

European Commission

Directorate General Environment

**The Potential of Market
Pull Instruments for
Promoting Innovation
in Environmental
Characteristics**

Executive Summary

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COWI

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The economic, energy and environmental context

Rising global consumption poses an immense threat to our natural environment and climate. The EU's reliance on 3rd countries to meet much of its energy demand transfers output and weakens economic productivity. In order to meet the challenges it will be essential to dramatically change the EU's – and the world's – use of energy and resources.

Meanwhile, the EU sees innovation as both its future source of competitive advantage in the world economy and an area where it under-invests. All three points are recognised in a large number of EU policy and strategy decisions.

Improving the environmental characteristics of products sold – for example greater energy efficiency – is one of the means by which the EU's challenges can be met. Many policies exist at EU and Member State level to promote shifts in products sales towards environmentally preferable products.

This substitution of environmentally preferable products for less green products can result in significant benefits – for example, an average fridge consumes one third of the electricity compared to an average fridge in 1995.

In addition to this direct effect, the indirect effect that increased sales of more energy efficient fridges might have on innovation in energy efficiency should not be neglected as greater current sales of energy efficient fridges led to faster innovation in energy efficiency.

This substitution of environmentally preferable products for less green products can result in significant benefits – for example, if 10,000 A+ classed fridges are sold, in place of 10,000 A classed fridges, the total energy saving in any one year would be in the order of 20% or nearly 600.000 kWh. But this direct effect is only one part of the energy saving. The medium term indirect effect that increased sales of more energy efficient fridges might have on innovation rates in energy efficiency may be even more substantial.

For example, if the rate of energy efficiency innovation for fridges increased from 2%/year to 4%/year, fridges in 10 years time would be 18% more efficient, and each year the additional energy saving would increase – e.g. after 15 years, fridges sold would use 25% less energy than fridges where efficiency innovation improved at 2%/yr. For products whose cumulative EU energy use is significant, this represents an important saving.

Influencing the rate of innovation in the environmental characteristics of products therefore appears to be a potentially very significant means to achieving the EU's environmental and energy policy goals – with a greater potential indirect benefit than direct benefit coming from policies designed to increase sales of environmentally preferable products.

Yet, despite this potential, policy instruments designed to increase sales of products often ignore their potential innovation impacts, and so fail to capture the full environmental and energy benefits that could come from innovation. They also often miss the benefits to the EU economy that would come from greater stimulation in innovation in product characteristics that are likely to become ever more important globally.

The potential of policy intervention

Demand pull instruments

The following policy instruments have the potential to deliver greater benefits from innovation. In this report they are referred to as "market pull instruments" because they work by providing positive stimulus – increasing market demand – for products or services with particular characteristics:

- Mandatory or voluntary eco-labelling or energy labelling schemes
- Green public procurement – GPP
- Innovative public procurement
- Differential tax rates
- VAT reductions/exemptions
- Subsidies
- Scrapping premium
- Feed-in tariffs
- White/green certificates – certification on use
- Awareness/information campaigns.

The chicken and egg dilemma

There is scope for policy instruments to be more effective at stimulating innovation in products, as they can help overcome the chicken and the egg dilemma faced by companies when considering their innovation strategies – and particularly which products they will commercialise and bring to market.

As innovation and commercialisation take time, companies have to be sure that there will be a future market for the product they are considering. They cannot necessarily predict that from the state of the current market, but must look into the future. They see that the future demand for any new product will be shaped by the products on the market then – including competitors' products.

So with demand influenced by supply and supply influenced by expected demand, a company's approach to innovation is strongly influenced by their future market expectations. The suppliers communal view of future demand, i.e. "the market's" expectations, will in fact be a major driver of the rate of innovation.

If these expectations are increased, or if more certainty is given about future demand, innovation rates should naturally rise. The expectations become self-fulfilling.

Perceived future market demand

This is a result of the fact that companies investing in innovation form a belief, rather than a certainty, about future demand. The introduction of the Energy labelling scheme within the household appliance sector illustrates how companies perceive the likely impact on the future market situation and how the scheme eventually shifts demand towards energy efficient appliances. What is interesting is that in 2002 companies were not in a position to predict with confidence the consumer's reaction to energy labelling in terms of demand shift. Instead, they had to have faith that eventually energy efficiency would be an important product differentiator. This faith in the ability of the energy labels to influence demand led to an increase in the supply of energy efficient appli-

ances, secondly consumers started to show a preference for energy efficient appliances and were often convinced enough to pay a higher initial price.

Risk and uncertainty	<p>Expectations and predictions of future demand obviously have a great deal of uncertainty. Companies such as GM respond in part to this risk by investing in a portfolio of future product technologies. Other companies respond by investing less in innovation than they would if they had greater certainty.</p> <p>Reducing the uncertainty about returns on innovation in environmentally preferable characteristics could boost innovation in that area.</p>
Additional potential benefits from market pull instruments	<p>A number of other indirect impacts are also likely to occur as a result of market pull instruments. Such impacts primarily occur on the supply side, for example:</p> <ul style="list-style-type: none"> • increased level of innovation within the companies affected directly by the demand pull instruments; • knock-on effects in diffusion of eco-products to other markets (both geographical and sector-wise) (trickle down and transfer); • as market conditions change manufacturers from other markets or sectors may be attracted bringing in new technologies or innovative concepts.
Trickle down	<p>In the personal computer industry it appears that trickle down of "good" technology does happen. This is component linked with "better" components generally costing more. Their initial use will be limited to the more expensive products in the range. As volume of sales increase, the cost of these components should drop, due to economies of scale. Eventually the component will become ubiquitous in the range. However, if minimum standards are regulated and set at too high a level too quickly this will cause a too high price jump. Lower end products do improve over time, both within a company and in the market as a whole. E.g. business PCs remain better than consumer PCs but consumer PCs of today have the specification of business PCs from 2-3 years ago. The same is true for specification improvements that trickle down from "good" to "bad" companies.</p> <p>Phillips gave evidence that this does happen but can take a few years to spread throughout the product range. The reason for this is simply that the customers who buy the cheapest range are not willing to pay the slight premium that installing the newer component would require. The component will only get into the lowest range when it is produced in sufficient volumes for it to be cost competitive. In other markets this is somewhat negated by some companies adopting the principle of striving for standard global designs in order to reduce component diversity and keep production cost down.</p>
Transfer to other geographic markets	<p>There is evidence that increased demand for eco-innovative products (for example in the EU market) leads to greater diffusion of that innovation into other geographical markets.</p>

With larger markets, and energy and resource use, outside the EU than inside the EU, the impact of transfer of preferable technologies to other markets offers great potential benefit.

Whether these benefits arise depends on the global markets for the products in question.

Textbox: Diffusion of eco-innovation to Chinese market for household appliances

The Chinese market for household appliances is now one of the largest and fastest growing in the world. Likewise the Chinese appliance industry is the largest in the world. In 2006 China accounted for about 70% of global production of air-conditioners, air-conditioner compressors and microwaves, and one third of global production of refrigerators, refrigerator compressors and washing machines.

Likewise, the export of Chinese white appliances is significant (see table below).

Chinese white appliances			
2006	Production	Export	%
	<i>million appliances</i>		
Refrigerators	31	17	55%
Washing machines	30	11	37%
Air conditioners	75	26	35%

By 2004 the EU had become China's main trading partner, while for the EU China is the second largest. China exports appliances to the EU, while the EU's economic involvement in China primarily consists of direct investments plus export of technology and components.

The Chinese export of appliances to the EU fell in 2005 and 2006 following the introduction of various standards and regulations, e.g. WEEE, RoHS, and energy labelling in the EU, which the Chinese products faced problems in fulfilling.

China is now in the process of promoting environmentally friendly white goods through a range of instruments: energy efficient standards, energy labelling, and government procurement. The aim of the Chinese reaction has been twofold: to reduce environmental impact but at the same time to increase Chinese manufacturer's global competitiveness.

The main barriers facing Chinese companies are:

- high R&D costs leading to higher prices for the consumers, which in itself is a hindrance for market uptake of energy efficient appliances;
- lack of technological know-how among Chinese manufacturers to develop essential components (e.g. compressors). Imports are possible but expensive.

Chinese companies are taking the following actions to overcome these obstacles:

- Joint research;
- Promoting technology;
- Market stimulation;
- Policy incentives

Diffusion of (European) eco-innovations impacting the Chinese market takes different routes:

- Direct sales of high-end energy-efficient appliances (Whirlpool, Siemens, Electrolux, etc) produced locally
- Export to the Chinese market of components and manufacturing equipment/know how (with the final appliances often exported back to the EU as a "made in China" product)

- Influence on the Chinese government to promote market uptake of energy efficient appliances. This will create an initial competitive advantage for non-Chinese manufacturers, but when Chinese manufacturers improve their production lines (implementing eco-innovation) this may "backfire" and enable increased EU market penetration by the Chinese.

Source: CASS (2008)

Within the electronics sector, as far as high volume production products (e.g. televisions) are concerned it is often company policy to strive for standard global design in order to keep production cost down. Hence production and design tend to comply with the requirements of the most stringent market.

For a range of bus technologies it is not profitable for the manufactures to maintain production of old and inferior technologies. For example, SCANIA sell around 50 % of their products in the Brazilian and Russian markets, but sell products which conform to EU market specifications.

Where it is economically preferably for manufacturers to meet different market demands (e.g. between China and the EU) from different production lines, diffusion of innovation between geographic markets is likely to be slower.

Finding from literature study

There is a significant volume of studies on innovation systems, including eco-innovation, some work covering the effects of market pull instruments on green consumption and innovation as well as an extensive literature on the extent to which environmental regulations drive innovation within firms. However, only few studies focus on the practicalities of how firms undertake innovation, let alone on the trickle down effects of innovation to other products and markets. The following are key findings of some central studies on the relationship between use of market instruments in environmental policy and the impact on innovation, and on the transfer of eco-innovation to other markets through internationalisation.

It is generally hard to identify the exact impact on eco-innovation of market pull mechanisms because (i) policy instruments used have primarily included CAC instruments, (ii) since a mix of instruments is often used the identification of their individual effects is hampered by data restrictions, and (iii) empirical assessments tend to be biased towards observable information.

Yet, progressively graduated prices have been particularly effective in helping to reduce consumption over time in some countries, and environmental subsidies and incentives (including green purchasing) are effective for supporting the development and more rapid diffusion of new cleaner technologies. Experience suggests that application of subsidies at an early stage leads to further (non-subsidised) technological developments. (EEA Report No 1 2006: *Using the market for cost-effective environmental policy*).

The short-term and long-term impacts of demand on innovation are obvious and statistically significant for specific groups of firms. In particular, firms which export, liquidity constrained firms, and firms not receiving public subsidies or not heading a business group, seem to be particularly sensitive to sales

when deciding how much to spend on R&D. While smaller firms' R&D efforts appear to react less and more slowly to demand growth compared to larger companies, no significant differences emerge between firms in low, medium or high-tech sectors. (IZA 2006: *Is Demand Pull Innovation Equally Important in Different Groups of Firms*).

Reforms are needed to make public policy and regulatory frameworks more conducive to innovation in a range of policy areas from the general business environment - especially in the services, particularly in the network industries - to international trade and international investment, financial markets, labour markets, and education. (OECD - 2007: *Innovation and Growth. Rationale for an Innovation Strategy*).

Both sustainability and growth require increased cooperation between the areas of innovation and environmental policy. Policies should target value chains and networks, especially to involve SMEs. A choice should be made between quick results and large results. Policy instruments should be used in a coordinated manner to achieve the best effect. (VINNOVA 2001: *Drivers of environmental innovation*).

Internationalisation of R&D is characterised by the increasing relocation and outsourcing of R&D activities in order to, among other things, bring R&D activities closer to new markets and tap knowledge sources abroad. Mostly development is outsourced, while basic research is still mainly done at headquarters. Many companies outsource R&D and innovation activities to suppliers, often small enterprises, which in turn must meet their clients' own environmental policies, in addition to or beyond regulatory requirements. This dynamic can stimulate environmental innovation and lead to positive spillovers, but it also constitutes a challenge for suppliers, often small and medium-sized enterprises (SMEs), who have to comply with environmental standards and regulations of many different countries, and meet the internal environmental requirements of their clients. (OECD 2008: *Environmental Innovation and Global Markets*).

How to design market pull instruments to maximise the energy, economic and environmental benefits from greater innovation in eco-efficient characteristics of the products

This study has sought answers to this question through literature research and interviews with a wide range of companies. It provides answers to three important questions that shape the discussion:

- *What factors influence the extent and direction of innovation within companies? And how do these differ between companies?*
- *How are expectations of future market demand formed?*
- *What factors influence the extent and direction of innovation within companies?*

The one universal and driving factor (as for all company decisions) is to protect and if possible increase profits. This desire by companies to maximise profits is a basic assumption of economics and although there is a clear variation in companies ability to do so it lies at the heart of any business decision.

The literature review and interviews made in connection with this study illustrate that there are as many factors and influences as there are companies and the relative importance of these changes (sometimes vary rapidly) over time and varies significantly between both companies and sectors.

Companies are nothing more than groups of individuals and as such they have their own individual and collective view of future trends. This view of the future is highly influenced and informed by the corporate culture and history of the company.

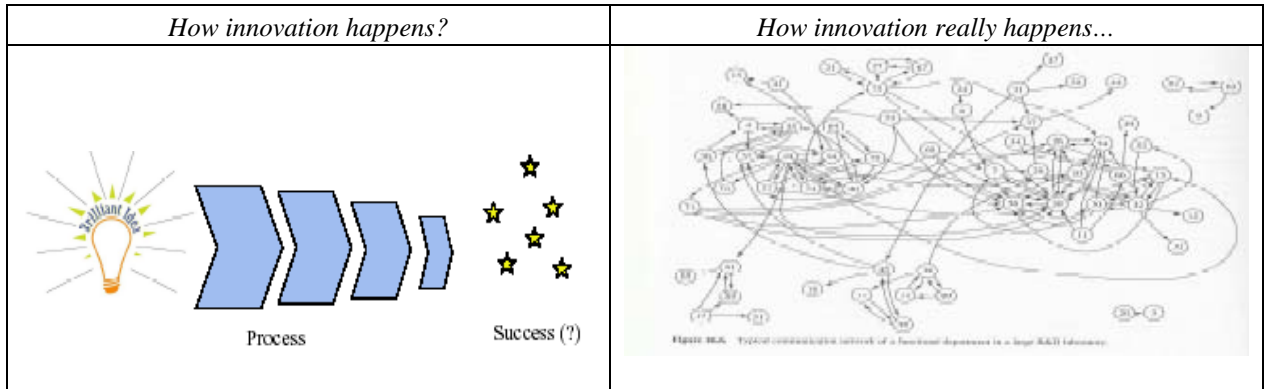
Companies have a wide variety of options available in terms of spending to maximise their profits. Companies will (with a varying degree of rationality and systemisation) compare these competing investments.

The most rational way to do this is to carry out standard investment analysis procedures and compare the relevant rates of return. In order to analyse R&D investments in this way companies will need to include an estimation of the potential benefits that the R&D investment could bring.

There appear to be a limited number of studies which focus on the practicalities of how firms undertake R&D / innovation and a lack of literature on the secondary effects, which are the subject of this study, e.g. the trickle down of innovation to other products and markets.

Linear, push-pull models still influence much practice and debate on eco-innovation and diffusion of eco-innovative products but they have many limita-

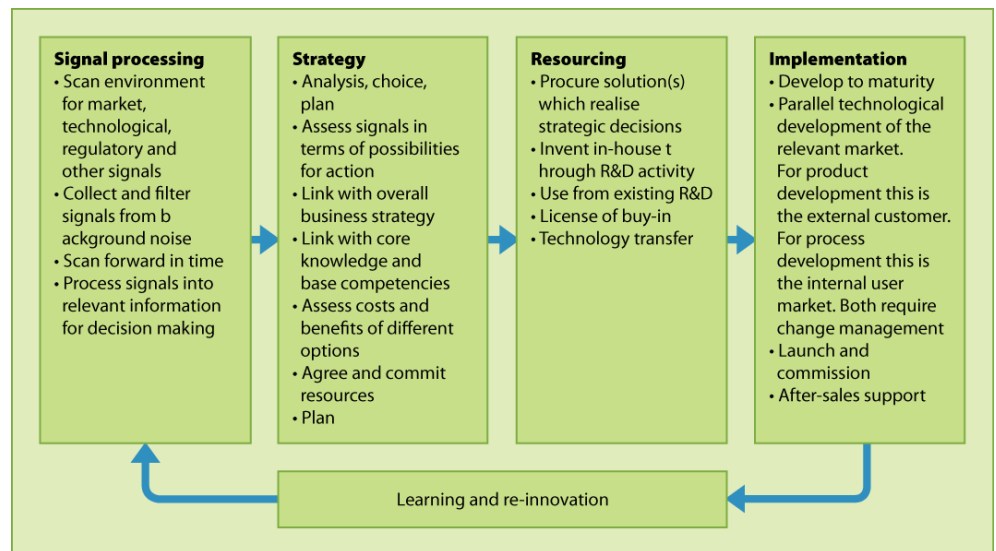
tions. More realistic dynamic models involve complex systems of disruptive and discontinuous events that involve networks of actors and sources, illustrated in the two figures below.



Source: John Bessant, Imperial College: *Developing high performance SMEs* (undated).

Commercial success is very dependent on the later stages of the innovation process, i.e. product development and diffusion.

Companies internal eco-innovation process



Source: Tidd, J. et al, (2005). *Managing innovation. Integrating technological market and organizational change.* John Wiley and sons Ltd.

The above model may be seen as a checklist and crude blueprint for effective innovation processes that characterise the simpler, continuous innovation processes. Here the "rules of the game" in terms of technological possibilities, market demands, competitor behaviour, political context, etc. are fairly clear. However, innovation is sometimes discontinuous in nature. Things happen which are outside the normal frame and result in changes to this standard paradigm.

Innovation processes have to deal with an extended and rapidly advancing scientific frontier, fragmented markets across the globe, political uncertainties,

regulatory instabilities, and competitors who are increasingly coming from unexpected directions. Thus, innovation networks are becoming increasingly important in order to make use of a wide set of knowledge signals needed for effective management of innovation.

Producers naturally seek to differentiate their products on criteria which their customers understand and consider important performance criteria.

Usually, the decision to commercialise is at least as important as decisions on how to invest in R&D. Companies are frequently aware of many innovations which they could introduce into their product ranges, but they choose not to develop all of these into commercial products – as they do not see profits arising from inclusion of those characteristics. This is particularly the case for sectors where significant R&D departments exist.

Timescales matter. For the auto industry, a lead-time of 10-20 years for major changes means that the companies have to start developing the technologies before they are sure that there will be a market for them. The development of such new technological trajectories is extremely costly. Increases in oil prices have increased interest in alternative fuels and more efficient engines, though market signals also come from public opinion and governments' intentions.

At the other end of the scale, the domestic detergents sector is highly competitive with product differentiation mainly achieved by marketing, e.g. product appearance and packaging. The products are relatively low tech, with a short lead time, meaning that "new" products have to reach the market quickly in order to offer a return.

Customers make purchases based on non-logical criteria and companies' prime goal is to make profit so in many cases even cost-effective (in terms of lifetime cost) innovations and products do not succeed.

Major step changes in products are often not introduced to the mass market due to the "cost chasm" of meeting the costs of the new product before the extra incomes it should generate are available, because diffusion (so sales) of truly new features is often slow.

From the policy side, innovation is influenced by the availability and ease of access to:

- R&D programmes
- Research funds
- Pre-commercial procurement
- Venture capital
- Innovative financing mechanisms.

Company-specific factors

Innovation is further affected by a series of aspects characterising the individual company that may be referred to as "company push factors":

- Size

- Company nature / history
- Supply chain position
- Competitive edge (market leader, follower)
- Green / CSR policies
- Path dependency issues
- Capital availability
- Technology spill-over.

These company characteristics contribute to determining the kind of products and services that a company brings to the market, affecting product dimensions such as functional properties (high end, low-end), immaterial properties, and environmental properties (energy and material use, emissions). And so they affect the response that companies, or sectors, will have to policy instruments designed to stimulate innovation through increasing future demand.

At the micro level, the demand-pull effect plays a varying role for the different sub-samples of firms. In particular, exporting firms, those which are liquidity constrained, those not receiving public subsidies and those not heading a business. (IZA 2006: *Is Demand Pull Innovation Equally Important in Different Groups of Firms*)

Key points on market pull instruments impacting eco-innovation

While smaller firms' R&D expenditures appears to react less and more slowly to the demand evolution in comparison with innovative activity decided in larger companies, no significant differences emerge between firms in low, medium or high-tech sectors.

A small company interviewed as part of this project – Global laser – reported that their small size makes the long term dedication of funds towards innovation difficult. If company incomes drop their entire focus quickly shifts towards maximising profit. Longer term investments (such as eco-innovation) are heavily scrutinised at board level as the return on them is less certain than other potential investments. Such investments will only proceed where a strong case can be made for a related cost saving and/or profit increase.

Policies aiming to increase demand may be particularly important in fostering innovation in specific groups of firms (such as liquidity-constrained firms).

It is clear that *expectations* of future market demand (that the R&D would enable) are key to this process. Some companies, particularly large ones, do include such data in their analysis, though they are by nature not fully predictable and will include a range of possibilities.

Cultures and innovation processes

All innovation (including eco-innovation) is clearly strongly linked to corporate culture and strategy. Corporate "Green" image is important for all of the multinationals spoken to as part of this study (e.g. SAAB (GM), SONY and Philips). For example Philips has set a target that 30% of their product range should be differentiated on green credentials by 2012. Likewise, SONY has a corporate target of achieving a 20% improvement in the energy efficiency of their product range every 5 years. For these companies investments in eco-innovation have a high priority and there is confidence that it will pay off in the long run through

sustained sales. However it is clear that eco-innovation will not be commercialised if the companies feel that it would impose an increase in product cost that consumer demand is unwilling to bear.

Technological development is not only achieved via top-down decisions, but also through bottom-up inputs, with some eco-innovations taking place because the employees come up with new solutions. The corporate culture (path dependent) of innovation in car companies is especially stated as an important driver of eco-innovation. For instance, the image of SAAB has always been "safety" and now having a "green" image is a prime motivator.

Textbox: Approach to and types of innovation

Fujitsu Siemens computers described their approach to innovation and the two different types of innovation process in the company:

1. Standard product development for all new and existing products. There is a set of criteria defined for the engineers to design the products to meet.
2. Product independent innovation. All employees (and others) are encouraged to bring forward ideas against five corporate "intents", one of which is green. However an idea which substantially increases costs (though makes a greener product) is unlikely to make it into production models.

Source: Fujitsu Siemens.

Eco-innovation in electronics, bus, car and truck industry

The car manufactures interviewed as part of this project are all deeply involved in eco-innovation. For example a leading corporate philosophy within both Honda and Toyota is continuous improvement of efficiency and functionality of their products.

Demand for eco-innovation impacts directly on the innovation process in the sector. Particularly for buses, coaches and trucks the innovation to enable more energy efficient vehicles is directly connected with customer demand. Increased future demand for more energy efficient vehicles is therefore a key driver for the industry to innovate.

Degree of investment required

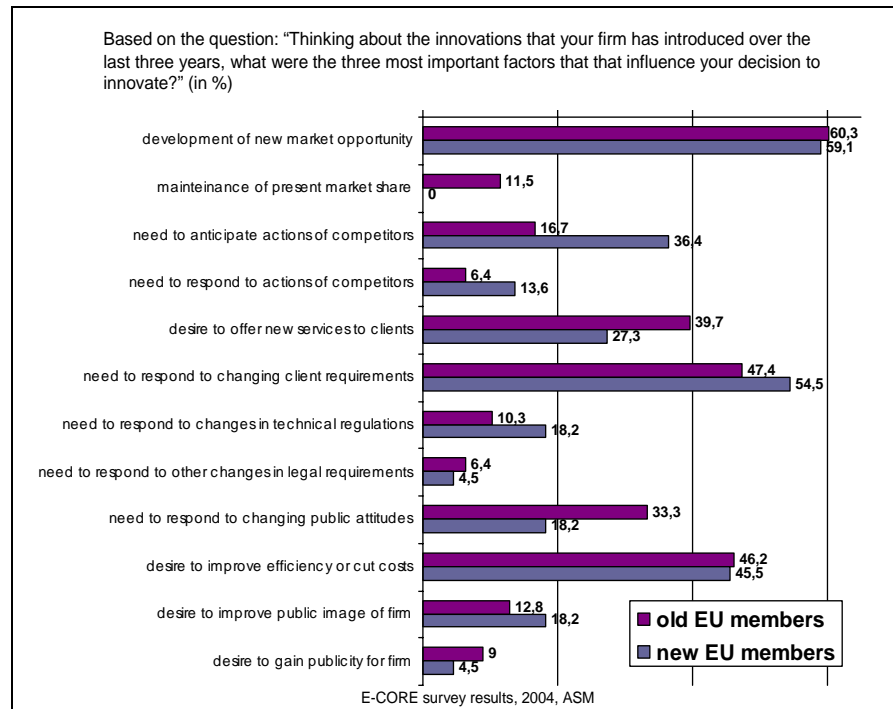
In order to impact on the decision making in the vehicle manufacturers the demand for the innovative products must constitute a considerable share of the market, as it is very expensive to develop new technologies in the industry.

Structure of the industry

Innovation is affected by the way signals are sent through the supply chain and by whom expectations of current and future market demand are formed. For example, in the construction industry, there is only a limited direct link between those who design and construct the buildings and the ultimate users. Thus, the users' demands and wishes tend to be obscured by other considerations. The final construction product, be it a residential house, office building or other product, is in most cases the outcome of interactions within the construction process rather than of continuous dialogue between the suppliers and the users and clients. The actors of the supply chain primarily react to what their respec-

tive clients request up and down the supply chain (immediate customer driven) and the expectations of new markets opportunities (additional profit motive).

Figure: Main drivers of innovation in the construction industry



Source: E-CORE (June 2004): Survey on attitudes to innovation. ASM, Poland.

A survey has investigated the main drivers of innovation in the construction industry, see table above. The survey seems to be the first of its kind to describe innovation issues in the construction industry in broad terms.

While the survey did not ask companies about the drivers of eco-innovation directly, significant drivers of innovation in general were found to be:

- development of new market opportunity (59-60%);
- need to respond to changing client requirements (47-55%);
- desire to improve efficiency or cut costs (46-47%);
- desire to offer new services to clients (27-40%).

Different motivation for innovation

The preparedness for change and the motivation and nature of innovation vary among the actors in the supply chain. As an example, for contractors in the construction sector informal innovation based on the know-how of the staff on site is predominant. Furthermore, contractors that are part of large construction companies with a large financial base are more inclined to engage in innovation than small companies with a limited financial base. The same applies to product manufacturers. Larger ones are more likely to be involved in radical innovation projects, e.g. relying on new materials and ICT, while smaller ones with less capital normally engage in less pioneering innovations, as they also tend to be more risk adverse.

If a business case for undertaking R&D in a new eco-innovative product used in construction is more promising than one of a less environmentally friendly nature, the former will gain support over the other.

Some larger product manufacturers have funds available for more innovative and risky eco-innovation projects in the form of venture spin-offs. This is where some of the more radical innovations take place. However, that depends on sector structure – the construction industry is characterised by many SMEs so there this is the exception rather than the rule.

Supply chain fragmentation

The fragmented nature of the supply chain is a strong barrier to increased eco-innovation in the construction industry. Where nobody stands to gain immediately from eco-innovative initiatives, the incentive to be first mover is less pronounced. This is the biggest impediment to eco-innovation in the industry. Some companies see supply chain cooperation as being strategically important, but many others have to be forced to enter into it.

Demand fragmentation

Attention must be given to the potential for transmission of incentives for stimulation of demand for products. In construction, the most influential actors of the supply chain as to the direction of demand and innovation are often not the owners- and especially not tenants and other users – but the engineering firms, architects, design firms etc i.e. the decision makers in construction projects, who may not be bearing the costs of a product, so may not be influenced in the same way by incentives.

Internal innovation structure

The innovation structure and process varies considerably between companies. Some larger companies with corporate policies and strategies, including R&D, have many production companies, often organised as subsidiaries. Some of these are in other parts of Europe or the rest of the world. For those companies core or more radical R&D is undertaken at headquarters level. The “intermediate” R&D results are further developed and adapted to local conditions at the companies' production units in its home country or in other countries. In this way eco-innovation is diffused to other countries in the EU or elsewhere. The centralised approach to core innovation activities is among other things explained by a need to ensure critical mass of technical and financial resources to be able to undertake complex and costly projects.

Product manufacturers and suppliers base their business decisions on what they expect their potential customers, present and future, require from suppliers when construction projects are tendered. This demand assessment is in turn based on past behaviour of their customers, their own judgements of where demand is moving in overall terms, i.e. mega trends. The product manufacturers have to make their own demand projection in order to decide on the right innovation direction and timing. They also carefully follow the development of policy instruments, especially the larger firms. Smaller companies have less capacity to do so and are generally less inclined to engage in major innovation projects, including eco-innovation, but tend to be more involved in adaptation.

Factors influencing demand expectations

The universal response to the question of what determines decisions on innovation was that customer requirements (market demand) are the prime driver of virtually all company decisions, as the company will see the sales of its product and hence profits, reduced, if these requirements are not met.

In all sectors companies reported that a key source of data on future demand expectations is current demand for both their own and competitors' products. If a product, which is differentiated on a particular aspect (such as its "greenness"), is seen to be gaining an increasing market share this will raise interest and increase the likelihood of products with this differentiating feature.

How expectations of future demand are formed

In addition to current sales information, for both their own and their competitor's products a company's view on future demand is influenced by their knowledge of the speed of product innovation that has *historically* been possible, so for example in consumer electronics, rapid product development is the norm.

Expectations of future market demand change over time. They can be heavily influenced by marketing and by external events (e.g. oil price rise). Expectations are based on many things expected to influence demand, including:

- Mega trends (climate change, energy prices, environmental degradation, water shortages, etc)
- Socioeconomic trends (consumer behaviour, political consumers, dematerialisation etc)
- Purchasing power (performance of national economies, distribution policies etc)
- Marketing campaigns and information from industry
- Demographic trends
- Globalisation.

Fijitsu Siemens stated that if a new buying pattern is seen to be developing (e.g. encouraged by a new energy label at EU level) this will significantly influence the focus of innovation. In terms of getting information on customer requirements they do ask customers directly but this sometimes gives misleading answers. Information is also collected by looking at what competitors offer and actual customer sales.

When questioned on the sources of their market demand information Global Laser reported that it mainly comes from customers. Trade journals and fairs were also used with particular reference to gaining information on what their competitors are doing.

Corporate culture

Other drivers of innovation include a corporate culture / commitment to "constant improvement". For example Sony reported that innovation is ranked second only to profit in terms of corporate aims.

Phillips reported that their view of the market and opportunities is key in terms of how they orientate their research and development. All potential R&D investments and product concepts in Phillips go through a standard process of "building a value proposition". An important part of this process is identifying consumer needs/wants and the trends apparent or predicted to influence these, this includes consideration of the wider influences on future purchasing patterns.

In some product markets, particularly those within the supply chain, i.e. component suppliers and those of a business-to-business nature the consumer is very well informed as to the specification they require. In these markets the customer is clearly the key information source on future demand expectations.

The role of NGOs and consumer organisations

The role of NGOs such as Greenpeace and consumer organisations should not be underestimated in terms of their influence in shaping future demand but also directly on company decision making. For example, Greenpeace published a guide to Greener Electronics, in which Apple, which got high marks for removing PVC and BFRs from products, announced shortly after the guide was released that it would be shipping the iPhone 3G with paper trays made from potato starch instead of plastic or Styrofoam.

Regulatory influences

Clarity of future policy direction has an influence on the strategic decision-making of companies in relation to eco-innovation, as this too influences expectations.

For the bus market, environmental regulation and customer demand are the two main factors influencing demand expectations and hence influencing innovation decision-making.

Sector and product characteristics where market pull instruments have greater potential to stimulate innovation

Sector characteristics versus effectiveness of demand pull instruments

This is an area where the study has not found any firm or conclusive evidence. However, based on the findings of this study it is possible to provide the following suggestions as to what factors should be considered when assessing the potential costs and benefits of eco-innovation.

Factors affecting the extent of the innovation effect

Mature product markets with relatively standardised products appear likely to respond well to demand pull (e.g. energy performance labelling). The reasoning is that a labelling scheme indicating "best in class" can act as a new product differentiator in an otherwise "dull" market, and will provide a new incitement to compete and hence steer innovation investment into eco-differentiation.

The construction market is more complex as they consist of many products or services coming together to provide the final user with a product, e.g. a house or an office building. The fact that the purchase decision is actually multiple decisions concerning multiple components with numerous value chains is one aspect of the complexity. In addition many of the purchasing decisions are not made by the final user, meaning that there are multiple incentives at play. Therefore designing a single demand pull instrument which meets the needs of all of these groups and helps promote eco-friendly decisions is very complex.

Size of the available "pool" of technology

On the assumption that if there is an available technology or approach that has not come to market, or only exists to serve a small niche market (like the low energy tumble drier which had been available prior to the energy labelling scheme but was only purchased by the most well informed and energy efficiency committed of purchasers) the market pull mechanism will strongly encourage its uptake. The problem with this factor is that it is difficult for those outside of the industry to know what "unused" technology companies have "on their shelves" or what could be transferred from for example commercial driers to domestic driers or business PCs to home PCs. It may also be the case that companies will have innovations available that no one outside of the company knows about.

Factors affecting the extent of the potential environmental benefits from innovation

- ***Energy intensity and scale in production and use.*** This is the most obvious factor to consider in a top down approach to identifying the most rewarding sectors and products to focus on in terms of maximising the potential CO₂ and other emission savings.

- ***Trickle down potential.*** There is clear evidence of "good" technology trickle down in televisions and PCs. The factors which appear to be conducive to this include the speed of development in these sectors, which implies that economies of scale are relatively quickly achieved. Another factor, which was reported for televisions but appeared to be less the case for PCs, was an approach to manufacturing which aimed at maximising international standardisation of components. This means that companies will produce products to be compliant (and attractive) in the most demanding market. Therefore if, for example, the EU introduced a demanding standard for television energy efficiency the required approach would quickly become the global standard.
- ***Commonality of components.*** This is included on the basis that where a product uses components that are also used in other products and sectors it is a fair assumption that the larger this degree of cross-over is the larger is the potential for innovative technologies to be either already available in another application, or to become available in another application and then cross-over.

Recommendations for enhancing market pull instruments

The key hypothesis underlying the study has been (for which evidence has been found) that market pull mechanisms do in effect increase demand for products demonstrating the environmental aspect being promoted (e.g. energy and material efficiency, absence of harmful chemicals, etc.). The study has also found evidence to the effect that expectations of increased demand for a particular environmental product characteristic do increase manufacturers propensity to invest in innovation to enhance this characteristic.

Market pull mechanisms are recognised as very useful tools in assisting customers and companies in this but there are varying opinions between firms on the optimum design of such mechanisms. For example concerns over energy labels for television sets among some companies include:

- Label targets will be seen as the end goal of innovation and once these levels are reached innovation efforts will reduce;
- The vast majority feel that market pull mechanisms are an excellent policy tool, with the opinion summed up by the Phillips interviewee who said of them that "If well conceived they are one of the most natural things for companies to respond to".

Qualities of demand pull instrument to be most effective in promoting eco-innovation

Well designed policies will stimulate eco-innovation. Good design points include:

- Future visibility, clarity (of aim and design) and commitment;
- In line with industry/ sector development cycle, varies by sector/product;
- Flexible and dynamic e.g.
 - Label with top rates beyond current best available and minimum standards (cut the tail),
 - Ability to update labels;
- Simple and (continuously) developed with sector – to avoid perverse optimisation by manufacturers, "fair" comparison by product type and purpose;
- Compulsory and consistent (by Member State, ideally global)
- Integrated approach, pushing and pulling all stakeholders and market actors in the same direction;
- Policy design to specifically maximise innovation
 - Links to R&D programmes and information flows;
- Very strongly market / product-specific;
- Holistic best practice in eco-design is very complex, probably best encouraged by routes other than market pull alone, e.g. regulations.

The most important aspect appears to be that they are designed to last over a long time horizon.

Long term perspective to reduce uncertainty

Companies often react in advance to their perception of future market demand, e.g. that eco-innovation decision is taken prior to an actual shift in demand. Therefore it is important that any market pull mechanism has a perspective that is as long term as possible. This long term vision is very important for companies seeking to define their corporate strategy – including the direction and priorities for eco-innovation. A market pull mechanism with a long term commitment (definitions of long term vary from sector to sector), which should ideally aim explicitly at standards well above those currently in force, helps companies justify longer term spending on innovation

This is of particular importance for those sectors where major innovations or even paradigm shifts are required. For example, the case of vehicles powered by bio-fuels, or electric cars where the up front investment is high and the R&D lead times long.

Transparency	The ultimate purpose of the mechanism needs to be clear to all those concerned – purchasers and manufacturers. This should ensure that any innovation is directed correctly. Any plans and schedules to update the mechanism need to be made clear from the outset, with the reasons for doing so also being made clear.
Awareness	Similarly, the extent to which the manufacturers and their suppliers are aware of policy that is likely to change future demand is particularly significant to its potential to change innovation. Communication of the policy is particularly important for SMEs, who may be very innovative, but are much less likely to be aware of policy development than large companies.
Dynamic schemes	<p>Mechanisms should ideally have a built-in incentive to continually strive for best performance. This calls for a dynamic scheme, for instance an A to G energy label where the A level moves up in line with the current "best in class" on an annual basis. The frequency of this updating needs to be in line with the speed of development that is evident for the sector or product in question. For example in consumer electronics the best performance would probably increase quicker than for white goods. Any market pull mechanism would need to keep up with this speed in order to remain credible and fit for purpose.</p> <p>The link to encouraging innovation here is that without a dynamic label there is a significant risk that companies will innovate up to the A label standard but not seek to go further. If the speed of update is driven by the regulator there is always a risk that the sector will outpace them in its ability to innovate. This is an area where there is benefit in sector involvement to ensure that this does not occur. A potential model for such sector involvement is the programme committees that are involved with setting sectoral research priorities in the Framework Programme.</p>
Involvement of industry	Mechanisms will benefit from this approach for several reasons. These include ensuring that any targets are not beyond some technically impossible barriers, that the methodology is technologically neutral to ensure no favouritism, and that the timings (for example for any future upgrading) are in line with industry development cycles and typical speeds.
Fair scheme	The market pull mechanism needs to be fair, with the same rules applying for all manufacturers and no obvious bias in favour of one company, for example, a technology which is only used by one manufacturer. This also means that national interpretation of a given instrument has to be as consistent as possible. This quality is of relevance to eco-innovation as without it the market pull mechanism could be accused of "picking a winner" which brings with it the risk of cutting off or becoming a disincentive to research into other potential approaches.

Clear and timely enforcement	Clear rules for enforcement to avoid cheating are important together with confidence in the rigour and appropriateness of the enforcement set-up. The speed with which enforcement reacts is particularly important for fast moving products or products with a short lifecycle and lead-time, such as consumer electronics.
Joint implementation with minimum standards	Many respondents favour a minimum standard for eco-performance to be introduced, to get rid of the 10-15% lowest performing products. This could work particularly well in combination with "best in class" or "power rating" mechanisms. This concept of "cutting off the tail" links to innovation in that it forces the worst performing products out of the market and ensures that products differentiated very largely on the basis of low cost (often achieved in part by using older, cheaper and less efficient components) cease to be available. This can be helpful in convincing consumers to accept the often higher product prices that eco-efficient product need to have. There are clear potential social equity downsides to this – in that less wealthy consumers may be excluded from the market.
Technology neutral	Any scheme should be technology neutral, meaning that the instrument should ideally set up performance targets, e.g. CO ₂ emission level and energy efficiency, leaving the choice of technology to achieve the targets to industry. This is essentially the same point as that raised above under fairness.
Not disturbing the market	There is a mixed view on the use of direct subsidies (e.g. that the consumer receives a discount when purchasing a product with preferable environmental characteristics) as opposed to a tax return scheme or a white certificate. The fear is twofold. First, that a direct subsidy just works as a discount and not as a way of building eco-awareness among consumers. Second that such direct subsidies are often only short term (often due to a dependence on national budgets) and will backfire when the scheme ends – because the product price will then appear inflated. However, a subsidy scheme can be ideal for some product groups such as those which require large up front investment in order to create critical mass in production and to get unit prices down.
Minimum administrative burden	SMEs in particular are concerned with the additional administrative burden associated with any instrument or mechanisms. Relatively speaking SMEs will face a comparative disadvantage to large companies who have relatively more resources to respond to new instruments.

A small company interviewed (Riochem – that produces portable water quality testing equipment) reported that they pride themselves on their innovation but would be wary of the administrative burden of any scheme which required them to provide additional information on the energy use and / or other environmental impact of their products. They felt they would be at a comparative disadvantage to large companies who have more resources to respond. They also felt that in their market the extra burden would outweigh the benefits – due to the low energy use of the machines and the relatively small size of the market.

Global perspective

There is no complete consensus on this issue but the majority view is that industry favours mechanisms which are applied on a scale as global as possible. This has clear innovation benefits in terms of trickle down effects but could well have social exclusion implications for markets where high performing products are too expensive. Other drawbacks include what are essentially cultural differences between the ways in which products are designed and used around the world.

Tackling the right market failures

The reasons for the lack of market uptake of more efficient products needs to be established and the instrument designed to tackle those reasons in the most efficient way. For example, in the construction industry one thing that has transpired from the interviews is that there is a general lack of awareness and information among users and owners of buildings of the potential for energy savings and use of more environmentally friendly products and systems in existing and new buildings. In other words, there is large scope for developing information strategies, including awareness / information campaigns targeted at all levels of the supply chain.

The above recommendations can be used when reviewing current schemes but also when considering introduction of future schemes

Conclusions

Given the great potential of innovation in environmental characteristics of products to bring about environmental benefits over time that may well exceed the direct benefits of policy measures, it is recommended that:

1. Policies to stimulate future innovation in the environmental and efficiency characteristics of products are explicitly considered as part of the environmental and energy policy; and
2. Policies which create demand for better performing products are purposefully shaped to maximise their environmental and efficiency innovation. Ways to do this have been considered above.
3. In order to maximise the take up and benefits available from eco-innovation, policies to promote it need to be designed in parallel with environmental policy, and vice-versa.