanese electronics companies have, even on other markets, when it comes to environmental compliance.

In 2001, the the Law concerning the Promotion of Public Green Procurement (Green Procurement Law) that came into force in 2001. As far as energy efficiency criteria are concerned, the Green Procurement Law incorporates the standards developed in the Top Runner Program (see Section 2.4.3). There are currently 12 product groups included in both the Top Runner Programme and the Green Procurement Law. Until 2004, computers were also included in the Green Procurement Law. However, as all the computers in the market have met the criteria, they were taken off the list of green procurement items. With the introduction of new Top Runner standards, computers will be reintroduced in the Green Procurement Law again (Naturvårdsverket, 2005).

4. Expert views

In order to obtain additional information on the perceived effectiveness of public policy instruments on innovation in energy efficient office appliances, a short questionnaire was sent to a number of experts in the area, mainly in the electronics manufacturing industry.[14] Of the twelve experts approached, seven responded. The results are summarized in Table 4.1.

Table 4.1 Summary of expert views on the role of public policy in energy efficient innovations in office equipment.

	Mean	***Range***
Extent to which public policy influences the development and diffusion of energy efficient office equipment (1 = to a large extent; 5 = not at all):		
▪ Development	2.6	1 - 4
▪ Diffusion	3.1	1 – 4
Ranking of policy instruments effectiveness in terms of promoting development and application of more energy efficient office equipment (1 = most effective; 5 = least effective)		
▪ Mandatory energy performance standards	2.4	1 – 3
▪ Mandatory public procurement	1.6	1 – 2
▪ Voluntary labelling	3.0	1 – 5
▪ Instruments causing electricity prices to increase	4.1	1 – 5
▪ Other*	2.7	2 – 4
Agreement with the following statements (1 = strongly agrees; 5 = strongly disagrees):		
▪ Innovations in energy efficiency of office appliances are mainly driven by technological opportunities and market demand. Policies aimed at improving energy efficiency do not really influence the magnitude or direction of innovation efforts in this industry.	2.1	1 – 4
▪ Governments can speed up the market penetration of energy efficient office appliances considerably by using stringent efficiency requirements in their procurement specifications.	2.1	1 – 4

*Instruments mentioned by respondents: subsidies; tax incentives; creating public awareness.

The experts appeared to have quite divergent opinions on the importance of public policy for the development and diffusion of energy efficient innovations. Some of them emphasised the overriding importance of (global) market demand[15] and the general concern about energy issues and climate change.[16] Others pointed to the important role of public

[14] The questionnaire and list of respondents can be found in Appendix I and II.

[15] Even though the public sector is a major buyer of office appliances, it does not dominate the market. For example, the share of the public sector in domestic consumption of 'office and data processing machines' in the EU-15 was estimated at 11.8% in 1995 (Pierrard, 2003, Table 9.1).

[16] As far as diffusion is concerned, some respondents also remarked that protection of innovations by patents may lead to higher prices (due to restricted competition or costs of licensing).

institutions as purchasers of office appliances and to the use of the Energy Star in public procurement, providing a strong incentive to improve energy efficiency. This is reflected in the ranking of policy instruments effectiveness, where a great deal of unanimity exists among respondents. Mandatory public procurement of energy efficient equipment is generally seen as the most (or second most) effective instrument, and mandatory energy performance standards also get a high ranking. Other instruments are considered to be less effective, although the range of rankings given is much broader here. One respondent remarked that the European ecolabel is totally ineffective, since it is not accepted and used by manufacturers.

Several experts stated that the energy efficiency requirements applied in procurement specifications (or in labelling criteria) should not be so stringent that they can only be achieved by a small number of suppliers.[17] The technological possibilities should be taken into account, allowing for variations in product types, performance requirements and functionalities. Measuring procedures and enforcement (avoiding free rider behaviour) were also mentioned as important items.

While keeping in mind the limited size of the sample (and a possible bias in answers due to industry's self-interest), it seems clear that suppliers would support binding instruments to steer the market towards more energy efficienct office equipment. At the same time, such instruments should be designed carefully, with a view to avoiding market distortions and ensuring cost-effectiveness.

[17] According to the Communication on the implementation of the Energy Star programme (COM(2006) 140 final), stakeholders consider that in principle the technical specifications should be set such that at the time of criteria definition approximately only 25% of the models available on the market would qualify for being awarded the label.

5. Summary and conclusions

Office appliances constitute a typical market where public procurement could play a role as a policy instrument to stimulate energy efficient innovations. Government itself is a major demander on this market and the volume of this demand is large enough for manufacturers to adapt their product specifications. Moreover, this large market share also ensures that public demand can 'pave the way' for the rest of the market, because economies of scale and learning effects will lead to price decreases, making the innovative product attractive for other market parties.

Even though there are also 'autonomous' factors, it is evident that public policy has played an important role in accelerating the introduction of energy efficient office equipment. In the USA, the obligation for federal government to purchase Energy Star compliant computers has led to a rapid market transformation in the 1990s. Japan has had similar experiences with its 'Top Runner' program. In the EU, policy makers still seem to shy away from mandatory energy efficient public procurement, even though our findings show that many public purchasers do not yet use energy efficiency criteria and that industry considers an obligation to do so an effective and acceptable instrument.

In a dynamic market, such as the office appliances market, public procurement can only be an effective instrument if the (energy efficiency) criteria are frequently updated so as to take the rapid technological developments into account. If more than 90% of the models on the market meet the requirements anyway, the instrument loses its power.

Obviously, the potential energy savings of energy efficient office equipment will only be achieved if the user acts accordingly (e.g. does not disable the energy management features of the device). In order to be effective, energy efficient public procurement should therefore be accompanied by organisational and educational measures to ensure that the potential efficiency gains are actually realised.

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Appendix I. Questionnaire used in the expert survey

Questions on the relationship between innovations in energy efficient office appliances and public policy instruments

Respondent's name and affiliation:……..

	1	2	3	4	5
1. In your opinion, to what extent is the **development** of innovations in energy efficient office equipment (computers, monitors, printers, copiers) influenced by public policy in the area of energy efficiency? (1 = to a large extent; 5 = not at all) *Explanation:*					
2. In your opinion, to what extent is the **diffusion** of innovations in energy efficient office equipment influenced by public energy efficiency policy? (1 = to a large extent; 5 = not at all) *Explanation:*					
3. Could you make a ranking indicating how you assess the effectiveness (1 = most effective; 5 = least effective) of the following policy instruments in terms of promoting the development and application of more energy efficient office appliances? ● Mandatory energy performance standards for all products on the market (such as in the Japanese 'Top Runner' program). ● Mandatory public procurement of energy efficient appliances (such as in the USA, where public purchasing should include criteria consistent with the 'Energy Star' scheme). ● Voluntary labelling schemes (such as Energy Star or the European ecolabel). ● Instruments leading to electricity price increases (such as energy taxes and CO_2 emissions trading), making low electricity use a more important criterion for the customer. ● One other policy instrument apart from the four mentioned above (please specify). *Explanation:*					
4. Please indicate to what extent you agree or disagree with the following statements (1 = I strongly agree; 5 = I strongly disagree). ● Innovations in energy efficiency of office appliances are mainly driven by technological opportunities and market demand. Policies aimed at improving energy efficiency do not really influence the magnitude or direction of innovation efforts in this industry. *Explanation:* ● Governments can speed up the market penetration of energy efficient office appliances considerably by using stringent efficiency requirements in their procurement specifications. *Explanation:*					

Appendix II. List of respondents

Mr James Booth
Lexmark International

Mr Malcolm Hemming
Xerox Ltd

Dr Reinhard Höhn
IBM Germany

Ms Tiny Huyben and Mr Roy Janssen
Océ Technologies BV

Mr Theo Schoenmakers
Philips Consumer Electronics

Mr Tsukasa Sera
Ricoh Europe

Mr Hans Paul Siderius
SenterNovem