European Commission

Directorate General Environment

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

Final Report

February 2009

COWI

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**COWI A/S**

**Parallelvej 2**
**DK-2800 Kongens Lyngby**
**Denmark**

**Tel +45 45 97 22 11**
**Fax +45 45 97 22 12**
**www.cowi.com**

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# Abbreviations

| Acronym | Description |
|---|---|
| A.I.S.E | The international Association for Soaps, Detergents and Maintenance Products |
| B2B | Business-to-business |
| CAC | Command and Control |
| CASS | Chinese Academy of Science |
| CECED | European Committee of Domestic Equipment Manufactures |
| CEPI | Confederation of European Paper Industries |
| CFL | TBC |
| CHP | Combined Heat and Power |
| CO | Carbon Oxide |
| $CO_2$ | Carbon Dioxide |
| COSHH | Control of Substances Hazardous to Health Regulations 2002 |
| CSR | Corporate Social Responsibility |
| CT and MRI scanners | (MRI= Nuclear magnetic resonance imaging) (CT= computerised tomography) |
| DPI | Demand Pull Instruments |
| EC | European Community |
| ECCREDI /BBRI | The European Council for Construction Research, Development and Innovation |
| EEA | European Environment Angency |
| EEV | Enhanced Environmental Vehicle |
| EMAS | Eco-Management and Audit Scheme |
| EMAT | TBC |
| EPBD | The European Energy Performance of Buildings Directive |
| ETS | Emission Trading Scheme |
| EU | European Union |
| EURIMA | European Insulation Manufactures Association |
| FSC | Forest Stewardship Council |
| GDP | Gross Domestic Product |
| GPP | Green Public Procurement |
| IA | Impact Assessment |
| ICT | Information Communication Technology |
| INGEDE | International Association of the Deinking Industry |
| ISO | International Organization for Standardization |
| IZA | Institute for the study of labour |
| MPI | Market Pull Instruments |

| | |
|---|---|
| MPM | Market Pull Mechanisms |
| MS | Member States |
| NIS | National Innovation system |
| $NO_x$ | Nitrogen Oxides |
| OECD | Organisation for Economic Co-operation and Development |
| OEM | Original Equipment Manufacturer |
| OES | Original equipment suppliers |
| PC | Personal Computer |
| PEFC | Pan European Forest Council |
| PWC | PricewaterhouseCoopers |
| R&D | Research and Development |
| REACH | Registration, Evaluation, Authorisation and Restriction of Chemical substances |
| RoHS | The restriction of the use of certain hazardous substances in electrical and electronic equipment directive |
| SME | Small and Medium-sized Enterprises |
| $SO_2$ | Sulphur Dioxide |
| ToR | Terms of Reference |
| UITP | The World International Association of Public Transportation |
| VAT | Value Added Tax |
| VINNOVA | Swedish Governmental Agency for Innovation Systems |
| WEEE | Waste Electrical and Electronic Equipment Directive |

# 1 Introduction

This report constitutes the findings of a study on the potential of market pull instruments for promoting innovation in environmental characteristics. The study was conducted by COWI A/S in collaboration with Ecotec Ltd. The study contract was signed in January 2008, and this report was finalised July 2008.

The study aims at providing an insight into and an enhanced understanding of the extent to which demand pull instruments promote innovation and to investigate the assumption that greater demand lead to greater innovation.

The study builds on the outcome of an extensive literature review; nearly 40 interviews conducted with industry representatives across a total of six industrial sectors, including business associations; researchers; and a workshop.

The study results are the sole responsibility of the Consultant. We highly appreciate the willingness with which researchers, representatives from industry and business associations have shared their knowledge and viewpoints with us for the purpose of this study.

The study is based on in depth investigation of a total of six economic sectors, selected based on their potential for eco-innovation:

- IT/Consumers electronics,
- Household appliances,
- Transport sector,
- Construction industry,
- Pulp and Paper Industry,
- Detergents.

## 1.1 Background

Rising global consumption poses an immense threat to our natural resources and environment. In order to meet EU's and the Member States' climate and resource efficiency goals it will be essential to dramatically change design, pro-

duction, composition and delivery of products and services. This will require innovation in all aspects of the value chain. This recognition is reflected in a large number of EU's policy and strategy decisions.

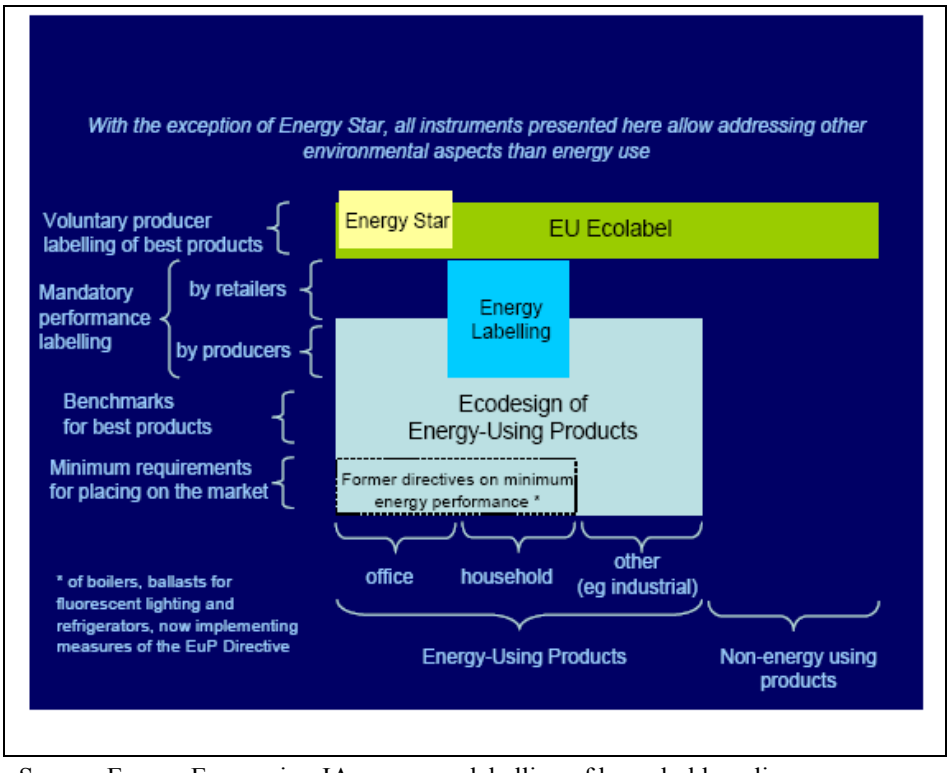
Market pull instruments

Market pull instruments are policy instruments which work to achieve their objective by increasing demand for products or services with particular characteristics. Increased demand for environmentally friendly products is expected to result in a generally higher level of innovation in response to shifts in demand patterns. A number of policy instruments of different nature have been implemented in recent years to facility the eco-innovation process. These include policies such as Energy labelling of household appliances, Eco labelling, Green Public Procurement (GPP) and VAT differential schemes. Green public procurement means that public purchasers take account of environmental factors when buying products, services or works. This is believed to result in stimulation of faster development and diffusion of environmentally beneficial products. Public procurement accounts for about 16% of EU GDP, likely to constitute sufficient critical mass to "green" the supply side by pulling environmentally beneficial goods (Eco products) into the market place.

The relationship between different demand pull instruments is illustrated below in Figure 1-1

In the following we will use the term market-pull policies to cover the various types of labelling initiatives weather these are compulsory or voluntary schemes.

*Figure 1-1 Relationship between different demand-pull instruments*




Source: Europe Economics, IA on energy labelling of household appliances

## 1.2 Direct and indirect impacts

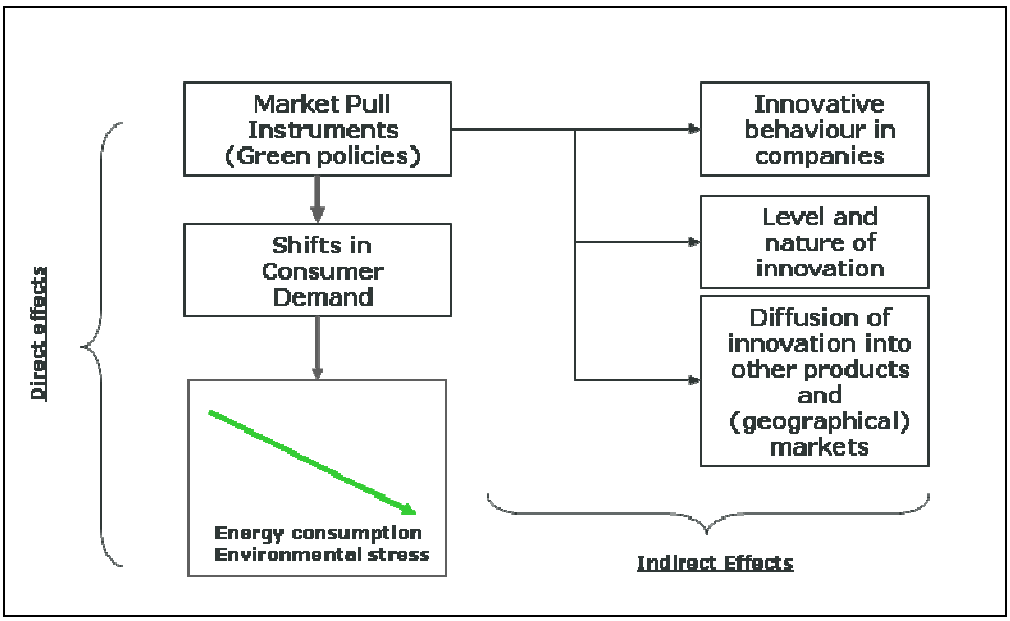
The direct impact of demand-pull policy instruments can be measured by its effectiveness in changing the buying behaviour of the customers towards more environmentally friendly products, e.g. products using less energy, products than can be produced with less material and other inputs, products that cause less emission to the environment, etc.

However, a number of indirect impacts are also likely to occur as a result of market-pull instruments. Such impacts primarily occur on the supply side, derived from change in the company's expectations regarding the market prospects leading to change in innovative behaviour within the company. The following likely reactions on the supply-side are the subject of this study:

- 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);
- as market conditions changes it might attract manufacturers from other markets or sectors bringing in new technologies or innovative concepts.

The causal relationships are illustrated in the figure below.

*Figure 1-2 Direct and indirect effects*




Source: Elaborated by Consultant.

## 1.3 Study objectives

The overall objective of the study is to provide an insight into the observed and perceived impact on how demand-pull policies affect the innovative behaviour within companies and manufacturers. Therefore the study aim is to investigate:

- to what extent a change in demand-patterns for eco-innovative products would result in changes in future innovation in those products (design, manufacture and performance) and the nature of that innovation; and
- to what extent increased demand for eco-innovative products may lead to greater diffusion of that innovation into related products (for example lower specification products) or to other geographic markets and to analyse the conditions in which that might happen.

It is important to distinguish between the incremental effects on innovation caused by demand-pull instruments, in addition to the innovation already happening in the company in response to the business environment, and market trends. Such a distinction however might be problematic to achieve as it is perceived that companies tend to regard all market trends as a whole and as such it will not be possible to clearly differentiate one driver from another.

The investigations, based on a combination of a literature review and empirical evidence, has been used to provide:

- a methodology for assessing which product markets would respond well to market pull measures and the potential consequent impacts;
- a set of recommendations on the qualities that a set of market pull instruments should have to be most effective in promoting innovation and whether any additional changes would complement existing market pull instruments.

## 1.4 Structure of the report

The report is structured as follows:

Chapter of 2 provides an analytical framework for the study including an outline of innovation processes and an overview of the different policies to promote environmental consumption and innovation that the study relates to.

Chapter 3 presents the findings of the literature review under the headings: (i) Using the market in environmental policy, (ii) Drivers of eco-innovation, (iii) Internationalisation of environmental innovation, and (iv) Environmental compliance and innovation.

Chapter 4 provides the main conclusions of the six sector studies structured around analysis of the following three main issues:

- Factors influencing demand expectations - what informs companies' views on future demand patterns?
- Effects of demand on eco-innovation - how views on demand influence the propensity to invest in R&D in general and eco-innovation in particular?
- Sector recommendations - reflecting their views on the qualities of a demand pull instrument that make it effective, or would make it effective, for the sector and company in question.

Chapter 5 contains a synthesis of findings across all the six sectors, drawing the salient points from the sector studies, the literature review and the workshop.

Chapter 6 proposes a methodology for identifying product markets with significant potential to benefit from market pull instruments.

Chapter 7 summaries and discusses the main recommendations for enhancing market pull instruments.

# 2 Analytical framework and study approach

The analytical framework for the study takes the environmental innovation system and innovation models as its starting point. These innovation-related topics are addressed in Section 2.1. Given the narrow focus on eco-innovation at company level, an overall analytical framework structure is introduced in Section 2.2 that serves as a reference point for the study. This structure includes the concepts of general demand drivers as well as command and control (CAC) instruments, demand pull instruments and supply push factors affecting innovation decisions. Considering that these concepts are central to the study, they are briefly described in Section 2.3. followed by a brief overview in Section 2.4 of other push and pull factors that are not the result, at least not directly, of public policy.

## 2.1 The innovation process and eco-innovation

Environmental innovation system

The area of sustainable production and consumption is given high priority by the European Commission, which has among other things resulted in an increasing focus on the integration of environmental and innovation policy. This study should be seen as a part of this process. Conceptual frameworks for understanding developments of environmental technologies and products through an innovation system approach have been developed by social science in the form of environmental innovation systems. These may be defined as the elements and relationships that interact in the production, diffusion and use of new and economically useful knowledge.

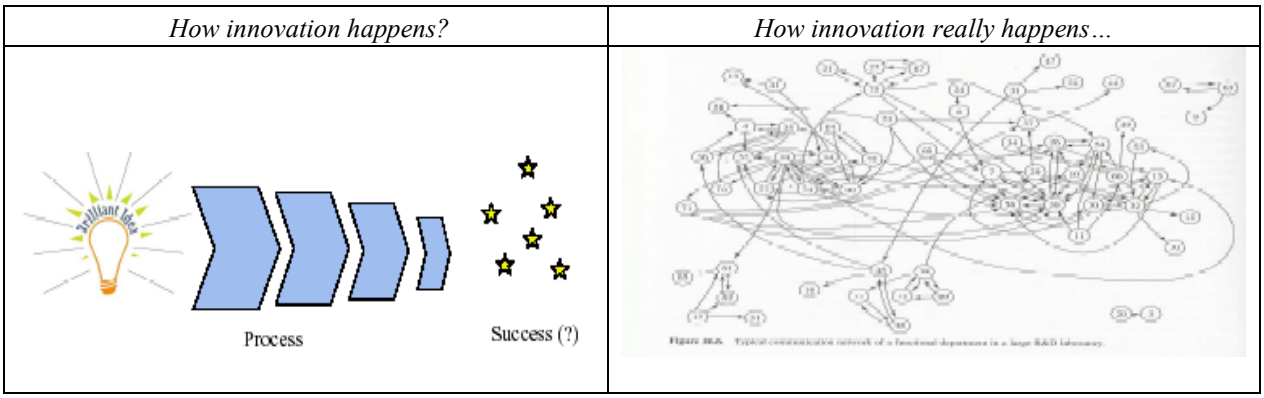
These elements consist of (i) business firms, (ii) knowledge institutions, and (iii) knowledge networks, clusters and incubation environments that all interact within a series of framework conditions. Such environmental innovation system lies behind this study in the sense that it is the framework within which policy requirements are analysed and policy instruments designed, be it command and control (CAC) instruments, demand pull instruments, technology push instruments or other interventions. The environmental innovation system contributes to understanding the dynamics of the innovation process but is not used directly in this report given the more narrow focus of the study.

Innovation models

An understanding of innovation models is necessary in order to study eco-innovation and diffusion of eco-innovative products in relation to market pull instruments. The development of innovation models started with the early linear, push-pull models that still influence much practice and debate, but they

have many limitations. Since then, more realistic dynamic models of innovation have evolved, involving complex systems of disruptive and discontinuous events that involve networks of actors and sources. The difference between the simple linear model and the complex innovation systems is illustrated in the two figures below.

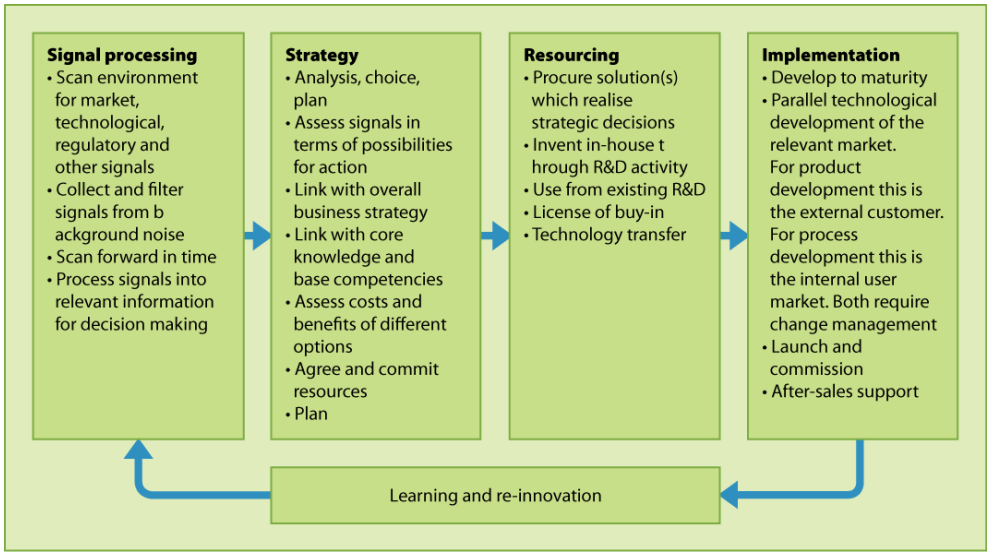
*Figure 2-1 How innovation happens*




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

Recent research points to the risk of being too preoccupied with the science base and novel inventions, since commercial success is very dependent on the later stages of the innovation process, i.e. product development and diffusion. Nonetheless, a simplified picture of the innovation management process is still helpful in order to have an understanding of the steps, or rather elements, it involves. The following figure may serve as a framework for understanding companies internal eco-innovation processes.

*Figure 2-2 Companies' internal eco-innovation process*




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

The above model may be seen as a checklist and crude blueprint for effective innovation processes that characterises 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 often discontinuous in nature with many backwards and forwards loops in the process.

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.

The importance of such networking not only applies to business-to-business relations. It is also important to build linkages within the national system of innovation. Government policy to support innovation is increasingly concerned with enabling better connections between for example the many small firms with technological needs and the major research and technology institutes, universities, etc, which might be able to meet these needs.

Environmental innovation (eco-innovation)

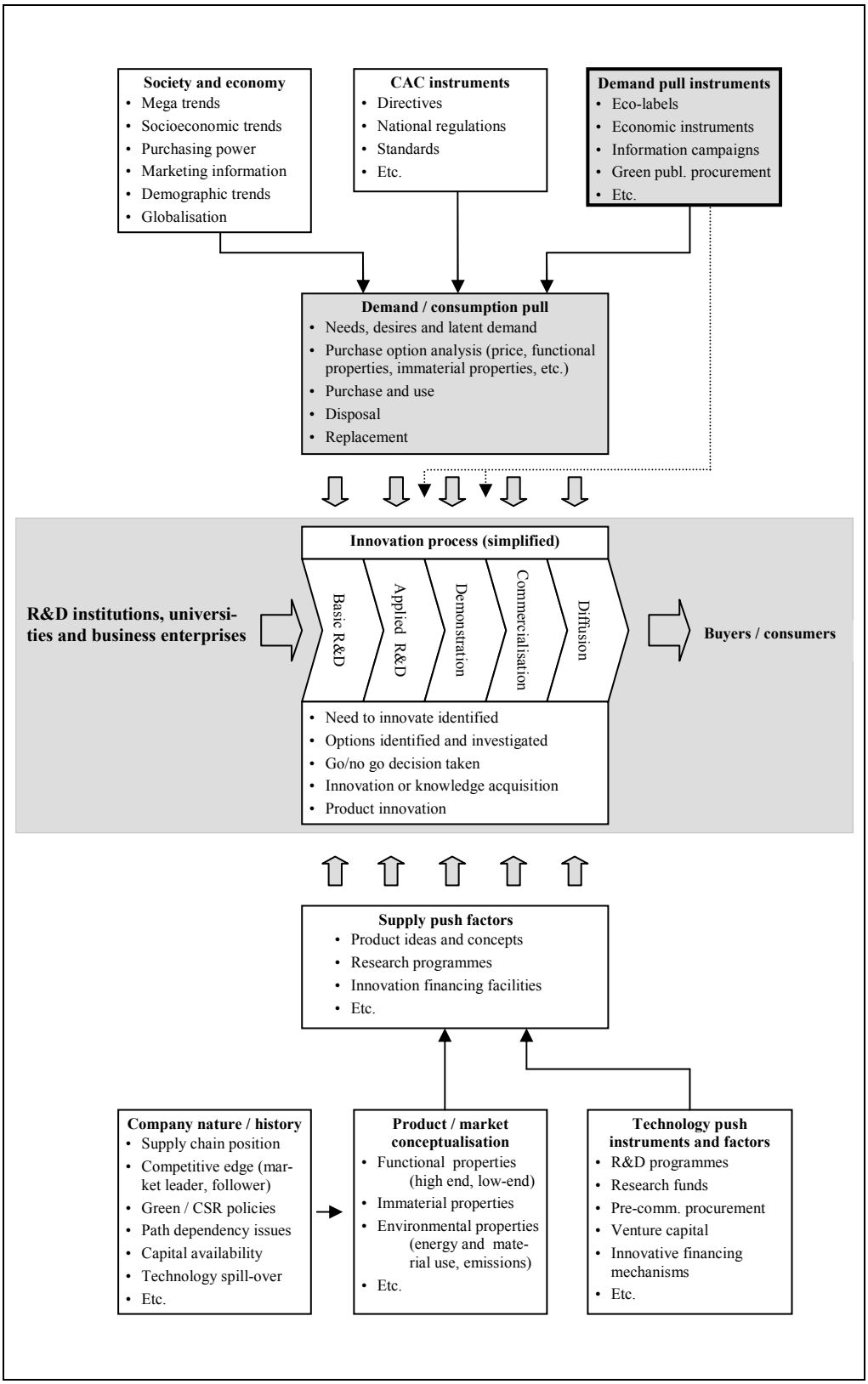
This study focuses on innovation that leads to products with environmentally beneficial characteristics - or put differently - products with less harmful environmental characteristics. This is also referred to as environmental, green or eco-innovation, which are synonymous concepts used interchangeably in the report.

Innovation may be defined in many ways. A broad definition commonly referred to is "the commercial or industrial application of something new – a new product, process or method of production, a new market or source of supply, a new form of commercial, business or financial organisation". "New" in this context is usually interpreted as new to the economy, and not just new to a single firm. The diffusion of technology already on the market is thus not included within innovation according to this definition. As a subset of innovation, eco-innovation may be defined as "innovation which serves to prevent or reduce anthropogenic burdens on the environment, clean up damage already caused or diagnose and monitor environmental problems".

## 2.2 Overall analytical framework

The analytical framework structure of the study is illustrated in Figure 2-3. The figure depicts the aspects of the innovation process and its links to the ultimate market for products, including the role of market pull instruments. It also indicates by way of shaded boxes where the focus of the study lies. Thus, the focus is on the changes in future innovation (middle box) resulting from increased demand for eco-innovative products, which in turn is affected by demand pull instruments. These instruments may also have a direct impact on innovation as indicated by the dotted lines.

*Figure 2-3 Analytical framework for assessing the potential of market pull instruments for promoting innovation in environmental characteristics*




Source: Developed by Consultant.

As the figure illustrates the ultimate aim is to improve the understanding of the effects of market pull instruments on the eco-innovation process. This includes the full range of primary and knock-on effects. In order to do this it is necessary to have an awareness of the entire cycle, illustrated in Figure 2-3, to fully understand the role and importance of market pull instruments. As the figure further shows there are many elements that affect a company's approach to and uptake of innovation results and how market pull mechanisms affect their products placement in the market.

The drivers of innovation shown in Figure 2-3 are further elaborated in the following.

## 2.3 Environmental policies to promote environmental consumption and innovation

The creation of framework conditions and incentives that stimulate demand for as well as prompt innovation in eco-innovative products is a matter of public policy. A range of instruments is available at European and national level to help accelerate the market development process (demand pull) and technology development (technology push). These elements include, but are not limited to:

**1. Command and control instruments**

- Regulation / legislation
- Standards

**2. Demand pull instruments**

- Mandatory eco-labelling schemes
- Voluntary eco-labelling schemes
- Energy labelling schemes
- Green public procurement - GPP
- Differential tax rates
- VAT reductions / exemptions
- Subsidies and incentives
- Scrapping premium
- Feed-in tariffs
- Emission trading schemes (tradable rights to emit greenhouse gasses)
- White/green certificates - certification on use

- Voluntary certification (charter, EMAS, ISO)
- Awareness/information campaigns.

From the other side, innovation is influenced by:

**3. Technology push instruments**

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

## 2.4 Other pull and push factors

Demand pull factors

In addition to the above demand pull factors, these are a series of other forces that drive 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 (demand, production, supply chains).

Company push factors

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

- Supply chain position (supplier, sub-contractor, OEM etc.);
- Competitive edge (market leader, follower);
- Green / CSR policies (low to high priority / relevance);
- Path dependency issues (decisions faced are limited by the decisions made in the past);

- Capital availability;
- Technology spill-over.

These company characteristics contribute to determining the kind of products and services that a company brings to the market, counting product dimensions like functional properties (high end, low-end), immaterial properties, and environmental properties (energy and material use, emissions).

# 3 Results of literature review

The purpose of this chapter is to present the results of the literary review that is used to create a theoretical basis for the study. The general impression is that there is a significant body of work on innovation systems, including eco-innovation, in general. Furthermore, there is 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, there appear to be very few studies which focus on the practicalities of how firms undertake R&D / innovation. There also appears to be 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. There seems to be more research done which examines innovation issues in more general terms than at the relatively micro level that this study addresses.

This chapter contains an overview of the documents collected and reviewed with a focus on using the market in environmental policy (Section 3.1), drivers of innovation (Section 3.2), internalisation of environmental innovation (Section 3.3, as well as environmental compliance and innovation (Section 3.4). Section 3.5 contains reference to case studies.

## 3.1 Using the market in environmental policy

The following documents cover the use of the market for cost-effective environmental policy.

OECD (2007)

*OECD (2007), Impacts of environmental policy instruments on technological change. OECD, Paris.* This is one of the most recent reviews on the subject and is perhaps the most up-to-date overview of the type of studies relevant to this demand pull study. The report surveys the empirical (economic) literature, assessing whether there is evidence of different effects on the rate and direction of technological change associated with different environmental policy instruments. Specifically, it reviews evidence for the hypothesis that market-based incentives have a stronger impact on rate and direction of technological change than non-market alternatives. The study contains the following key points on market pull instruments (MPIs) impacting eco-innovation:

- Economists generally believe that market-based instruments can provide stronger incentives than CAC regulations to adopt cheaper and better pollution control technologies;

- It is hard to identify the exact impact (on eco-innovation) of policy instruments / market pull mechanisms because:

  - environmental regulation has mainly used CAC instruments,
  - since a mix of instruments is usually used the identification of their individual effects is hampered by data restrictions,
  - controlled laboratory or field experiments are virtually non-existent, and
  - empirical assessments have a tendency to be biased towards observable information, like changes in abatement costs number of patents (citations), physical characteristics of technologies, etc.;

- Despite the link between policy and impact being unclear, evidence reviewed suggests that environmental policies do clearly impact on technological change;

- Higher energy prices lead to emission reductions;

- Financial incentives for technology development are usually stronger under market-based instruments.

EEA (2006)

*EEA Report No 1 (2006), Using the market for cost-effective environmental policy*. The report presents an assessment of the main and most recent developments in the use of market-based instruments in European environmental policy. It covers a range of instruments which are used as tools to achieve environmental objectives. These instruments include: environmental taxes, charges and deposit-refund systems, environmental tax reform, emissions trading schemes, subsidies, and liability and compensation requirements. The instruments are explored with reference to their effectiveness and political barriers to their implementation. A checklist for effective market-based instruments is outlined. The key points on MPIs impacting eco-innovation (market based instruments are reviewed by type) are as follows:

- Tradable permits: it is too early to evaluate the success of the EU trading scheme for $CO_2$ emissions. Nevertheless, the positive reactions in financial markets, the lively trade at times, and the more than tripling of the carbon price (as of September 2005) since the start of the trading scheme, suggest that the scheme is making progress in the right direction. Now $CO_2$ has a price, and companies under the scheme are looking for new technologies to reduce costs of such pollution;

- Environmental taxes: evidence on the environmental effectiveness of taxes is broadly positive. In general they work when the tax is sufficiently high to stimulate measures to abate pollution levels. Austria, Denmark and the Netherlands are using different policy packages to reduce $CO_2$ emissions;

- Environmental charges: progressively graduated water prices have been particularly effective in helping to reduce consumption over time in some countries (e.g. Denmark, Hungary);

- Environmental subsidies and incentives (including green purchasing) are widely used and effective for supporting the development and more rapid diffusion of new cleaner technologies such as catalytic converters, low $CO_2$ vehicles, and renewable energy - especially wind and solar power. Experience suggests that application of subsidies at an early stage leads to further (non-subsidised) technological developments;

- Liability and compensation schemes: these are relatively new fields of environmental policy strengthened by the adoption of the EU liability directive with which Member States had to comply by 2007.

DG Enterprise/ Innovation (2004)

*DG Enterprise/Innovation: New Products and Services (2004): Analysis of Regulations Shaping New Markets. Final Report. Karlsruhe*. A comprehensive review of the impact of regulations for shaping new markets. The report sets out a (macro) conceptual framework of the various relationships between regulation and innovation. This framework is presented by analysing the various impacts of these regulations on innovation. It gives an overview of regulatory systems shaping new markets, including a new taxonomy of product market regulations.

It presents views of stakeholders, especially companies, on the impact of the regulatory framework on innovation. It contains the main results of three in-depth case studies covering the pharmaceutical, food and environmental sectors (see Section 3.5: Case studies). In addition, examples of standards responsible for the development of new markets are presented. The report concludes with an outlook of future regulatory policies taking the innovation dimension explicitly into account. Key points on MPIs impacting eco-innovation are:

- Regulation is technology-specific and consequently so is the link between regulation and innovation;

- The market for organic food has grown relatively strongly in Europe, because European farmers converting to organic production receive additional payments, whereas the regulatory framework conditions are similar to the USA. This case shows that the transaction costs occurring in transition phases have to be compensated for by restricted financial subsidies, because favourable framework conditions are not sufficient;

- The above phenomenon can also be found in the case of wind energy, whose success in some European countries can only be explained by the availability of stable demand conditions through guaranteed energy prices. This continuous demand created incentives to invest both in research and development and to provide the necessary infrastructures. The resulting efficiency gains resulted in an increased competitiveness of wind energy compared to other conventional energies, which allowed a longer term re-

laxation of the price guarantees and an exposure of wind energy producers to competition from other energy producers.

IZA (2006)

IZA (2006): *Is Demand Pull Innovation Equally Important in Different Groups of Firms*. The paper is a closer specific match to the issues of concern to the study, containing the following point:

> "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".

The paper carries out a cross-section/time-series analysis using a panel of 216 Italian manufacturing firms over the period 1995-2000. The paper contains a critical review of previous studies and literature and conlcudes, for example, that R&D investment is path-dependent (David, 1985; Arthur, 1988) and cumulative (Nelson and Winter, 1982; Dosi, 1988; Ruttan, 1997), and so any explanation of present innovative activity necessarily involves considering the role of previous innovative activity.

This is also true at the level of a particular firm: innovation moves along a "technological trajectory" and R&D investment is characterised by structural inertia and cumulative complementarities (Bresnahan, Brynjolfsson and Hitt, 2002; Colombo and Delmastro, 2002; Dosi, Levinthal and Marengo, 2003).

The paper also includes a proposed taxonomy of firms which should be more sensitive to the demand-pull inducement mechanism and discussion of the results from the panel analysis, both in aggregate and as applied to the different groups of firms.

Key points on MPIs impacting eco-innovation are:

- In previous literature demand-pulled innovation emerges as an important interpretative category at the macroeconomic, sectoral and firm levels;
- The provided micro econometric evidence does not reject the demand-pull hypothesis, yet the role of sales in inducing R&D expenditures is only barely significant in the overall sample;
- The short-term and long-term impacts of demand become obvious and statistically significant for specific groups of firms. Specifically, exporting and liquidity constrained firms, and firms not receiving public subsidies and 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 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;

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

- Public subsidies emerge as substitutes of expansionary policies in increasing firms' R&D expenditures.

## 3.2 Drivers of eco-innovation

A number of studies, which consider general and green innovation at system level and the role of "green drivers" have been reviewed.

OECD (2007)

*OECD (2007): Innovation and Growth. Rationale for an Innovation Strategy. OECD, Paris.* The report states that there is an increasing realisation that innovation has moved to centre stage in economic policy making, and that a co-ordinated, coherent, "whole-of-government" approach is required to foster it and enhance its economic impact.

The document provides an up-to-date synthesis of knowledge and understanding developed by the OECD on this subject in recent years. Exploring links between policy and innovation at a global system level, the synthesis highlights needs for agenda reformation and strengthened political leadership and resolve to guide its implementation: "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".

EEA (2005)

*EA: Eco-innovation. Potentials and challenges of tomorrow's technologies Perspectives for business, Europe and the environment*. Background paper. Copenhagen, 19-20 April, 2005. This paper provides a brief introduction to key areas of interest for fostering eco-innovation within European businesses. The paper highlights the importance of technology (nanotechnology, biotechnology and information and communication technology (ICT)), market perspectives and stakeholder dialogue for enhancing green innovation. However, it does not go into detail about the relationship between market mechanisms and eco-innovation or provide explicit examples.

VINNOVA (2001)

*VINNOVA, The Swedish Agency for Innovation Systems (2001), Drivers of environmental innovation. VINNOVA Innovation i fokus VF 2001:1*. This work is an early attempt at identifying drivers of environmental innovation. The study provides an overview of existing literature on how external demands drive environmental innovations within firms. It contains the following points on MPI impacting eco-innovation:

- 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;

- There is a choice to be made between quick results and large results. Policy instruments should be used in a coordinated manner for best effect.

Interlinkages and Policy Integration Conference (2004)

*An Innovation System approach to Eco-innovation - Aligning policy rationales, The Greening of Policies - Interlinkages and Policy Integration Conference. 3-4 December 2004. Berlin, Germany. Dr. Maj Munch Andersen*. The paper focuses on the dynamics of creating synergies between innovation policies and environmental policies in order to integrate sustainability issues into the economic process. The paper explores differences in rationales and instruments underlying environmental and innovation policies. It argues that an essential means to achieve policy integration is to set up a shared consistent framework and a vision for the promotion of eco-innovation. Points of relevance to the study include:

- The national innovation system (NIS) perspective is proposed as a possible way forward. It often forms the basis for innovation policy but is little applied to environmental issues. It can be seen as a framework that may align competitiveness and sustainability issues and hence innovation and environmental policy;

- "The NIS perspective, based on evolutionary economic thinking, represents a new policy rationale, a rationale first of all giving knowledge based innovation and competitiveness a pride of place. A strategy for green competitiveness sets new demands on the rationale and competencies of the actors involved. These are requirements which both the environmental and innovation authorities will have great difficulties in handling."

Green marketing (2002/2004)

There is literature available on green marketing. This could be considered a type of market pull instrument in that products with lower environmental impacts are promoted on this aspect in the hope of increasing their sales. Green marketing incorporates a variety of activities, including modifications to products, changes to the production and distribution processes, packaging changes, and modifications to marketing communications.Examples of the literature in this area include: (i) Jacquelyn A. Ottman (2004) *Green Marketing: Opportunity for Innovation*, and (ii) Jacquelyn A. Ottman (2002): *Eco-Design, Eco-Innovation and the Customer: Lessons from the Green Graveyard.*

## 3.3 Internationalisation of environmental innovation

OECD (2008)

*OECD (2008), Environmental Innovation and Global Markets. OECD, Paris.* The report concludes that one of the features of the internationalisation of R&D is the increasing relocation and outsourcing of R&D activities in order to, inter alia, bring R&D activities closer to new markets and tap knowledge sources abroad. This is also the case for environmentally related innovation. It is mostly development that is outsourced, however, while basic research is still mainly done at headquarters.

Globalisation facilitates outsourcing of production, and supply chains are becoming increasingly globalised. Many companies outsource R&D and innova-

tion 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 countries, and meet the internal environmental requirements of their clients.

## 3.4 Environmental compliance and innovation

There are interesting parallels to be drawn to the wealth of work, which has been done on the various approaches that companies adopt to complying with environmental legislation. This issue has attracted significant attention and has revealed a number of interesting points:

It appears that companies that adopt a proactive response to compliance, i.e. those that look to be "ahead of the curve" actually achieve higher levels of profitability than those companies, which only seek least cost compliance. This issue is covered in a recent paper:

UMR GAEL (2007)

UMR GAEL - Laboratoire d'Economie Appliquée de Grenoble (2007): *When and why does it pay to be green?* The paper is concluded with the table below that shows a series of ways in which companies can benefit from complying with environmental legislation / regulations (which could be considered extreme market signals of the same nature as market pull mechanisms).

*Table 3-1 Positive links between environmental and economic performance - a summary*

| **Possibilities to increase revenues** | **Circumstances making this possibility more likely** |
|---|---|
| i) Better access to certain markets | More likely for firms selling to the public sector (construction, energy services, transport equipments, medical products, and office equipments). |
| ii) Possibility to differentiate products | More likely when:<br>a) Credible information about the environmental features of the product;<br>b) Willingness-to-pay by the consumers;<br>c) Barrier to imitation. Wide range of possibilities. |
| iii) Selling pollution control technologies | More likely when firms already have R&D facilities. |
| **Possibilities to reduce costs** | |
| iv) Regulatory cost | More likely in industries that are highly regulated like chemical, pulp and paper, metallurgy, etc. |
| v) Cost of materials, energy and services | More likely when:<br>a) Firms have a flexible production process;<br>b) Firms are in highly competitive industries where optimization of resources is important.<br>c) Firms are in industries where market-based |

| | |
|---|---|
| | environmental policies are implemented. |
| vi) Cost of capital | More likely for firms with shares exchanged in stock markets. |
| vii) Cost of labour | More likely for:<br>a) Firms whose emissions may affect the health of their workers;<br>b) Firms that seek to attract young well-educated workers;<br>c) Firms located in areas where sensitivity to environmental concerns is important. |

Source: Elaborated by Consultant

Much of the work in this area centres on testing the Porter hypotheses that states "the need to improve environmental performance will trigger innovation that can offset the costs of compliance".

Cirano (2007)

*Cirano (2007): Environmental Policy Innovation and Performance: New Insights on the Porter Hypothesis.* This hypothesis remains controversial and much discussed. The paper studies an OECD data set with the following findings.

Jaffe and Palmer (1997) present three variants of the Porter hypothesis. The "weak" version posits that environmental regulation will stimulate certain kinds of environmental innovation. The "narrow" version of the hypothesis asserts that flexible environmental policy regimes give firms greater incentive to innovate than prescriptive regulations such as technology based standards. Finally, the "strong" version posits that properly designed regulation may induce cost saving innovation that more than compensates for the cost of compliance.

The paper tests these three hypotheses using data on the four main elements of the hypothesised causality chain (environmental policy, research and development, environmental performance and commercial performance). The analysis includes data from over 4,200 facilities in seven OECD countries. In general strong support is found for the weak version, and qualified support for the narrow and strong versions.

OECD (2007b)

*OECD (2007b): Environmental Policy and Corporate behaviour. Chapter 4: An empirical study of environmental R&D: what encourages facilities to be environmentally innovative?* Using the same data set this chapter of the OECD report tested the same hypotheses. The findings were that there was strong evidence to support the claim that public policy can induce investment in environmental R&D. Furthermore, there is limited evidence to support the claim that the use of flexible policy instruments (such as performance standards and economic instruments) is more likely to induce such investments than prescriptive regulations (such as technology based standards).

However, it is found that the application of flexible policy instruments can be an important factor to promote the adoption of an environmental accounting system, which in turn induces investment in environment-related R&D. The study also concluded that facilities which invest in environment-related R&D

are thought to be more likely to identify innovations that result in environmental-commercial synergies than those which do not invest in environment-related R&D.

Journal of Business Chemistry (2005)

*Journal of Business Chemistry (2005): Chemicals Regulation and the Porter Hypothesis. A Critical Review of the New European Chemicals Regulation.* The findings of the two above works are partly echoed in this study looking at eco-innovation in Japanese manufacturing firms. The key findings of the research paper were:

- Regulation increases the number of firms with environmental R&D;
- Regulation increases the share of environmental R&D to general R&D: (i.e. supporting the "weak" Porter Hypothesis);
- Liquidity constraints matter;
- Flexible instruments (performance based standard) promote environmental R&D, but prescriptive instruments do not. (i.e. supportive of the narrow version of Porter Hypothesis);
- Listed firms or firms exporting to global market are more likely to spend more environmental R&D.

Other work reviewed[1] on the Porter hypothesis considered its application in the chemical industry with regard to the application of the REACH legislation. The interesting aspect of this work for the study is in relation to the different ways in which legislation affects companies' innovation and competitiveness depends on their corporate approach. Two basic corporate approaches are described, namely cost leadership and differentiation. The strategies are linked to market and competition conditions. The cost leadership approach will work in sectors and for companies with a low cost structure and requires process innovations. Differentiation requires getting new and better products into the market. This is most possible where there are not major cost and time implications to developing a product and getting it to market.

## 3.5 Case studies

The Australian Government is in the process of phasing out incandescent light bulbs in favour of compact fluorescent bulbs.[2] Interesting aspects for the study are that the Australian government says it is confident that new products, which are able to meet some of the applications where existing CFLs do not work very well (e.g. dimmers), will become available. This implies a faith in innovation. In addition all the lamps are imported implying an international aspect to the work and that the lower efficiency bulbs previously sold in Australia might instead be sold in other markets. On the down side this is more of a regulation than a market pull mechanism.

[1] See: http://www.wirtschaftschemie.de/journal/20051-19-36.pdf

[2] http://www.climatechange.gov.au/energy/cfls/index.html

| | |
|---|---|
| | Phillips Lighting is very active in producing innovative and green products[3]. The company is a high profile market leader in this area and also well aware of EU legislative and labelling policy etc. |
| OECD (2007) | *OECD (2007), Impacts of environmental policy instruments on technological change. OECD, Paris*. Literature reviewed in this report contains several examples of companies demonstrating eco-innovations as a response to market-pull mechanisms (though much more regulatory in nature). For example, evidence based on a dataset of 51 US chlorine manufacturing plants (1976-2001) shows that regulation increases price of chlorine and as a result exit of facilities using environmental inferior options. Adoption of technology was not directly affected. |

[3] See: http://www.lighting.philips.com/gl_en/environment/eco- de signed_ prod ucts.php?main=global&parent=4390&id=gl_en_environment_sustainability&la ng=en

# 4 Results of sector studies

This chapter contains the main findings from the six sector case studies. Each sector is described according to the following headings:

- Sector description: The basic characteristics of the sector with regard to size, products produced, production structure and competition aspects;
- Factors influencing demand expectations: General customer demand, sector expectations, innovation patterns, corporate culture etc. as well as policy instruments;
- Effects of demand on eco-innovation: How companies take into account the above factors in decisions regarding innovation, including the extent to which innovation diffuses from the key product lines addressed to related products;

Sector recommendations: Recommendations as to how policy instruments can best be designed in order to stimulate innovation in environmental characteristics of products and services.

It is important to point out that this section contains points, which may appear somewhat tangential to the main focus of the study. However, the recommendations, for example, flow very naturally from the information and views collected from sector stakeholders and have been included for completeness and also to illustrate the complexity of innovation as a whole. Without this there would be a risk that the role of market pull mechanisms would be seen as something that can easily be isolated from other factors affecting innovation, which would not reflect reality.

## 4.1 IT / consumer electronics

The eight interviews carried out in this sector were with representatives of, or experts in the electronics sector. This included representatives of four major producers - Sony, Phillips, Panasonic and Fujitsu/ Siemens, an electronics trade association, two electronics SMEs and an expert in commercialising electronics research.

### 4.1.1 Sector description

The electronics sector is diverse, ranging from mass market products sold directly to the public (e.g. television sets) to bespoke components sold business to business. The product which has received the greatest attention in the interviews is television sets but many other products have been discussed.

Some companies offer a wide range of products, for example Phillips, who have three main divisions. These are healthcare, which produces products such as CT and MRI scanners; Lighting, with products ranging from street lights, to theatre lighting to home and auto; and consumer lifestyle which produces products from electric toothbrushes to television sets.

The industry works with a global perspective with components sourced from all around the globe with even SMEs often exporting significant portions of their production.

### 4.1.2 Factors influencing demand expectations

Customer demand

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

In many business to business transactions customer expectations with regard to the green credentials of their supplier are tested via requests for the presence of a company environmental policy or accreditation to standards such as ISO 14001.

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.

One of the companies spoken to (Global laser - a UK SME who produce lasers for alignment and measurement applications) also quoted customer demand as the prime driver for their innovative efforts. The company operated on the principle of designing bespoke solutions to their customers needs. This approach ensures both satisfied customers and helps with customer retention as getting a customised solution from another supplier will not be simple. Legislation, such as RoHS[4] and WEEE[5], was quoted as another prime driver of innovation, for example they have been obliged to switch to a lead free solder. This issue had been anticipated by large electronics companies in advance of the legislation but small companies (such as Global Laser) did not consider how they would comply until much nearer the deadline.

*Textbox 4-1 Case study Green Laser*

[4] The restriction of the use of certain hazardous substances in electrical and electronic equipment directive

[5] Waste Electrical and Electronic Equipment Directive

When asked about eco-innovation Global Laser reported that none of their customers have ever asked them to look at low energy / green lasers. However they have taken the decisions to develop one. This was largely based on them discovering a way to reduce the power required without harming the utility of their product for certain applications. They are also considering ways in which the production of the laser itself can be made less resource intensive. The issue they are encountering with this aspect is a lack of benchmarks (on eco impact) to compare themselves against for their products plus the fact that none of their competitors have ever marketed this attribute ("greenness") of the product. They are therefore concerned that the potential buyers of their product may not consider "greenness" to be an important attribute. They are planning to test market their "green laser" at trade shows to ascertain demand and reaction. It may be the case that this is a very low priority amongst their market - price, quality etc. may be more important.

The company management had interesting concerns about adding the "green" image to the company brand. They felt it is less of a concern for blue chip companies - who have a long and established brand because as a small company they have worked hard to develop a brand and are therefore very wary of changing (or being seen to dilute this) in any way.

Source: Interview with Global Laser

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. They see the "green" market as an important opportunity and as such have an internal target that 30% of their product range should be differentiated on green credentials by 2012. Their R&D efforts are therefore increasing in this area.

All potential R&D investments / 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 certain product categories "green" issues are a known consumer preference, however in other products (and in certain geographical markets) consumer insight is lacking and other drivers are more important. For example Phillips experience indicates that cost is a more important driver in the UK than in other northern European markets. Market pull mechanisms were referred to as an important tool in such markets.

The representative of Sony televisions reported that in their experience consumers do not generally consider eco issues when purchasing a television. The key factors in decision making, relate to appearance and performance. Products with more features (and more quality in terms of consumer appeal) will consume more power than those with less. This makes approaches such as simple A to G energy labels in isolation difficult as (unlike with white goods) an A label is not an indicator of product quality. The consumer needs more information in order to make a decision informed by both quality and energy efficiency.

Innovation processes

Siemens / Fujtsu 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 are a set of criteria defined for the engineers to design the products to meet. For example on green credentials - a list of substances which are not to be used (which may go beyond legal requirements), or compliance with the energy star rating. The exact nature of the criteria depends on the product class and type but usually a new product will be designed to have a lower energy use than the one which it replaces.

**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 increases costs though makes a greener product, is unlikely to make it into production models. If a product is greener but much higher cost it would be a poor decision to take it to market if customers are unwilling to pay the premium. Most purchasers remain mainly motivated by cost.

Making efficient and green products is high up the corporate agenda but the importance varies product to product. It is an important issue in business pcs but in the server market most customers don't care. This makes it non commercial to produce green products (in the server market) as the customers are unwilling to pay the margin.

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. Those asked say that they are interested in a "green" computer but their final buying decision is much more influenced by price. Though their impression is that this attitude is changing.

Information is also collected by looking at what competitors offer and actual customer sales. In terms of eco-innovation the same question is asked as of any differentiator - does it increase sales? At present the answer is not uniform. Both behaviours are apparent with the market inconsistent - general impression is that green is becoming a more important market driver.

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.

Regulation

Regulatory drivers have been important in the electronics industry in the recent past. Regulations such as WEEE and COSHH have forced producers to remove certain materials from their products, such as lead based solders.

Product differentiation

Producers naturally seek to differentiate their products on criteria which their customers understand and consider important performance criteria. If eco issues (such as energy consumption) are not considered of importance by the con-

sumer / purchaser companies will not make efforts to improve performance. This can be an issue of customer awareness and a split between end user and purchaser (e.g. some public procurement is done by purchasing departments driven by cost criteria) but in some markets other performance measures will always have more importance, for example accuracy is vital in scientific instruments.

Retailer / wholesaler pressure

When questioned on whether there was ever any pressure from retailers to supply "greener" products. Siemens / Fujitsu reported that the signal from sales teams is that although retailers express an interest in green issues the final purchase decision is still mainly driven by price (reflecting their customers behaviour). The industry generally recognises that the knowledge and conscience (i.e. willingness to act) of customers needs to be improved. Action is needed to influence public opinion and to provide the information that they need to make "green" decisions.

### 4.1.3 Effects of demand on eco – Innovation

Innovation in electronics

As a company Sony themselves have high internal standards in terms of the energy efficiency of their products, for example with regard to standby power consumption their products have had lower consumption than the proposed EU standard.

There is a natural process of innovation and improvement in the electronics industry which moves at a rapid rate. Initially new products often have high energy consumption but it is a natural progression for this to reduce as design and components quickly improve. For example a 1970s colour television would have a typical load of 500w, this is now reduced to 50w.

The speed of product development in consumer electronics is very fast so in order to keep pace with this any labelling scheme would need to be equally dynamic. The example of 3D television sets which are currently under rapid development was raised as although the technology is new and energy intensive (and would thus get a poor energy label) consumers would still want the product due to its functionality.

An expert with a long experience in electronics innovation made the following general points regarding drivers of innovation and the role of market pull mechanisms in the electronics industry. 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. With good information provided customers will make better decisions though the issue of time preference (tendency to value initial capital cost savings higher than long term operating cost savings) will always exist.

With electronics in general innovation which reduces the heat output reduces the need for cooling which is of cost (and energy efficiency) benefit. However 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. Infrastructure constraints are also an important issue here – for example many early energy saving bulbs would not fit in standard lamp shades (this is still an issue).

The expected lifetime for electronic products is becoming shorter which in itself could be a negative influence for energy efficiency due to a shorter period over which energy savings are available to recoup higher capital costs for more efficient appliances.

Eco-innovation in electronics

The UK trade association for electronics agreed that their industries' products do have scope to improve in terms of energy efficiency and eco performance and that is a product differentiator which has potential to influence consumer's choices. 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:

- The difficulty of a simple A to G rating as larger televisions will be by definition higher energy users.
- Label targets will be seen as the end goal of innovation and once these levels are reached innovation efforts will reduce.

The scheme design preferred by many companies would be a simple power rating (Watts) with a label for the best performing products in a number of classes. This would need to be updated on at least annually. There is a lack of consensus reported as to whether such labels should be compulsory.

It was also pointed out that energy savings can also be achieved via product configuration. For example a high brightness setting on a television increases the power used and reduces the set life. However the default brightness setting on many televisions is set at a high level in order that the set performs well in a brightly lit showroom environment. Research shows that many users do no alter this setting in use. A simple step in the set up of televisions when they are first turned on removes this issue and saves energy.

The Sony representative also commented on the rapid speed of innovation in the electronics industry, quoting the example of a 1985 Walkman which would last 2hours on 2 batteries compared to a current MP3 player which lasts 80 hours on a full charge. This speed of innovation is part of the industry, particularly at Sony who have a corporate target of achieving a 20% reduction in energy use of their end products every 5 years. Any market pull mechanism would need to keep up with this speed in order to remain credible and fit for purpose. Another potential problem with energy labelling schemes is that manufacturers may well be unwilling to reveal upcoming energy saving technologies in their products (for example in order to update the target levels for an A grade) as this would give advance warning to their competitors and loose a potentially important advantage. This implies the need for a rapid procedure in updating labelling (so that an innovative product is able to enter the market with an immediately appropriate label) and/or the need for those charged with

updating the labelling to refrain from sharing manufacturers product details with other manufacturers until the product comes to market.

***Trickle Down***

In the pc 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 sales volumes 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 standard are regulated and are set at too high of a level too quickly this will cause too high of a 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 as the business pcs from 2-3 years ago. The same is true for specification improvements / trickle down from "good" to "bad" companies.

There are differences between markets, the EU has become a harmonised market, the US is catching up (in terms of energy efficiency requirements / interest). The Japanese market has always been very interested in energy efficiency. China and other Asian countries are less interested (yet) but it is expected that the energy price will cause them to become more interested.

When questioned on trickle down of eco-efficient technology through their product ranges Phillips responded that it does happen but can take a few years. For example a very low power standby setting was first now available in their top television range (of 4). The relevant component (after 1-2 years) is now installed in their two middle ranges but will not be installed into their bottom range (which is the cheapest and biggest seller) for 2 to 3 more years. 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 component would require – even though it would make economic sense over the product lifetime. The component will only get into the lowest range when it is produced in sufficient volumes for it to be cost competitive with the standard component. From a strictly economic "cost of carbon saved" perspective it would make sense to use public funds to subsidise the installation of this component until its cost dropped enough.

In terms of trickle down into other markets this was somewhat negated by a company principle of striving to standard global designs in order to reduce component diversity and keep production cost down. In order to achieve this high volume production products (e.g. televisions) are designed to comply with the requirements of the most stringent market, so if this was the EU this would become the global standard. This is less the case for lower volume products e.g. audio products.

In terms of the effect of demand for eco innovative products influencing R&D Phillps reported that in some cases eco-innovation is cost neutral (to them) but its often not. Therefore they will only invest in it if they are confident that it is a genuine influence on purchasing decisions. It would be counter intuitive for

them to invest (and potentially increase the product cost to consumer) when their purchase decision is largely driven by other issues, such as quality, design, price etc.

### 4.1.4 Sector recommendations

Those interviewed had a number of interesting views on how market pull mechanisms could most effectively function and hence influence innovation, in the electronics sector.

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." Legislative tools were less well regarded with many considering them an imposition, constraint on innovation and often leading to poor outcomes (such as the requirement for a standard digital box interface on the back of all TVs which was reported as very little used by consumers).

There was also general agreement of the need and benefit of providing more information to the customer to enable a better eco-informed decision. A number of opinions emerged on the qualities they should posses:

A need to reflect the diversity of the market, as products with more features will consume more power than those with less. Without this ability any labels will appear counter intuitive to the consumer as higher specification products will have a "poor" label and lower specification products a "good" label.

A number of those asked supported a clear power rating as opposed to a label. As this enables transparency. Others felt this should be combined with a "amongst the best in class" label.

This best in class approach was favoured by those familiar with the Energy Star labelling scheme on computer equipment. This was praised for its rewarding of the best in class, its global nature and the efforts it makes to get industry input into what is technically and financially feasible.

There were varying opinions as to whether labelling schemes should be compulsory and who should enforce them. Large companies would be the most likely to comply with voluntary schemes but this cost would be most likely avoided by the lowest cost producers. Others suggested that retailers could operate the schemes – and only sell labelled products.

Most of those interviewed felt that global as opposed to local is preferable in labelling schemes.

In terms of the personal computer (PC) market Siemens / Fujitsu stated that there is a debate about the validity of an A to G type rating within the company. Some are in favour of it but in general those that are most involved in the issue are less in favour of this approach for the following reasons; computers are sold

with a very wide degree of variation in specification. This multiplicity of configurations makes a simple labelling system difficult as it is not fair to compare low specification machines with high specification ones. Power consumption will be higher where there is more computing "power". For PCs the graphics card is a key component in energy use. The company have yet to see a labelling scheme which copes with this. Showing typical energy use during a "use cycle" would also be difficult as it is hard to define a typical load. It would not be practical to measure the energy use of every pc built.

Siemens would generally be happy with a combination of minimum standards at the bottom of the market, in combination with the energy star scheme rewarding the best 25% of the products in a market. This combination of measures removes the issue of very low cost (but inefficient) products and provides a simple (in comparison to labelling) indication of which products are among the highest performing.

Would be supportive of requirements on large procurers (especially of servers where to date there has been little interest in energy performance) to only purchase units with an energy performance above a certain minimum. This would send clear market signals. Some private companies already do this.

Phillips also reported that a diversity of views exist with regard to energy labels for televisions. Some feel it would influence consumer behaviour while others feel that other product characteristics will remain of paramount importance. However if a label was introduced there is a very high likelihood that it would induce investment into Eco-related R&D. How well the consumer is able to interpret the label information is key. Even if the labels only increased awareness without much influencing the purchasing patterns they would do some good and the information collected on product performance would also be useful for informing / designing other incentives.

It was stressed that labels ideally need a long term and ambitious perspective as this helps orientate R&D towards these goals. In the electronics industry "long term" in terms of product development can be only 3-4 years. This places a need on regulators to act quickly in order to keep up with the market. This does not seem to have happened in white goods where it was felt the market has outpaced the regulatory headspace.

Sony also supports the need to label and stated a preference for a display of power use (in on and standby) combined with a best in class award. They also pointed out that a significant (30% and growing) part of the market is being served by unknown brands and if they are not made to comply their cost advantage would increase. The prevalence of these low cost brands varies by market with the UK being the largest EU market and their price level suggests old technology. Sony would like to see minimum legal standards on energy use in order to achieve a level playing field.

For a diverse and small market segment, such as that served by Global Laser, it was felt that energy labelling schemes would be unlikely to be imposed. Given the high presence of small companies in many of these sectors and the fact that

many of these only respond when forced to by legislation, this may prove a more productive approach to achieving eco policy goals.

The other small companies interviewed (Riochem – who make 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.

## 4.2 Household appliances

This section is based on literature review and interviews with CECED (trade association), Whirlpool (It), Electrolux (BE) and Miele (DE).

### 4.2.1 Sector description

The household appliance industry is a true global industry with large European players. Most of the large European manufacturers have several factories worldwide. Large appliances are usually produced locally due to high transportation costs and a need to produce according to the local market, e.g. consumer demand and habits, as well as legislative requirements.

The sector is highly competitive with very narrow margins and there is a widespread existence of over-capacity on the production side, likely to results in concentration of the industry in the short to medium range. The table below presents the key figures of the sector.

*Table 4-1 Household appliances sector - Key figures*

| Household appliances sector | Key figures |
|---|---|
| Direct and indirect jobs | 500.000 |
| Revenue | EUR 40billion |
| Investments the last 10 years, mainly eco-innovation | EUR 10billion |
| Product platform life | 5-7 years |
| Product average working life | 10-13 years |
| Long term price trends, nominal terms | Flat |
| Energy efficiency (1995-2006) | up to 45% |
| Actual reduction in energy consumption (1995-2006) | -15% |
| Investments (1999-2004) | +25% |
| Net profit (1999-2004) | -25% |

Source: CECED

Non-European brands have a relatively low market share on the European market, while for European players the European market accounts for the order of 50% of their total turnover. The Asian markets are seen as the new emerging markets and many of the European brands have already established factories there.

### 4.2.2 Factors influencing demand expectations

In 2002, energy labelling was introduced in EU and is now regarded as the main driver for innovation within the industry. In the beginning there was reluctance towards the label within the industry, but now the general attitude towards energy labelling is positive and it is seen as a main driver of innovation. Furthermore, it is perceived as a main product differentiator leading to improved competiveness.

Compared to the Energy STAR (US) and the Top Runner (Japan), the Energy labelling scheme is much more ambitious and has resulted in EU manufacturers being at the high-end in terms of energy efficiency appliances also globally.

Shortcomings of the current label scheme

There are however some shortcomings of general and specific nature concerning the energy labelling scheme:

- Sanctions for cheating are to weak
- The industry favour implementation of dynamic labelling, were the standard constantly moves upward and thereby stimulate innovation further as providing innovation and investment incentives.
- With the current labelling scheme, innovation has hit the ceiling. Efficiency beyond A++ is not recognised and cannot be introduced to the market.

Recycling

Recycling is another regulated area (Recycling Directive) of importance for innovation. The problem here is that the implementation of the directive differs among the member states hence not all countries have the same wording after transposing the directive into national legislation. In some countries it is not explicit that each company are responsible for their own recycling. Only if each company is responsible for taking back and recycling their own products sufficient investments will be channelled into the eco-design.

The target is to recycle 75% of a given appliance. In principle everything can be recycled but at increased marginal costs. Currently the cost of recycling is around 15 EUR per item, e.g. a refrigerator. Again only if same rules apply for players it will be respected. Moreover, different rules contributes to fragment the internal market creating different framework conditions for producers in different EU MS

Future demand

The overall socio-economic trend is green. Consumers are becoming more and more aware of energy efficiency and are increasingly demanding energy efficient appliances indicating that the labelling scheme as an instrument are working. However there is a limit for which the consumers are willing to pay for the

last bit of energy efficiency, i.e. the marginal cost of eco-efficiency (Electrolux interview).

It is expected that consumers to an increasing degree in the future not only will demand more green products but also, due to increasing energy prices, will make more rational choices concerning operational costs of household appliances

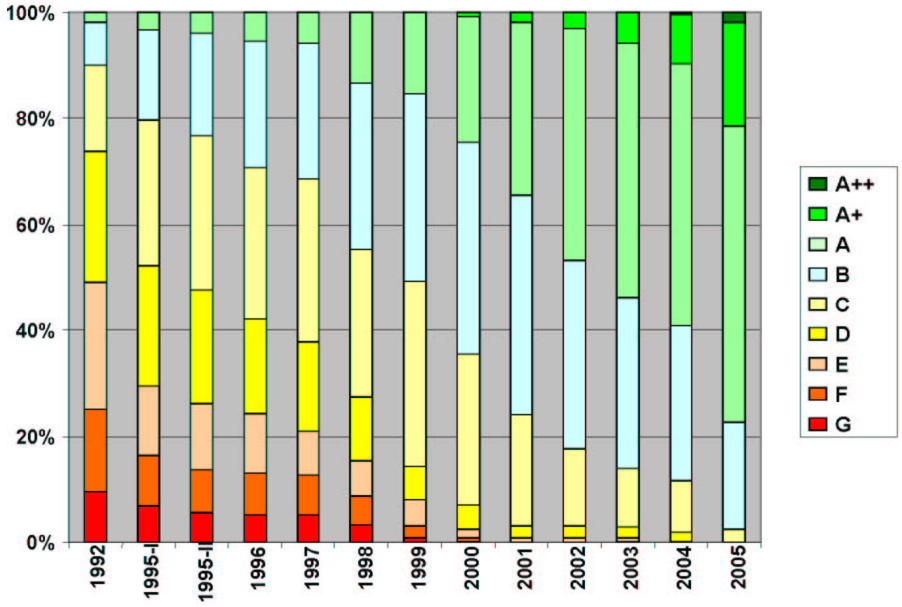
### 4.2.3 Effects of demand on eco-innovation

Energy labelling has been extremely efficient in driving innovation towards energy efficiency and eco-innovation spending in companies has increased considerable in the past years.

Energy label has intensified Eco innovation

Generally speaking, an average fridge is consuming less that half of the energy compared to the 1992 level. Top of range fridges (label A++) are down at 30% compared to 1992 level as indicated in Figure 4-1. However, the curve is flatting out, e.g. marginal cost compared to unit of energy efficiency is increasing.

*Figure 4-1 Energy performance of Refrigerators*



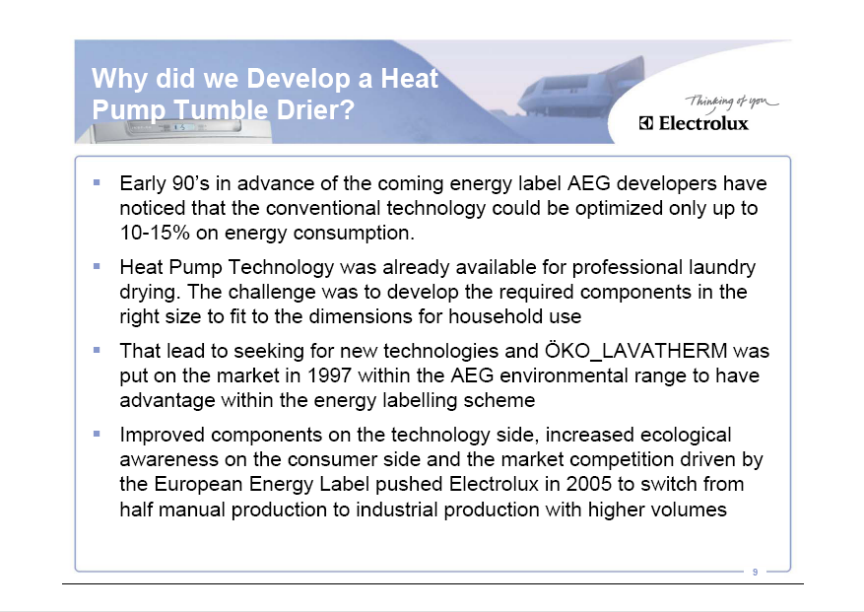

Source: CECED

Further R&D into variable speed compressors, vacuum panels and new gels is required to bring energy efficiency to an even lower degree. In the medium term (5-10 years) it is believed that energy efficiency could reach the 10% level (compared to 1992 energy consumptions).

Different factors influence the innovation decision, and this is illustrated by the following two text boxes.

*Textbox 4-2 Electrolux Tumble Dryer*

Following the implementation of the energy label, Electrolux managed to develop a radical new heat pump for tumble dryers that actually reduced energy consumption by 40%. The new appliance got ranked in Cat. "A", as opposed to any other tumble dryers on the markets where none was higher than "C". This market advantage has lasted for 5 years and only now the competitors are launching similar products. The price is about the double and earnings have been good.




Source: Electrolux

*Textbox 4-3 Drivers of Eco-innovation ATAG*

**Environmental care at ATAG Group**

In 1999, ATAG Group B.V. was a manufacturer of major domestic kitchen appliances like ovens, hoods and electric and gas hobs. At that time it had six production sites, in The Netherlands, Germany and Hungary, counted about 3.000 employees and had an annual turnover of $ 300 million. Up to 1993 ATAG Group did undertake no other environmental initiatives than complying with environmental governmental and regional regulation. The company started to go beyond compliance in 1993, when a long-term cooperation with Delft University of Technology started. Together with two other knowledge centres, TNO Industry and Gastec, the four partners initiated a long-term research project on eco design and eco-innovation.

From an ecological perspective the kitchen can be seen as an integrated water and energy consuming system. This system performs with a considerably higher efficiency than usual if kitchen appliances would become intelligent and learn to interact. The result is a reduction in terms of energy and water consumption as well as an increase in comfort and customer satisfaction.

With these objectives in mind ATAG Group initiated the project "Eco-design & Intelligent Energy Control for Major Domestic Kitchen Appliances". A range of five innovative product concepts has been developed, each combining a new set of customer benefits with outstanding water and energy efficiency figures. The result of this three-year "eco-innovation project" was a set of five concept appliances and a range of technological findings that, after further elaboration, would lead to a new generation of intelligent and interactive kitchen appliances.

Simultaneously, and in addition to the eco-innovation initiatives, ATAG Group worked on

implementation of eco-design principles into the processes deployed for product development as well as purchasing. In 1993 a company specific eco-design guide was developed, called the ATAG Group Eco-design Manual.

Projects were done to develop eco-design targets together with those employees who were to meet these targets, and to actually apply and internalise eco-design. As a result, eco-design targets were formulated and on-line projects were executed for two product groups (cooking hoods and ovens). These eco-design targets were meant for, and set by two departments in particular (product development and purchasing). One of the results of these eco-design efforts concerned the redesign of packaging for cooking hoods. The original packaging consisted of cardboard, wood and expanded polystyrene; the new mono-material packaging is made out of cardboard. A life cycle analysis by means of EcoScan software showed that the new mono-material packaging had an environmental load of 18 mPt, whereas the traditional had 72 mPt ("millipoints").

What now were the stimuli and barriers ATAG Group faced in the field of eco-innovation and eco-design?

First, a strong external stimulus was the emerging European Union energy-labelling scheme. Kitchen appliances like refrigerators and freezers were already wearing an obliged energy label, indicating their energy consumption (class A to G). A similar directive was in development concerning ovens. This proved to be a strong stimulus for ATAG Group to reconsider the energy consumption of their ovens, and to study the options to reduce the energy consumption to the extent that ATAG ovens would obtain an energy A-label.

A second stimulus related to the expanded "innovative ambitions" of the company. The company's innovative ambitions were increased thanks to the co-operation with three institutes that identified new technological possibilities, which ATAG on its own would not have explored. Dutch government sponsored the eco-innovation research project. This enhanced the scope of the technology search considerably and, in combination with the related external governmental monitoring, increased the firm's innovative ambitions as well.

Source: Hemel (1998)

Labelling as ex ante stimuli to innovation decision

As mentioned above, the two case studies illustrate that the innovation decision is driven by a combinations of different factors, stimuli and expectations to future market development. An important element to notice is the way the expectations to the upcoming labelling scheme, as the decisions were actually taken before the energy scheme actually came into force enforced the expectation to a future more green demand. In this case the labelling scheme acted as an ex post stimuli to market expectations.

Global competiveness

As all main players in the industry are global players, with about half of their turnover created outside Europe, it would be evident to assume a direct spill-over effect in terms of innovation to the global markets. However, due to the high transport costs for large household appliances such as refrigerators, washing machines, dishwashers, freezers etc. production tends to be relatively continental or regional. In other words appliances sold in Europe are mainly produced in Europe; likewise appliances sold overseas are primarily produced overseas. European manufacturers, with the exception of Miele, have set up local production factories overseas. As a consequence overseas production produces according to the standards, and buying power and preferences, of the local market. Current requirements in China are Label C-D where as in Europe D is illegal today. On the Chinese market, the market share of European manufacturers is less than 10%. However, industry is expecting overseas market to become stricter with respect to requirements on energy efficiency, in particular

the Chinese market is seen as an important growth market. European brands, therefore would have a competitive advantage at least in the medium term.

### 4.2.4 Sector recommendations

Based on the review of the sector, the following recommendations can be made:

General recommendations

- Incentive schemes: VAT, buy-back old appliances, direct financial incentives, white certificates. Incentive schemes has worked well in Italy, France and Spain;
- Revision of the energy label is needed, but it has to be towards a dynamic scale, new numbers need to be added providing the right incentives for manufacturers to innovate;
- The proposal by the EC just to change the "letters" will not work;
- Incentive schemes have a tendency to distort the market, in particular when they come to a stop. In some countries the financial incentive are paid back over the tax bill, this seems to work better as the consumer still see the right price on the invoice, otherwise it will just be regarded as a discount;
- VAT schemes – same effect as incentive schemes;
- Replacement schemes, i.e. the government finances the buying back of outdated appliances, are good thing as they do not as such disturb the market and contain a direct message to the consumer that old appliances are $CO_2$ heavy;
- $CO_2$ labelling might work in the future if the important indicators are included – also transport $CO_2$;
- Education and awareness (chicken and egg) is important. Also to let the consumer understand that one thing is the cost of the appliance another thing the running costs. That a more expensive appliance might be more costly up-front but it pays off in the longer run given lower annual operational costs (energy bill)
- The perception of the consumer is often that a higher kwh indicated on a given appliance (e.g. vacuum cleaner) equals better efficiency. Which in fact is not true!;

*Textbox 4-4 A case for EU action*

**The responsibility of the Global community**

CECED is of the opinion that the global community is to take further action and responsibility towards introducing stricter energy efficiency requirement at a global scale and to support incentive schemes for the emerging market in order to encourage uptake of en-

ergy efficient appliances.

CECED have made the calculation of excess energy consumptions if current market uptake of refrigerators (e.g. in China only 10-15% of households own a fridge) is satisfied by low end products (poor energy efficiency) compared to a label A+ product. The result is scaring, and can only be solved by an incredible number of extra power stations or nuclear power stations to be built. The point is that it would be much more cost efficient for the global community to subsidies in the order 50 EUR per sold appliances to encourage take up of energy efficient appliances.

In EU27 alone, CECED has calculated that 8TWh of energy are wasted every year using outdated and energy ineffective appliances. Incentive schemes have been very efficient in Italy.

The second hand market is another negative externality. A large amount of second-hand appliances (now illegal to resell in Europe) are being exported to mainly Developing Countries.

Source: CECED

## 4.3 Transport sector

Eight interviews have been conducted with companies in the transport sector, hereunder six OEMs (original equipment manufactures) and two OES (original equipment suppliers). The OES are suppliers of products to the OEMs. Three companies are major car manufactures (GM/SAAB, Honda and Toyota) and three companies are manufacturing buses (Volvo Buses, SCANIA and Mercedes Buses). The interviewee from SCANIA also provided information on innovation with the truck section of the company.

The OESs are Dinex, a Danish manufacturer of catalyst technology, and e-Traction, a Dutch manufacturer of electric motors for the transport sector.

The part of the transport sector that is investigated is the car industry and the bus industry, and only to a limited extent the truck industry.

### 4.3.1 Sector description

The last 15-20 years there has been a development of merging and acquisitions of vehicle manufactures. The global market of vehicle manufactures is today made up of around 15 large companies. The OEMs outsource a large part of the manufacturing of components and parts, e.g. 75 % of the production of the car industry is outsourced. A large potential of eco-innovation in the car industry is within the value chain (Christensen, 2007).

A highly regulated industry

Honda has made a life-cycle assessment of $CO_2$ emissions from their vehicles. According to their assessment 6 % of $CO_2$ emissions are generated by manufacturing the vehicle and 78 % by driving the vehicles (Honda, 2007). A very important environmental impact connected with the transport industry is therefore the operation of vehicles.

Impact of CAC instruments

Since 1992 the emission of new vehicles has been regulated through the setting up of increasingly strict Euro standards. Starting with Euro 1 for light and Euro I for heavy vehicles. The standard includes among other emission of $NO_x$ and

CO. Manufactures of light vehicles have since 2005 had to meet the Euro 4 standard for emissions from new vehicles. The Euro 5 standard is planned to be implemented in September 2009[6]. Similarly, new heavy vehicles are presently to cope with the Euro IV standard, and already from September 2008 a new Euro V standard is being implemented.

The Euro standard emissions do not include emission of $CO_2$. In 1995 the European Commission launched a strategy for reducing $CO_2$ emissions from cars called *A Community Strategy to reduce $CO_2$ emissions from passenger cars and improve fuel economy.* The strategy was based on three pillars (Christensen, 2007):

- Setting up of a voluntary agreement with the car industry on reducing the average $CO_2$ emission from new cars.
- Establishing of a labelling scheme displaying the $CO_2$ emissions and fuel efficiency of new cars.
- Encouragement of the Member States to implement fiscal instruments to support the dissemination of vehicles with a low level of $CO_2$ emissions.

However, the strategy for reducing $CO_2$ emissions turned out to be of limited success. The voluntary agreement with the car industry set up targets for continuous reduction of the average $CO_2$ emission of new cars. The purpose was to reduce the $CO_2$ emissions of new vehicles with 25 % from 186 g $CO_2$/km in 1995 to 140 g $CO_2$/km in 2008. By 2005 only three car manufactures, Fiat, Renault and Citroen, had managed to bring down the $CO_2$ emissions of their vehicles so they where likely to meet the voluntary target in 2008 (Transport & Environment, 2006).

In 2007 the Commission reviewed its strategy for achieving reduction in $CO_2$, and it has proposed an integrated approach to target the reducing $CO_2$ emissions. According to the proposed regulation the car manufactures will be obliged to bring down the average $CO_2$ emission of new cars to 130 g $CO_2$/km by improvements in engine technology[7] by 2012 (European Commission, 2007).

The industry as a whole has only to a limited degree experiences the impact of demand pull instruments.

Financial instruments

There has been a lack of common approach to use financial incentives among the Member States. A number of MS have, however, applied financial instruments, including tax reductions for fuel efficient vehicles (Christensen, 2007). There has until now been no regulation of $CO_2$ emissions from heavy vehicles.

[6] For light commercial vehicles with weight above 1,305 kg, the Euro standard 5 is implemented by September 2010.

[7] An additional 10 g $CO_2$/km has to be achieved by other technical means (e.g. more energy efficient tires) or by use of biofuels (European Commission, 2007).

GPP

June 6, 2008, the EU transport ministers agreed to introduce more binding elements into the law in order to ensure that the procurement of public vehicles take life-cycle costs of the vehicle into consideration. The environmental impact of the vehicle is to become a mandatory criterion in the procurement procedures (ENDS, 2008).

### 4.3.2 Factors influencing demand expectations

The factors to impact demand expectations differ for the car industry and the heavy vehicle industry and is therefore analysed separately.

Bus and truck industry

Environmental regulation and customer demand are the two main factors influencing demand expectations and hence drives the innovation decision. The setting up of the Euro standard has had a very big impact on the eco-innovation of the industry. In order to comply with the regulation, the industry has had to make considerable innovations. The reduction of emissions included in the Euro standard can be achieved by calibrating the engine and by applying of catalyst technology. In both cases the result is increasing fuel consumption.

As the life-cycle cost of operation of heavy vehicles is very high, there is a significant customer pressure to develop more fuel efficient vehicles. This pressure has been intensified by the increasing fuel prices. Due to the connection between reduction in $NO_x$ emissions and declining fuel efficiency, there is no demand for trucks that go beyond the Euro emission standards. For buses the case is very different. Among 50 % of the bus market is made up by city buses. The bus operation in European cities is outsourced to operators that have a concession for a period of typically six years. As a part of the concession the local government set up requirements for the environmental performance of the vehicles. Due to a politically based desire for a clean local air environment, the requirement for $NO_x$ emissions of the vehicles often exceeds the present Euro standard.

For the manufactures of heavy vehicles, the development of eco-innovation is to a wide extent given by the environmental regulation and the customer demand. Eco-innovation is a must, and a precondition in order to stay in business and to maintain competitive edge. Making eco-innovation is however also a part of the companies' core values, desired corporate strategy and are an important element of the Corporate Social Responsibility (CSR) reporting. All interviewed manufactures of heavy vehicles are developing or have developed new environmental friendly technologies. Mercedes-Benz Buses and SCANIA have developed hybrid buses and Volvo Buses have developed and commercialized gas fuelled buses in response to future expectations.

Car industry

In order to be on the European market the car manufactures have to comply with the Euro standard. Regulation therefore also plays an important role for the car industry. Nevertheless, there is not as clear a connection between customer demand and decreasing fuel consumption of the vehicles. The reason for this is primarily that there, until the present oil crisis, has been a trend towards customer demand for heavy cars with large engines and high fuel consumption. There is therefore somehow a mismatch between supply-push and market-pull,

mainly due to the inertia of the car manufacturers' development cycle compared to the much shorter reaction time of the consumer to change preferences from "big is beautiful" to "low carbon footprint"

The interviewed car manufactures are all deeply involved in eco-innovation. A leading corporate philosophy within both Honda and Toyota is continuous improvement of efficiency and functionality of their products. Honda has for instance set up a target for reducing the $CO_2$ emissions of their cars by 10% in 2010 with a baseline in 2000 (Honda, 2007). R&D on eco-innovations is a continuous process in the companies. Toyota and Honda were the first companies to launch hybrid vehicles, and in June 2008 Honda commercialized a fuel cell powered car – the FCX Clarity model. For SAAB, Toyota the Honda it is important to be market leaders in developing eco-innovations, and CSR is valued as an important driver for eco-innovation.

Decision-making on R&D and commercialization

R&D and commercialization are two distinct processes in the companies. The R&D process within eco-innovation is an important part of the companies' overall strategy to gain competitive edge. They try to make estimates of potential market demand for the technology. Developing radical new technologies e.g. the fuel cell and hybrid technologies, is very time consuming. A lead-time of 10-20 years means that the companies have to start developing the technologies before they are sure that there will be a market for the products. The development of such new technological trajectories is extremely costly, and the aim of the investment is potential markets for the innovations. Increasing oil prices have entailed an augmented interest for alternative fuels and more efficient engines, but the market signals is also to a wide extent impacted by the public opinion and the governments intentions. Due to uncertainties associated with the future demand for specific technologies, the large corporations (e.g. GM) invest in the development of parallel technologies in order to risk minimize. In other words by investing in a portfolio of technologies, companies diverse risk and maintain the possibility of swopping from technology to another as market signals becomes clearer.

Technological development is not only made by top-down decisions, but also through bottom-up inputs and some eco-innovations take place because the employees are coming up with new possible solutions. The corporate culture (path dependent) of innovation is in car companies especially stated as an important driver of eco-innovation. For instance, the image of SAAB has always been "safety" and now "green" is the name of the game.

*Textbox 4-5 Case study Mercedes-Benz Buses*

Mercedes-Benz has developed a hybrid technology that is implemented in the Citaro G Bluetec Hybrid Bus. The initiation of the development of the hybrid technology was based on a corporate desire for developing technologies with reduced fuel consumption, in parallel increased oil prices as an external driver reinforced and complemented the internal strategic decision. Mercedes estimated that in the long term a market for hybrid technology would eventually emerged - while in the short term there were no direct market perspectives. The costs associated with the development of the technology are extremely high. Formerly, the Bus section of Mercedes-Benz gained from technological development made in the truck section. This has now changed so a lot of the most promising R&D work is

made by the bus section. Economies of scale has not yet materialized hence the unit price of the product remains very high.

Source: Michael Goepfart, Mercededes-Benz Buses and Coaches,

SAAB's innovation of an engine that runs on bio-ethanol has been a more incremental innovation. When the company decided to go for the innovation of the technology, there was no actual demand for the technology, and the market take off has been totally dependent on the market pull instruments, that the Swedish government put in place to support the market penetration of the innovation. This is further touched upon in 4.3.3.

e-Traction is a small Dutch company that has developed a technology called TheWheel. The technological concept consists of electric motors placed directly in the wheels. The advantage of the technology is according to the manufacturer significantly more energy efficient propelling of the vehicle. TheWheel was developed without a market demand for the technology. On the contrary the company has experienced a lack of interest from one of the potential markets, the bus sector. The company's rationale for developing the TheWheel can be said to be a combination of in-house capability to coined with environmental concerns rather than an actually demand pull impact.

The chicken and egg dilemma

The companies have to be sure that there is a market for the mass product that they are commercialising and here timing of the innovation is crucial. It only makes sense to bring a product to the market, if there is a demand for it. The demand is however also developing with the products that are offered on the market. For vehicles fuelled with biofuels it is important that the infrastructure is in place so it is possible to fill the vehicle. City bus operators often have their own tanking facilities hence infrastructure of fuel supply is rarely a hindrance for the city buses as opposed to private cars.

Supply chain pull

The interviewed companies state that they are setting up the requirements for their suppliers. The innovation in many of these OESs therefore primarily aims at coping with the OEMs' requirements. Dinex is a Danish manufacture of catalyst technology and the environmental performance of their products have to cope with emission requirements set up by the OEMs. These requirements are r to comply with the Euro standard, or to cope with tendering requirements for city buses.

### 4.3.3 Effects of demand on eco-innovation

Spill over effects

Through UITP (The World International Association of Public Transportation) the bus industry has set up the voluntary emission standard EEV (Enhanced Environmental Vehicle). There is a customer demand for vehicles that are able to meet the EEV standard and the Euro V standard that is yet not mandatory. Further, the emission standards vary from country to country and city to city. In larger cities as London and Paris specific requirements for emissions are set up. Bus manufactures have to comply with these standards in order to be included in the tendering process for purchasing of new city buses. Coaches and tourist buses are not pushing the innovation in the same way as city buses, but the new technologies developed for city busses do spill over to these buses as well.

For a range of technologies it is not profitable for the manufactures to maintain production of old and inferior technologies. SCANIA is for instance selling around 50 % of their products for the Brazilian and Russian markets. These markets are presently regulated according to the Euro III standard, and are on the way to implement the Euro IV standard. Some of the vehicle models that are introduced on these markets do only comply with the Euro III standard, but new models introduced on these markets will comply with the Euro IV standard. In this case there is a spill over effect from high-end specification products to lower specification products.

Mercedes-Benz Buses have achieved the German label Blauer Engel for environmental friendly products. The labelling scheme sets up requirements for the environmental performance of buses. Mercedes had to fulfil certain requirements in order to achieve the label, and in order to maintain the label, Mercedes has to make environmental improvements on a continuous basis. The acquiring of the label has been an advantage for Mercedes as the label is a requirement for some of their German customers. Future demand for buses labelled with Blauer Engel is a driver for the company to make eco-innovations in order to be able to meet the continuously stricter requirements of the label.

Public procurement

For one type of bus UITP has made a baseline comparison of the fuel consumption of various models. This baseline is frequently included in tender requirements, and is therefore an important driver for some bus manufactures to improve the environmental performance of their vehicles.

Where public procurement is a key driver of eco-innovation in the bus industry, it plays no significant role in the car industry. The public demand for cars constitute not a sufficiently large share of the car market to impact significantly on the car manufactures decision making.

Financial incentives

Financial incentives may be an efficient mean to support market penetration of new environmental friendly vehicles. The only company where the application of financial incentives has been a key driver of innovation is SAAB. SAAB differs from the other vehicle manufactures, as they primarily focus on the domestic market. In Sweden the government has applied an array of market pull instruments to support the market up take of cars fuelled with biofuels. The case of SAAB is described in Textbox 4-6.

*Textbox 4-6 Case study SAAB*

SAAB is producing cars to a niche market. SAAB primarily manufacturers relatively large cars. A very high share of there product are sold on the domestic market. Since 2004, SAAB has developed cars that run on 85% bio-ethanol. When SAAB decided to go for the development of the technology a range of circumstances were taken into consideration.

First, the corporate culture in SAAB supports the development of environmental friendly technologies.

Second, there was at this time a comprehensive public debate in the Swedish media on the opportunities for more environmental friendly fuels. Market signals from the public opinion and positive statements from the Swedish government convinced the company that bio-ethanol would be worth to go for.

Thirdly, increasing oil prices was also taken into consideration.

The development of an engine running on 85 % ethanol has been a relatively short development process. The basis of the engine is normal gasoline fuel engine. The engine is altered so it both can be fuelled with ordinary gasoline and bio-ethanol. The commercialization and further development of car fuelled on 85% bio-ethanol, has been very dependent on governmental support through the establishing of a range of market pull instruments.

If a car fulfils certain requirements it is in Sweden accepted as a Clean Vehicle. The following financial instruments are applied in Sweden:

-There is a SKR 10,000 subsidy on new Clean Vehicles.

-There is tax discount on 20% of taxes for environmental cars used as company cars.

-Hybrid cars and cars fuelled on biogas are granted a tax reduction of 45%.

-Biofuels are supported by being exempted from taxes.

-The annual taxes are calculated according to the vehicles $CO_2$ emissions.

-Clean Vehicles cars are exempted from road tax in Stockholm

-In many municipalities Clean Vehicles are charged lower parking fees or parking is free

Moreover, it was made mandatory for fuel stations selling more than a fixed level of fuels also to supply alternative fuels, i.e. bio-ethanol and biogas. The Swedish government has set up targets for State procurement of environmental cars. 85% of the cars procured by the State have to be environmental cars.

Source: Anna Petre, SAAB, 23 May 2008

The interviewed car manufactures have not reached the voluntary reduction of average $CO_2$ emission of new vehicles. The voluntary agreement has not been a strong driver of eco-innovation. The labelling scheme stating the $CO_2$ emission and fuel consumption of the vehicles, is nice costumer information, but the customers are investigating the car market profoundly before purchasing new vehicles and the information of fuel efficiency has existed in the car industry for a long period of time. Environment is not the most important issue for customers buying new cars, but is more seen as one issue among other issues (Miljöbyrån Ecoplan, 2005). There are strong indications that demand from consumers for more energy efficient vehicles do not constitute a strong driver for innovation in the automotive industry.

### 4.3.4 Sector recommendations

The transport industry is a rather competitive industry, but also an industry consisting of a relative few but very big global players. Strict regulation of the industry has a large impact on eco-innovation of emission technology. $CO_2$ emission is however not included in such regulation yet, but there is an increasing policy focus on reduction of the transport sector's $CO_2$ emissions, and the industry is making a range of innovations that will bring down the energy consumption and the $CO_2$ footprint of the industry. The background for decision making on such innovations takes in an array of conditions. The manufactures makes long-term estimates of the future market demand and as a part of these estimations, signals sent from the policy makers play an important role. The more clear targets policy makers set up, the easier it is for the industry to cope with these targets. Due to the long lead time on development of new innova-

tions it is important to set up fixed targets for emission standards with a long notice time (10-12 years). Application of financial instruments and the establishing of the needed infrastructure are efficient ways to promote the market uptake and further development of energy efficient vehicles and vehicles driven by alternative fuels.

Effect of increased demand for eco innovative products in the transport sector on future innovation

Due to their large size the OEMs in the transport sector have the resources to make profound investigations of the customer's present and future demand. The customers future demand may turn up to differ significantly from the anticipation the OEMs have made, this is a risk connected with a market, where there is a long lead time for development of new technologies. The OEMs do, however, not only react to changes or anticipated changes in customer demand but are also creating demand by introducing new products on the market. This also accounts for more energy efficient vehicles. The OEMs only account for around 25% of the parts used to manufacture their vehicles. A large part of innovation in the sector – and thereby also innovations that bring down emission from the driving of the vehicles – is conducted by OESs. The OEM set up requirements for their suppliers and thereby are pushing innovation up-streams the value chain.

Demand for eco-innovation impacts directly on the innovation process in the sector. Particularly for buses, coaches and trucks the innovation of 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. This effect is though smaller for the car industry where the present market is not influenced the same way by demand for fuel efficient vehicles. Demand from consumers for more energy efficient vehicles is not a strong driver for innovation in the automotive industry.

An increasing demand for clean vehicles will, however, impact directly on the innovation processes in the industry. The case of Sweden shows that increased demand for clean vehicles have lead to an increased eco-innovation among OEMs. A future demand for more energy efficient vehicles will lead to further innovation of such products. In order to impact on the decision making in the OEMs to make innovation the demand must constitute a considerable share of the market, as it is very expensive to develop new technologies in the industry.

Effect of increased demand for eco innovative products on diffusion of that innovation

As mentioned above the innovation within bus and truck technology differs from innovation in the car industry. The major focus on reduction of emission and decreasing fuel consumption implies that eco-innovation plays a major role for the innovation in the bus and truck industry. The result of new eco-innovative innovation trickles down to the other products that the OEM manufactures. For the car industry the relationship is less unambiguous. The engine technology is continuously improving with respect to energy efficiency, but due to customer demand for large and heavy vehicles with large engines and a range of accessories, the result is vehicles with high fuel consumption. In this case the trickling down of eco-innovation to other products is not necessary entailing more energy efficient vehicles. With respect to the application of alternative fuels, it is possible to propel all sizes of cars with alternative fuels. On a long term perspective, the OEMs expect that an increased demand for vehi-

cles propelled by alternative fuels, e.g. electric cars and fuel cell technology, will entail that these technologies trickle down to a range of different car models. The precondition for this is, however, that there will be a demand for these technologies.

The technological development in the car industry is integrated with the technological development in a range of other industries. The lithium battery technology was originally developed for other appliances, where there was a need for light batteries with high power capacity, e.g. in cell phones. The lithium battery technology is now being adapted in the automotive industry to be used in electric and hybrid vehicles. This is an example of spill-over effect from other industries that have been used in the car industry. The fuel cell technology will properly become used in a range of applications where it can substitute diesel generators, e.g. in cities where the emissions form diesel engines contribute to the local air pollution.

Recommendation on how policy instruments best can be put in place to stimulate greater rates of eco-innovation in the sector

- Public procurement plays a big role for driving innovation in the bus industry. By setting up specification 10-12 years in advance for the city buses the municipalities want to procure in the future, the bus manufactures will have time to make the necessary innovation to fulfil the future requirements. Public procurement on the other hand has little potential for driving innovation in the industry as the public procurement of cars constitutes a rather limited part of market.

- The case from Sweden shows that the establishing of financial incentives and the necessary infrastructure has had an enormous impact on the innovation of vehicles that run on biofuels. The combination of application of financial instruments to support market take up and the establishing of an infrastructure for alternative fuels are an efficient way to drive eco-innovation the industry.

- The automotive sector is difficult to impact on the customers demand by applying other demand pull instruments than the financial. Labelling of $CO_2$ emissions and the setting up of voluntary agreements with the industry has not a substantial impact on demand for duel efficient and clean vehicles. This is primarily due to the customers valuing other features of new cars, e.g. comfort, security and prestige in having a large vehicle, which implies heavier and less energy efficient vehicles. With increasing fuel prices this might change.

The most efficient driver of environmental improvements in the industry has been regulation, and the most efficient way to drive innovation will, except of financial instruments, be regulation of $CO_2$ emissions and by internalisation of eternal costs – as it is already proposed by the EU Commission. Ín Table 4-1 below is a list of recommendations expressed by the sector during the interviews.

*Table 4-1 Recommendations expressed by the transport sector*

| Recommendation | Description |
|---|---|
| Technology path independency | There is a common understanding in the industry that the best way for governments to support the development of eco-innovation is in a technology path independent way. The politicians should set up the targets e.g. in terms of $CO_2$ footprint but it should be up to the companies to chose the technologies they see most suitable to achieve the target. |
| Clear targets | The setting up of clear targets for the future is very important for the industry. Due to the long lead time on development of new technologies the industry needs to know the environmental requirements that they will have to comply with in the future. The signals that the politicians send are very important for the companies in order to access future market demand and thereby to reduce uncertainties for the investment decision to be taken now. |
| Public procurement | The public procurement of buses is a very strong driver for innovation among bus manufactures. By setting up requirements that go beyond the performance of existing technologies, innovation can be reinforced. However, the requirements have to be set up well in advance. If a large city for instance set up the tender requirements for the buses they will purchase in the future, the bus manufactures will have an incentive to make adequate investments into the innovation process in order to be competitive in the future. |
| Needed infrastructure | The development of eco-innovation in the car-industry is dependent on the accessibility of alternative fuels. It is a problem if the Member States only support specific types of alternative fuels. |
| Financial instruments | The setting up of financial instruments is an efficient mean to support the market up-take hence stimulating further development of eco-innovations. As part of such economical incentives environmental friendly cars can be freed from car toll and allowed free or cheap parking lots, as it is known from Stockholm. |
| Labelling schemes | Some of the bus manufactures see the establishment of a type of eco-labelling as a potential for driving innovation. The labels have to include continuously more strict requirements in order to be effective. For the truck industry the setting up of such labelling schemes is difficult. There is a big difference in how to design a truck that is going to drive in mountains compared to a truck driving on plain land. The measurement of the fuel consumption of trucks therefore has to take the actual usages of the vehicle into consideration in order for the labelling of the vehicle to make sense. |
| Harmonization of requirements | The requirements for emission standards for city buses differ significantly between the Member States and from city to city. A harmonisation of these emission requirements would help the industry to make the eco-innovation on emissions more efficient. |
| Complicated procedures | It is very difficult for small companies to get part in the R&D subsidies that EU offers. The procedures for applying for these subsidies are too complicated and time consuming. |

Source: Developed by Consultant based on sector interviews.

## 4.4 Construction industry

This section builds upon information from four interviews, three of which were with product manufacturers, i.e. Grundfos, Danfoss and Rockwool, and one with the business association: The European Council for Construction Research, Development and Innovation (ECCREDI / BBRI). In addition, written material from the national and EU levels was used.

### 4.4.1 Sector description

Economic importance

The construction sector may be defined as all the activities that contribute to the creation, maintenance and operation of the built environment. The sector is very large. It is the largest single economic activity in Europe accounting for

around 10% of GDP and for over 50% of fixed capital formation. In 2004, the sector employed more than 13.2 million people directly. These represented 7.3% of total employment, but the figure does not include the manufacturing industry and downstream services related to construction. The residential sector represents 46% of total construction in the EU, the non-residential sector 31% and civil engineering 23%.

Supply and user chain

The industry is characterised by a complex and fragmented supply and user chain consisting of many actors, a large number of relatively small firms, and a big number of relatively small construction projects. The fragmentation is caused by the main disciplines involved and a long and complex supply chain bringing together different specialist. Low profit margins combined with traditional procurement tend to lead to adversarial relationships among the actors who are often disinclined to enter into supply chain wide relationships. This leads to many deficiencies in terms of productivity, costs and quality. The principal actors involved in the supply chain are:

- *Users*: the owners, tenant, lease-holders or others;
- *Service providers*: those partly or fully in charge of the exploitation and maintenance of buildings and infrastructures;
- *Owners*: initiators of construction projects, investing in design and construction of the assets;
- *Architects and engineering firms*: in charge of design and, in some cases, of coordination of the construction activity;
- *Contractors*: specialised in technical aspects related to construction;
- *Product distributors*: commercial/technical intermediaries between product manufacturers and contractors;
- *Product manufacturers*: produce the elements needed for the construction;
- *Material suppliers*: provide materials necessary for the production of construction products.

Competition

Most of the construction industry serves national and local markets and is not in competition with suppliers from outside Europe. Moreover, the diversity of firms and the "construction business system", i.e. the typical division of responsibilities and relationships that characterise construction projects, differ from country to country. Globalisation of the industry is therefore very limited apart from the development and marketing of some of the products that the industry uses in its construction activities.

"Green" diversity

The actors of the industry are also very different. Some designers and contractors create building and infrastructure works of international recognition. At the other end of the scale there are countless individual small construction related firms that operate in very local markets, mostly undertaking small domestic building and maintenance works. For these firms new environmentally innovative products and the associated innovation are far removed from their daily concerns. However, new innovations over time influence their activities

through the products and services they use and the policy instruments, notably regulations, that govern their work.

### 4.4.2 Factors influencing demand expectations

Actual markets

There are three main market segments, namely the residential, the non-residential and the infrastructure market. Two other market dimensions are: works related to existing buildings and construction of new buildings. Buildings generally have long service lives of several decades up to 100 years or more. There is a low replacement rate of the building stock (around 1% per year) and an even lower rate of building demolition.

Focusing on the market for sustainable construction – or eco-construction – this concept can be defined as the creation and responsible management of a healthy built environment based on resource efficient and ecological principles. It is characterised by minimisation of resource consumption, maximisation of resource re-use, use of renewable and recyclable resources, protection of the natural environment, creation of a healthy and non-toxic environment; and pursuit of quality in creating the built environment. The three market segments react differently to the sustainable construction market potential.

There is only a limited direct link between those who design and construct the buildings and the 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. However, there is a trend towards more green demand and it could be supported by more information targeted at the right levels. The actors of the supply chain primarily react to what their respective clients request up and down the supply chain (immediate customer driven) and the expectations of new markets opportunities (additional profit motive).

Potential markets

There is large scope for eco-innovations in the building sector. As to existing building stock this includes insulation work, double glazing, acoustic developments, etc, which will have immediate effects in terms of energy efficiency and hence effects on climate change, indoor air quality, re-use/recycling and other sustainability issues like safety and accessibility. Construction of new buildings has the potential of incorporating more environment-friendly products and processes and will therefore affect sustainability issues in the long term. Innovative technologies exist which could substantially improve the energy performance of buildings by more than 30% at reasonable cost in the short term, or which could offer opportunities for decentralised energy supply with renewable energies. But the market for sustainable construction needs to be further developed.

The demand for eco-innovative products and complete buildings that most owners, tenants and users exercise is somewhat limited with a similarly limited impact on eco-innovation. Therefore, regardless of potentially positive attitudes

among end-users to eco-construction (possibly supported by economic growth, increased purchasing power and an increasing share of citizens focusing on sustainability issues) demand for sustainable construction and renovation has to come especially from the levels of the supply chain preceding the end-users in the majority of cases.

Textbox 4-7 below lists a series of innovation themes and environmental demands as identified by the European Construction Research Network while Textbox 4-8 describes demand expectations for energy efficient pumps and related innovation in pump manufacturing company.

*Textbox 4-7 Innovation themes and environmental demands*

The European Construction Research Network has identified the following key goals for meeting environmental demands in the future:

Cheaper and more effective ways of improving the thermal performance of existing buildings, without incurring major disruption or changes in appearance;

More intelligent control systems, responsive to user requirements without intervention;

More efficient glazing, heating and lighting systems;

Novel cooling devices;

Localised power generation systems, enabling greater use of “waste" heat, and more;

Independence from conventional sources;

Re-use of water in buildings without introducing health risks;

More flexible buildings, so that new uses can be accommodated without the need for early replacement of otherwise satisfactory components and materials;

Increased use of recycled and waste materials and industrial by-products in construction products;

More durable components to reduce resource usage in maintenance and operation;

Improved techniques for removing pollutants from previously used sites, cheaper and safer means of underground construction.

Source: European Construction Research Network (2005): *E-CORE, Strategy for Construction RTD.*

*Textbox 4-8 Demand expectations and innovation in pump manufacturing company*

Grundfos is one of the world's leading manufacturers of pumps. Circulator pumps for heat-

ing and air-conditioning (about 50% of the world market) and other centrifugal pumps for industry, water supply, waste water and dosing are the major products. Grundfos has recently developed the Alpha 2 A Rated Pump, which is the most advanced and energy-efficient domestic circulator of its kind on the market today.

Pump systems nowadays consume almost 20% of total electrical energy worldwide. Grundfos was a main initiator of a classification scheme in relation to energy labelling for circulators pumps. Circulators are now labelled with the A-G energy label well known from the white goods and household lamps market. The labelling scheme came into force in March 2005 and is controlled by a voluntary industry commitment agreement, which is managed by Europump that is the European Association of Pump Manufacturers representing 18 national associations in 14 Member States, Turkey, Romania, Russia and Switzerland.

In Europe there are approximately 120 million central heating pumps in operation in houses, and of these about 10% are newly installed or replaced each year. The average pump installed in European households falls under category D or E. Since new energy-saving pumps of category A consume up to 80% less electricity than other circulators, energy savings of several million EUR per year are possible.

This is an example of an initiative of product manufacturers to meet the general societal environmental objective of energy savings. It only indirectly responds to a demand from those in the construction industry that design and construct buildings or procure circulator pumps as there is limited explicit demand for such products from owners, users or tenants despite the large potential energy savings and associated environmental benefits.

Source: Grundfos interview and company material; scientific and newspaper articles.

Regulations

Regulations and standards affect demand. The construction industry is subject to many regulations and several thousands of regulations and standards apply to the industry in Europe alone. They are often country-specific, reflecting national building traditions and concerns leading to requirements that buildings should be constructed to recognised standards of technical performance. Regulations introduce minimum and maximum standards where the buyers concerned often are unable to make informed judgements. Regulations can promote demand and innovation by setting high performance standards but they may also act as barriers to innovation.

The European Energy Performance of Buildings Directive (EPBD) entered into force January 2003. It emphasises minimisation of energy consumption based on a common methodology for calculating the energy performance of a building taking account of local climatic conditions. It is applied throughout the EU. Minimum standards for energy performance are determined by the Member States and applied both to all new buildings and to major refurbishments of existing large buildings (larger than 1,000 $m^2$) with effect from January 2006.

Demand pull instruments

Public authorities have the potential to support eco-construction through a number of means. One way is through green public procurement (GPP), which is particularly relevant for public institutions like schools, kindergartens, nursery homes, hospitals, old people's home. This opportunity has been exploited by the Member States to a surprisingly limited extent with less than 20% of the invitations to tender containing solid green criteria. These have typically related to environmental harmful matters, the timber used, energy use and savings, and water efficiency. One major reason offered is that the departments dealing with building procurement on the one hand and building operation and renovation on

the other draw on different budgets and that national and local politicians and administrators rarely base their procurement decisions on life cycle considerations related to the assets being acquired.

Other economic instruments such as indirect taxation and targeted subsidies are also used but policies on subsidising construction vary greatly in the EU Member States. Some have introduced indirect support by removing the tax burdens associated with construction. In other states a fixed amount of funding is available regardless of the investment sum.

### 4.4.3 Effects of demand on eco-innovation

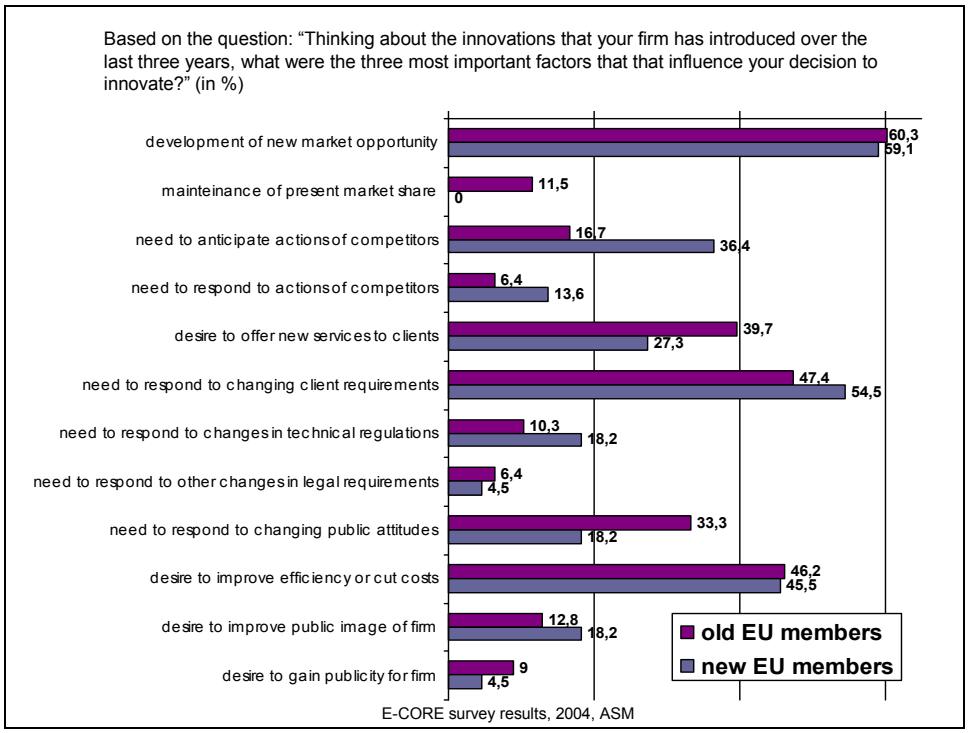
The effects of demand on eco-innovation is analysed based on the drivers of innovations, links between demand expectations and eco-innovation and factors that affect eco-innovation decisions.

**Drivers of innovation**

Innovation survey

In assessing the effects of demand on eco-innovation in the construction industry, the point of departure is the drivers of innovation in the industry in general. According to a survey undertaken in 2004 the main drivers of innovation in the construction industry in general were as follows:

*Figure 4-2Main drivers of innovation in the construction industry*




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

The survey covered 347 construction firms in throughout Europe. Around 40% of the respondents were from the old EU Member States and the remainder

from new Member States, especially Poland accounting for 93% of the responses from the latter. The survey covered both design firms, product manufacturers, contractors, research-oriented firms, research and higher education institutions, and trade associations. The survey appears to be the first of its kind to describe innovation issues in the construction industry in broad terms.

In general, the significant drivers of innovation 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%).

The survey did not ask companies about the drivers of eco-innovation directly. However, drivers such as "desire to improve public image of firms", "need to respond to public attitudes" and "desire to gain publicity for firm" as well as CAC drivers like "need to respond to technical regulations and other legal requirements" could be interpreted to be the major drivers that include eco-related issues. The survey found these drivers to be comparatively less important that those stated above. However, "meeting client requirements" could also relate to environmental issues.

This supports the general finding from the literature review and interviews conducted that there is limited explicit demand for eco-innovative products in the construction sector. Products and inputs are not so much judged on their green properties but rather on whether they meet the functional requirement defined by the client. If the product has an imbedded environmentally friendly attribute it is an additional benefit, but it is not a demand dimension that is a qualification in its own right.

Different motivation for innovation

The preparedness for change and the motivation and nature of innovation vary among the actors within the supply chain. For contractors, 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.

**Link between demand expectations and eco-innovation**

Profit motive

Considering that the main drivers of innovation in the construction industry are to develop new markets, meet the customers' requirements and offer them new services in order to be most profitable, any eco-innovation in that direction would be interesting to the actors in the construction supply chain. In other words, 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. This is supported by the literature review, interviews and the E-CORE study on innovation. Further, there is no evidence to suggest that a good potential for eco-innovations in a company contributes to increasing R&D budgets and spend, let alone has the effect of crowding out innovation in less environmentally friendly products.

This may not come as a surprise as it is strictly in line with the generally proven premise that firms in market economies are profit maximising. However, some firms may have corporate policies that compel them to adopt strategies that maximise their focus on eco-innovation, partly because it may be part of their statutes, partly since it will improve their green image, which in itself may serve as a marketing tool.

However, there is an expectation and an increasing awareness among the actors of the supply chain of climate and environment issues becoming key issues in the construction sector in the future. This is strongly advocated by their respective interest organisations (business associations) that are generally more sensitive to those signals from both policy and consumer levels than tends to be case for the actors individually.

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. Given, however, that the construction industry is characterised by many SMEs 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. If these barriers cannot be broken down by demand pull factors, the only means to do it would be CAC instruments which tend to be less effective and efficient than market based factors, including market pull instruments. Some companies see supply chain cooperation as being strategically important, but many others have to be forced to enter into it.

*Textbox 4-9 Optimisation of cooling and air-conditioning systems in the supply chain*

Danfoss operates globally as a large supplier of compressors and automated solutions to the refrigeration and air conditioning industry. The products are used within a number of business areas, such as household, commercial, food retail and industrial refrigeration as well as air conditioning, products for the wholesale refrigeration market and automation in various specific industrial sectors.

Refrigeration and air-conditioning are energy-demanding. Recognising an increasing general as well as market focus on solutions to reduce overall energy consumption - and thereby $CO_2$ emissions, Danfoss' R&D is increasingly targeted at energy-saving products as well as other environmental challenges like the reduction of the amount of refrigerant used and the use of natural refrigerants in applications, where possible, as well as in the development of electronic expansion valves.

However, as Danfoss' products are used in large refrigeration and air-conditioning systems produced by OEMs and other companies there is a need for systemic solutions rather than

optimisation of individual elements of the systems. By seeking system rather than component optimisation there is much to be gained. For example, there is no point in developing a highly efficient compressor if it is used in a sub-optimal system that only barely makes it qualify for a good score in an energy labelling scheme.

To this end Danfoss' has taken the initiative to establish or has entered into strategic development alliances with some of its biggest customers within refrigeration and air-conditioning, including producers of refrigeration systems for supermarkets. The aim is together with the alliance partners to develop systems that maximise energy efficiency, minimise the use of refrigerants and oils, and make the systems as compact as possible with the lowest material use possible. Only if such systemic approach is adopted is it likely to achieve these goals.

Source: Danfoss interview and company material.

*Textbox 4-10 Eco-innovation spill-over from one product group to another*

Grundfos' main product line is pumps for heating and air-conditioning as well as other centrifugal pumps for industry, water supply, waste water and dosing.

Development of the so-called NoNOx urea dosing systems is a spillover effect from this main product line of Grundfos pumps. Grundfos has developed and marketed dosing pumps for a number of years. Digital dosing pumps make it possible to dose liquids with great precision. Work with these pumps formed the background for the development of the technology behind the Grundfos Urea Dosing System.

The technology allows very precise dosing, thereby enabling a vehicle catalyst to remove most of the damaging nitrogen compounds - NOx compounds - in the exhaust of diesel engines by reducing them to harmless nitrogen and water through a process known as selective catalytic reduction (SCR). A stepper motor and advanced electronics are employed to deliver precise amounts of urea, i.e. AdBlue, over a wide range of fuel flow. Grundfos NoNox solutions can be used with most Euro 1, 2, and 3 applications, achieving Euro 4 and 5 emission compliance.

Grundfos secured a prestigious order to deliver the NoNox system to be fitted on 4,000 busses of Beijing before the Olympics in 2008. China is already in 2008 adopting the Euro 4 norms for heavy vehicles while the norm are to cover the rest of China two years later.

Source: Grundfos interview and company material; scientific and newspaper articles.

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. Sometimes production subsidiaries find it difficult to internalise the innovation inputs created at central level. In smaller companies the distance between innovation and production is shorter.

Policy instruments

The main policy instruments affecting eco-innovation are directives and national regulations setting standards of technical performance including energy performance. There is only limited use of market pull instruments such as green

public procurement, labelling, and economic instruments involving taxation and subsidies.

Examples of economic instruments are subsidies for ecological or organic buildings, subsidies for clean technologies and products, and renovation (including insulation) loans for buildings with interest rates varying with energy efficiency achieved based on subsequent energy audit. Economic instruments are sometimes used in conjunction with employment generating policies. Further, a number of Member States have developed a kind of labelling system for construction materials.

The Eurocodes is a set of European Standards for the design of buildings and other civil engineering works and construction products. They cover in a comprehensive manner the basis of design, actions on structures, the principal construction materials, all major fields of structural engineering and a wide range of types of structures and products. However, they do not explicitly address sustainability issues like energy and environmental aspects.

In consequence, the construction industry has limited views on the usefulness of market pull instruments as drivers of innovation. Most companies are more familiar with the effect of their own or the sub-industry's marketing efforts and have often not thought of the potential effect of public market pull such as public information campaigns.

In many instances the environmental goals and the related innovation pull can only be achieved through deployment of a mix of policy instruments. In order to induce policy makers to develop policy instruments to support environmentally friendly behaviour of the actors in the supply chain they form interest groups or lobby organisations. This is exemplified in the Textbox below.

*Textbox 4-11 Stimulating eco-innovation through a manufacturers association*

The Rockwool Group is a major supplier of products and solutions based on stone wool. The Group is amongst the global leaders within the insulation industry. Other products include building related products such as acoustic ceilings and cladding boards.

With 40% of Europe's energy being used in buildings, this is the largest single energy-using sector. More energy is used in buildings than is used in either transport or industry. Buildings have a very high energy saving potential. A properly insulated home uses only 27% of the energy that is needed to heat a standard house built before 1974.

Insulation is by far the most reliable and important measure to reduce the energy use in buildings, as it accounts for 78% of the total energy reduction potential. Energy saving and energy conservation planning are key to capturing the potential.

Against this background Rockwool has taken a series of initiatives at national and EU levels to promote insulation as a means to reduce energy consumption and further develop its business. It has taken the lead in lobbying for more and better insulation use in buildings, among others through EURIMA, the European Insulation Manufacturers Association that represents the interests of all major mineral wool producers throughout Europe.

Rockwool has contributed to developing EURIMA material to influence EU policy makers in a direction that the insulation manufacturers believe will be necessary towards a 20% reduction in heat related energy use in buildings by 2020. The material recommends the combined use of CAC and demand pull instruments as well as technology push instru-

ments:

*Step 1: Create a strong regulatory framework*
1. Revise the Energy Performance of Buildings Directive;
2. Ensure effective implementation of the Energy Services Directive;
3. Implement minimum EU requirements on energy performance of buildings.

*Step 2: Develop effective incentives*
1. Provide EU funding for energy efficiency improvements;
2. Remove VAT for energy efficiency improvements.

*Step 3: Provide proper information*
1. Provide consumers with regular and clear information on cost-effective energy efficiency improvements;
2. Improve best practice sharing on energy efficiency.

Source: Rockwool material and interview, and EURIMA publications.

Insulation material is an example of a product that is environmentally friendly by definition, not because of progressive innovation leading to increasingly more green products. However, insulation production itself is also subject to innovation, especially by making the production process more energy efficient and by using more waste products as inputs and using other energy sources.

**Factors affection eco-innovation decision-making**

Effect of increased demand for eco-innovative products of eco-innovation

Expectations about future demand for eco-innovative products and complete buildings in the construction sector are shaped by a number of factors and so are decisions to undertake eco-innovation. The most influential actors of the supply chain as to the direction of demand and innovation are engineering firms, architects, design firms etc. – and to a varying degree the owners, i.e. the initiators of construction projects. However, many owners, and especially tenants and other users have only limited impact in determining demand.

The demand for environment friendly products and building concepts expressed by key decision-makers; including consulting engineers, experts and advisers, is mainly influenced by the extent to which a general trend towards greener or more sustainable construction is going to penetrate the market as well as construction and product costs (but rarely life cycle costs), regulations, building standards, and to some but quite limited extent market pull instruments. The latter have been used to a limited degree in construction in the past but are not considered main drivers of demand and innovation by the industry.

Present regulations and standards as well as other policy measures are also taken into account. Planned or anticipated policy instruments are considered in order to make sure that a building or construction will meet expected future technical performance requirement, including energy efficiency, in-door climate requirements, maintenance and operation issues, etc. If not, the engineers, designers etc. will face problems with their customers, i.e. the initiators of the projects who have to be ensured that the buildings satisfy both present and anticipated future requirements. Not only is this important to meet public demand. It also has an impact on the future market price of the building or other construction which is an important issue for the building owner.

Owners, but especially engineers, architects, designers and others involved in the detailed design of the project, therefore keep a very close eye on the development in technical standards, often assisted by their interest organisations that are responsible for keeping them informed about these aspects. They also need to be fully informed about market pull instruments in order to provide the best advice and recommendations to the building owners who are their clients. This is particularly the case for economic instruments that may swing the choice of a building concept or material choice in a particularly green direction for example.

Product manufacturers and suppliers on their part 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, whether new integrated and more eco-friendly design concepts are under development, applications etc. The product manufacturers have to make their own demand projections in order to decide on the right innovation direction and timing in accordance with these demand expectations. They 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 product adaptation.

Competition also plays a role. Manufacturers of simple and heavy inputs that are used in large quantities are often shielded from international competition given the national nature of the construction markets, while producers of electronic devises, pumps, sensor systems, measuring devices, advanced fittings etc. are more prone to competition and therefore more innovation intensive.

Some products have long innovation lead times and therefore require that innovation decisions be made long before the market eventually materialises. This goes for any product including eco-innovative products. If the company decides to go ahead, it may get a first mover advantage and competitive edge when demand takes off and becomes buoyant, but in some cases the market may not materialise. The manufacturers factor these risks into the decisions. Sometimes a product market may be overtaken on the inside by new material inputs that have been developed in the meantime by downstream suppliers. This requires them to make decisions on an incomplete information basis. There more risk adverse, the more disinclined the companies are to engage in major innovation initiatives towards more eco-innovative products.

Generally, if the anticipated demand arrived at through such process is of an environmentally friendly nature the companies will make innovation decisions reflecting such eco-orientation. If less so, they will tune innovation efforts to products with less environmentally characteristics in order to maximise profits. Thus, 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 be chosen.

Diffusion of innovation to related products

The material and evidence gathered does not provide any unequivocal conclusion regarding how eco-innovations diffuse to other product lines within companies or between companies. It appears though, that such diffusion primarily takes place within larger companies with a strong capital foundation that base their business development on well formulated business strategies.

Where this is the case firms typically set a market, product or innovation goal and allocate resources to acquire the technology necessary, be it through their own R&D efforts or through acquisition. In such processes firms often scout around for technology inputs from other product areas or sectors that could meet the product and innovation goal set. In some instances, companies have technologies at their disposal internally that can be applied to different product markets.

The slowly emerging tendency in the construction industry to begin seeing construction in an integrated perspective is likely to lead to spillover effects, but this is only slowly beginning to show. Once entire systems and concepts with many components and inputs are to be optimised against well-defined environmental criteria, the areas, products and materials, that fail to meet these criteria in a combined structure, will loose out and other more environmentally friendly ones will be needed. This is beginning to affect eco-innovation, but many actors in the supply chain still act in a very independent way.

### 4.4.4 Sector recommendations

Based on the review of the sector the following recommendations can be made concerning two dimensions:

- Quality dimensions required in order to make market pull mechanisms effective; and
- Scope for changes to existing demand pull instruments or possible new ones.

**Quality dimensions required to make market pull mechanisms effective**
In spite of the relatively limited use of market pull mechanisms (MPMs) in the construction industry the qualities or attributes required to make them as effective as possible in promoting innovation could include the following.

*Table 4-2 Attributes of good demand pull instruments in the construction industry*

| Attitude | Description |
|---|---|
| Support long term environmental policies and objectives | There should be a clear link between the MPM and a (long/longer term) environmental policy objective. This is clearly the case for MPMs in the construction sector. The problems is rather that while much EU policy addresses energy efficiency and sustainable construction, very limited efforts have been made to investigate the potential of deploying MPMs to meet objectives and targets. |
| Supported by science and economics | MPMs should be supported by scientific evidence and economic considerations. As an example, this was the case for the introduction of the voluntary labelling scheme for |

| | |
|---|---|
| | circulator pumps. It has also been used by the European Insulation Manufacturers Association for enhancing use of insulation in buildings. They should highlight financial saving potentials for consumers, profit opportunities for the actors involved in the supply chain, and environmental benefits to society. |
| High potential impact among consumers and users | The MPMs should address issues that make an impact. The insulation case shows the great potential for energy savings but few DPI initiatives addressing the users and other parts of the supply chain have been taken to exploit the potential. Solar PVs, for example, have received much attention but have less saving potential seen in a cost perspective. |
| Reach as many consumers or users as possible by targeting the right level in the supply chain | MPMs such as labelling schemes should reach and inform as many consumers as possible. The circulator pump label may not be known or understood by most private house owners or users, and would therefore not have much impact on the decision to purchase pumps, which is left to the plumbing and heating service companies. Labelling schemes would gain from the support of public information campaigns. Messages should be comprehensible for consumers and users, i.e. use of layman like terms should be pursued. Information should be easily accessible through easy-to-find websites and other information sources. |
| High backing from suppliers | MPMs should be supported by the majority of supplies to be effective. E.g. voluntary labelling schemes primarily favouring first movers may get limited backing by suppliers if the market is not ripe for the introduction of the label. This would limit its impact among consumers. |
| Avoid sub-optimisation | Eco-labelling of building materials and systems at component level may lead to sub-optimisation at system level. Some parties in the construction sector therefore argue in favour of labelling of building as a whole rather than of its components. |
| Possibility and quality of enforcement (important for credibility of instrument) | To the extent enforcement and/or monitoring is an issue (mandatory labelling schemes, GPP rules, subsidies etc.) a system should be in place to do so. If not, credibility dwindles. Construction materials not meeting environmental declarations have reduced consumer trust in voluntary labels. |
| Maximise synergies with other policy instruments | Before design and introduction of MPMs, their potential synergies with other policy instruments (CAC and technology push) should be investigated to maximise impact. |

Source: Elaborated by Consultant

Study findings

**Scope for changes to existing market pull mechanisms or possible new ones**

The review of the construction industry made in this chapter has not been of such nature and depth that it is possible to suggest changes to existing or introduction of new market pull mechanisms in the construction industry.

One thing that has transpired from the interviews is, however, that there is a general lack of awareness and information among users and owners of buildings regarding 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.

There would also seem to be a potential for enhancing the use of GPP by way of information measures combined with regulations requiring public institutions to adopt sustainable procurement policies, especially in areas where there are both financial gains to be made by the public authorities concerned and economic benefits to society at large. Today this is often hampered by the separation of investment and operation budgets.

Use of financial instruments such as publicly guaranteed loans for obvious energy saving projects, e.g. building renovation and insulation in existing buildings, with interest rates based on energy saving obtained have been suggested. Along the same lines insulation manufacturers suggest the use of EU structural funds to support energy efficient renovation of the building stock and removal of VAT on labour and materials used for energy efficiency improvements.

A system of building certification that makes energy consumption levels much more visible to owners, tenants and users could be introduced. Boilers and air conditioning systems above minimum size would be inspected regularly to verify their energy efficiency and greenhouse gas emissions.

Introduction of compulsory building audits including energy efficiency and other environmental performance have been suggested, just like it is required for vehicles in many countries.

Taskforce proposals

The report of the taskforce on sustainable construction "Accelerating the Development of the Sustainable Construction Market in Europe" from 2007 addresses policy instruments related to innovation and sustainable construction. While based on a substantial work effort, it does not arrive at many conclusions as to the potential of using market pull instruments. It states:

> "Market based instruments can prove to be the appropriate instrument for meeting a well defined common interest objective, when they do not distort competition or create extra administrative burden for enterprises. The decision to use incentives should follow a thorough analysis of potential negative and positive effects which should include social, economic and environmental impacts. Alternatives should be considered, cost effectiveness of options should be compared, and the risks of imperfect implementation and unintended consequences should be carefully taken into account. In general, incentives should be clearly limited in scope and time."

In its roadmap to sustainable construction the taskforce recommends a few demand pull instruments and other initiatives to be considered:

- Develop guidance for the choice between EMAT and the Lowest Price and for the use of Life Cycle Costs in construction works - Promote Life Cycle Assessment for construction products ("Environmental Product Declaration") and for buildings (standardisation work in progress);
- Develop voluntary performance targets to enable the implementation of incentives and other policy measures to promote sustainable buildings and construction practices;
- Define the framework for technical assessment adapted to a rapid certification of innovative products to sustainability criteria;
- Show the business case for an effective supply chain and identify relevant contractual, management, financial and insurance arrangements.

## 4.5 Pulp and paper industry

The main focus of this sector study is on paper producers, supplemented with information on up and down stream challenges in order to put information into perspective on how market changes affect eco-innovation in the sector. The section is based six interviews, four with producers of paper and two interviews with industry organisations. The section is moreover supplemented with academic literature and studies of the pulp and paper industry, particularly a study of Paula Kivimaa on the "The innovation effects of environmental policies" with focus on the Nordic pulp and paper industry" (Kivimaa, 2008).

### 4.5.1 Sector description

Size of the industry

The pulp and paper industry count a large number of producers mainly from North America, North Europe and South East Asia. It is a mature industry with long traditions in Europe. The biggest paper producing country in Europe is Germany, followed by Finland, Sweden and Italy. Finland and Sweden are the main pulp producers in Europe. In 2005, the European pulp and paper industry had a turnover of € 74 billion (CEPI 2008a). The industry has some 260,000 direct employees in Europe and contributes to the employment of an additional 1.8 million people indirectly (CEPI 2008a). Particularly in some rural areas the industry plays an important economic role.

The European industry consists of 800 companies (CEPI 2008a), of which 25 are among the 100 largest in the world (PWC 2007). In Europe there are some 1200 paper mills and many of the companies in the industry have invested mills outside Europe, particularly in Asia. European production[8] counts for 27% of world production of paper and board products.

Products and markets

The pulp and paper industry produce a range of paper products mainly for packaging and printing paper, used for i.a. newspapers, magazines, and books, but also paper tissue, kitchen towels (CEPI, 2008a). According to CEPI, 75% of the European production is sold on European markets; where as 25% is exported.

The paper industry is on the B2B market. The primary customers of the paper producers are wholesalers and printing houses which respond to the demand of end users.

Competition and globalisation
Environmental impact and increased environmental awareness

The environmental impact from paper production derives mainly from waste products, i.a. waste water, energy consumption, hereunder electricity, and emissions of i.a. $NO_X$, $CO_2$, $SO_2$ and chemical use. Waste products and emissions have been significantly reduced during the last decades, among others because of stricter environmental regulation as is returned to below in section 4.5.3. The industry is also making use of a range of labels and certifications to demonstrate their focus on the environment.

[8] Based on information on CEPI member countries: Austrial, Belgium, Czech Republic, Finland, France, Germany, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland and UK

Labels on sustainable foresting were the first labels to be recognised and widely applied within the sector and these labels are according to interviews a key in the sustainability debate for the industry. According to CEPI, the significant role of virgin wood as a raw material must be recognized as there is no recycling without access to virgin wood. Here the certifications of sustainable logging are important in showing that the industry is taking responsibility.

Eco-labels, hereunder the Nordic Swan and the European eco-flower are used increasingly. According to one of the interviews demand for products with the EU eco-flower is not only from European customers but also from the US there is increasing demand for products labelled with the EU eco-flower. This indicates a diffusion of demand for products with environmental characteristics.

Also Environmental management systems, hereunder ISO and EMAS[9] certifications are used as part of demonstrating CSR. Changes made in order to comply with the requirements of these management schemes have led to more environmentally friendly production processes, according to the interviewees. All companies interviewed during this study stressed the importance of this as part of their positioning in the market. The use of these certifications does however, according to CEPI, depend on the sixe of the company, as the certification may involve significant cost for small producers.

### 4.5.2 Factors influencing demand expectations

The question about how the companies make their expectations of future demand is sensitive, and during the interviews it was only possible to get limited information on this issue. This must be seen in relation to the current situation of the sector. It is as mentioned above a mature industry with high competitive pressure. Moreover, ot is a sector with a relatively low R&D investment (Kivimaa et al., 2008 p. 51) According to CEPI there probably are several closures a head in the industry. This influences the strategic thinking of the producers hereunder the demand expectations and innovation patterns. Nevertheless, based on the information provided during the interviews it is clear that there are three key factors influencing the expectations of demand:

Consumers

One indicator taken into consideration in forming future demand expectations is customers preferences. This covers both the quality and quantity of the products hereunder the willingness to pay. This depends on state of the market, trade conditions as well as current trends. For instance, if it is trendy to buy recycled paper, demand for these products may be assumed to increase, where as if it is luxury that is prevailing, paper products demanded are often white and bright.

According to some of the interviews, environmental criteria are to an increasing degree becoming part of the customers' assessment of the quality of a product and this is also a factor when assessing future demand.

[9] EMAS – Eco-Management and Audit Scheme

Competitors

The actions of the competitors are also part of assessing the future demand. As the competition is fierce it is important to not fall behind the competitors and their developments are followed closely. This counts for both, quality and price competition and as seen in section 4.5.3 this impacts on the innovation patterns.

Conversely, competition may also be a benefit for the producer. In some cases the entrance of a competitor on the market can actually lead to increased demand for products. According to one of the interviews, first mover benefits are limited in some cases as customers do not want to take the risk of relying on one producer only, hence the entrance of a second mover may reduce the risk for the customer and lead to a significant increase in demand.

Policy

Policy developments play a role in the assessment of how the market is expected to develop and which market opportunities will arise. It is considered important to have knowledge about future developments at an early stage in the policy process. Introductions of policy measures or policy objectives, both for the paper industry directly and for other sectors may influence the market opportunities of the industry as case examples in section 4.5.3 will show.

The importance of these three factors on the innovation decision and for the eco-innovation patterns in the industry will be elaborated further in section 4.5.3 below.

### 4.5.3 Effects of demand on eco-innovation

The interviews indicate that innovation in the sector is mainly focused on production processes and focus on product innovation is somewhat more limited. This is also supported by findings of Kivimaa (2008, p. 38). As the competitive pressures on the sector increase so do the incentive to minimise cost of production and this is one of the key drivers behind process innovation. Demand for high quality products, e.g. with a higher brightness, or products with certain environmental characteristics, are important signals taken into the innovation decision making. Overall, the drivers for innovation in the paper industry are:

- Regulations and standards at national or EU level
- Emission trading schemes
- Increasing raw material cost
- Competitive pressures in the sector
- Product differentiation
- Market signals, hereunder trends and estimated future demand
- Voluntary eco-labelling schemes (Eco-flower, sustainable foresting labels)
- Voluntary certification (charter, EMAS, ISO)
- Corporate social responsibility (CSR)

Process innovation

According to Youtie et al, the innovation efforts has particularly two foci, to minimise waste and by products that are harmful to the environment, and to reduce the capital and operational cost in order to promote efficiency (Youtie, 2006)

Minimisation of waste and by-products has particularly been driven by introduction or expectations of environmental regulations. According to a study of innovation cases by Kivimaa (2008) particularly introduction of policies on waste reduction and management as well as policies on climate change has led to eco-innovations. In the Nordic paper industry cooperation with research institutes or universities and access to innovation support has also been an important driver for innovation with environmental benefits.

*Textbox 4-12Transformation of waste to useful resource*

Public policies and R&D support was in the 1980s driving the development of clean technologies to use black liquor, a by-product of the sulphate process in paper production. Research initiated to transform black liquor into electricity failed to reach commercialisation. New focus on climate change and the introduction of the EU Emission Trading Scheme (ETS), policies and goals for biofuel use as well as increasing oil prices has contributed to create a new market both for electricity and bio-fuels from gasified black liquor. R&D is still ongoing however commercialisation of biofuel based on black liquor is expected in 2010-1011. Also biofuel from biomass waste products produced in integrated pulp and paper mills is being developed and commercialisation is expected already in 2008

Source: Kivimaa et al 2008, p. 26

The case shows how different factors influence the innovation process: R&D support, introduction of policies and market factors such as increasing oil prices has been drivers behind these innovations. Requirements on biofuel in the transport sector has created a new market opportunity for the sector which as mentioned above is under hard pressure and suffering from over capacity.

The other key driver for process innovation, as identified by Youtie et. al. (2006), is reduction of capital and operational cost in order to promote efficiency. The importance of reducing the cost of production was particularly emphasised during the interviews. This cost reduction may though have positive effects on the environment and strengthen the CSR. Particularly the increasing energy cost hit the industry hard and this has lead to new innovative production processes and has contributed to a shift from fossil fuels to new use of renewable fuels which may be considered a process eco-innovation stimulated by market forces.

In the paper industry demand for environmentally friendly products is, according to the interviewees, significant. During all interviews the role of eco-labelling was emphasised as a driver for innovation and having eco-labelled products in the product line was regarded important to maintain market position and gains market shares. The effect on innovation due to pressures to reduce cost and responding to demand pressures is illustrated by the change in energy source by Dalum Papir, Denmark, as illustrated in Textbox 4-13 below.

*Textbox 4-13 Eco-innovation driven mainly by reduction in production cost*

In 2007, Dalum Papir, changed the primary source of energy from fossil fuels to bio-fuel installing a 45 MW bio-fuel boiler. This has led to significant reductions. The $CO_2$ footprint has been reduced 90% and reductions have been made in energy consumption and waste

water.

This change has proved a good business case for Dalum. It has enabled the company to maintain its position in a competitive market. Also from the demand side the environmental profile of the company has a positive effect. Many customers put significant weight on the sustainability and the substitution and strengthened the position of the company as among the leaders in this respect. This is seen as one of the innovations that will contribute to secure Dalum increase in demand in the future.

Source: Interview Riis Sørensen. 03.06.08 and www.dalumpapir.dk

Increased awareness of environmental challenges and focus on climate change in the society has also been expressed in demand for environmentally friendly products. Within the paper industry, the introduction of labels for sustainable forest use, such as FSC or PEFC, has been significant and created a shift into using virgin pulp from sustainably harvested forests.

Demand is also a key driver behind innovations particularly concerning product development, hereunder product qualities as brightness and the weight of the product. Several respondents also emphasised that environmental characteristics of the product is to an increasing extent becoming a part of the quality indicators of the product and is part of the customers decision making produces. This induces greater focus on environment among producers and contributes to stimulate new innovation in for products and production processes as mentioned above.

Increased demand for recycled products has led to a range of innovations as seen both in the case from Hartman and INGEDE in Textbox 4-14 and Textbox 4-15 below. It has moreover led to innovative logistical solutions as described in Textbox 4-16. The three cases illustrate how demand may trigger innovation with environmental benefits, and how this technology may spread geographically.

*Textbox 4-14 Hartmann AS -- Innovation driven by demand for recycled products*

Hartmann, producer of packaging from recycled papers, has introduced new technology that recyclable and biodegradable fibre packaging made from recycled paper. The innovation was driven by increased demand for their product.

This increased market was to a large extent created by the introduction of policies i.a. producer responsibility based systems for packaging as well tax schemes favouring fibre packaging over plastic in some EU countries. Also other market factors contributed to drive the innovation. Increased oil prices led to higher prices for plastic making, making moulded fibre packaging increasingly competitive.

The environmental benefit from the invention derives from reduced use of material, energy and waste. The moulded fibre technology platform is available to external customers on licences, which contributes to the technology is diffused to other producers and possibly also into other markets.

Source: Kivimaa 2008, p. 47, Kivimaa et. al, 2008, 5 p. 26 and www. Hartmann.dk

*Textbox 4-15 INGEDE – improved deinking technology stimulated by demand for recyclable fibres*

INGEDE is an association uniting the deinking industry, and its members are paper mills

and research departments. The organisation supports research in deinking technology and "wants to bring everybody involved together to ensure and improve the recyclability of paper products. The better the deinking process will be developed, the bigger the contribution of paper manufacturers is towards avoiding waste and protecting the environment." Research undertaken has lead to improved deinking technologies, e.g. OptiQ AB, that is diffused to the industry through licensing.

Source: A. Fischer and www.Ingede.com

*Textbox 4-16 Myllkyoski – innovation driven by demand for raw materials and customer demand*

Paper mills are often located in rural areas. The establishment of the Alsip Mill 12 miles southwest of Chicago represent a new approach to logistics that reduce transportation of both inputs of raw materials and of the final product as the mill is located with favourable access to recyclable paper and in proximity to the mills customers – the printing houses. Moreover, state of the art technology for de-inking was imported from European mills securing high quality products with increased brightness and low weight of the final products indicating a diffusion of technology from Europe to the US to meet demands of customers for recycled high quality paper products.

Source: E. Peltonen and www.myllykoski.com

These cases indicate that both customer demand and demand for raw materials may stimulate innovations with an environmental benefit ad how the innovation may diffuse to other producers and other markets.

It is important to be able to show the environmental efforts to the customers and here certifications and eco-labels play a role. The interviews indicated that this is an important positioning dimension and increased demand for environmentally friendly products increase the innovation to comply with the demands of customers and consumers. The labels have led to increased customer focus on labelled products and this has induced companies to adapt their production processes to comply with the label and certification requirements.

There are evidence that increased demand for eco-innovative products has resulted in changes in innovation patterns, both as regards the product itself but also in regards to processes and logistics. In some cases, demand is triggered by introduction of policy measures in other industries which have the indirect effect of creating demand for products requiring eco-innovations in the pulp and paper industry. This is the case both by introduction of producer responsibility linked to packaging in other sectors and the introduction of bio fuel targets. Increased demand for the product that actually lead to increased innovation is however in often linked to other factors influencing the innovation decision. Kivimaa et al (2008) have identified three types of market changes that "have affected the emergence, development and commercialisation" of environmental inventions[10] (Kivimaa et al 2008 p. 28):

- Changing in existing markets for pulp and paper products which have made the producer companies aware of a need to adapt to the market either by improving cost efficiency and economies of scale, to create new products for existing markets or to create products for new markets and value chains.

[10] Based on 12 case studies also used in Kivimaa 2008

- EU level environmental policies creating new or improved existing markets for recyclable or recycled products, bio-energy etc.
- Changes in other markets that have influenced the need for efficiency improvements or new product markets, e.g. changes in oil prices.

There are furthermore indications that increased demand for eco-innovative products may lead to diffusion of technologies into other geographic markets. The degree to which technology diffuses into related products is less clear and further research is needed.

### 4.5.4 Sector recommendations

The analysis indicates that future demand expectations are made on expectations of changes in customer preferences, such as quality and quantity hereunder trends influence consumers. Secondly, as this sector is under immense competitive pressures, actions of competitors are followed closely and thirdly, policy developments influence demand expectations and changes in policy within the sector or in other sectors may have a significant influence on demand.

The analysis indicates that a combination of measures contributes to create a change in innovation patterns towards securing processes and products that are increasingly sustainable. Particularly legislation together with R&D support has proved to have had an effect.

It is also clear that regulations in other markets, such as in electronics or transportation, has had a positive indirect effect in stimulating eco-innovation as the market has been created for the sector products or by-products. This indicates that market pull has an effect. When a market is created the focus on innovation follows for the companies to be able to meet the demand of the market.

Based on the interviews, there is also a clear indication that the eco-flower works. All the companies interviewed put great efforts into complying with the recommendations of the eco flower. Moreover, the EMAS certification was applied and seen as a driver to green the production patterns as many customers require that the paper producers can demonstrate their sustainability in order to be considered as a supplier. This indicate that the demand drive the paper producers into making concrete changes to comply with the visible and tangible standards.

Among the interviewees, there was also great focus on the $CO_2$ footprint and standardized requirements for estimating this was requested. As mentioned above, the environmental profile of the company and the environmental characteristics of the product is to an increasing degree becoming part of the quality assessment of customers and policy should attempt to strengthen this development as it does lead to innovative changes in production.

There have been spill-over to other geographical markets. Technology from European producers has been exported to their mills in other continents, as seen with the Myllykoski mill in Canada. Also other producers export their technol-

ogy. Both Hartmann and INGEDE, licences their use of their technologic advancements. Also the eco-flower has according to one interviewee spilled over to other markets. The company experiences express demand for eco-labelled products from their US customers, indicating a spill-over of environmental awareness to the US.

In developing labelling schemes it is though important to consult the industry as to secure that the label contains motivation for innovations where there is an eco-innovation potential within the sector

Characteristics of policy instruments

Policy instruments should thus be formed as to:

- Combine the use of a range of policy instruments, hereunder R&D support, which have shown to be an important driver in the Nordic industry.
- Secure spill-over effects from the introduction of policies in other policy areas, such as introduction of producer responsibility in other sectors, affecting the market for pulp and paper production.
- Increase consumer knowledge and awareness of eco-labelling
- Eco-labelling schemes should be developed in cooperation with the industry in order to secure stimuli where innovation potentials are the biggest

It is the perception of the interviewees that it is pivotal to make it a trend to by environmentally friendly products, hereunder recycled paper products in order for consumer demand to increase. There is thus little faith in the use of tax reductions for recycled paper – it is the perception of some of the interviewees, that this would make the products appear cheap. It is important to rather focus on making these products trendy and the obvious choice for the modern consumer.

Given demand is likely to lead to innovation

If assumed that demand exists for environmentally friendly products is established or foreseen it is based on the information gathered during this study likely that producers adapt production to meet this demand under the assumption that this will generate profit.

## 4.6 Detergents

This section focuses on the production of detergents and is based on interviews with A.I.S.E (Trade Association) and supplemented with academic literature and information on the web pages of selected companies and organisations.

### 4.6.1 Sector description

Detergents are big business, and the world market is dominated by a few very large companies, and Procter &Gamble (US), Unilever (UK), Colgate Palmolive (US) and Henkel (DE) are among the biggest. Economies of scale, notably in the construction costs of the huge drying towers used to convert liquid detergents into powders, mean that it is difficult for small firms to enter the powdered detergent market. Procter & Gamble has recently acquired a number of

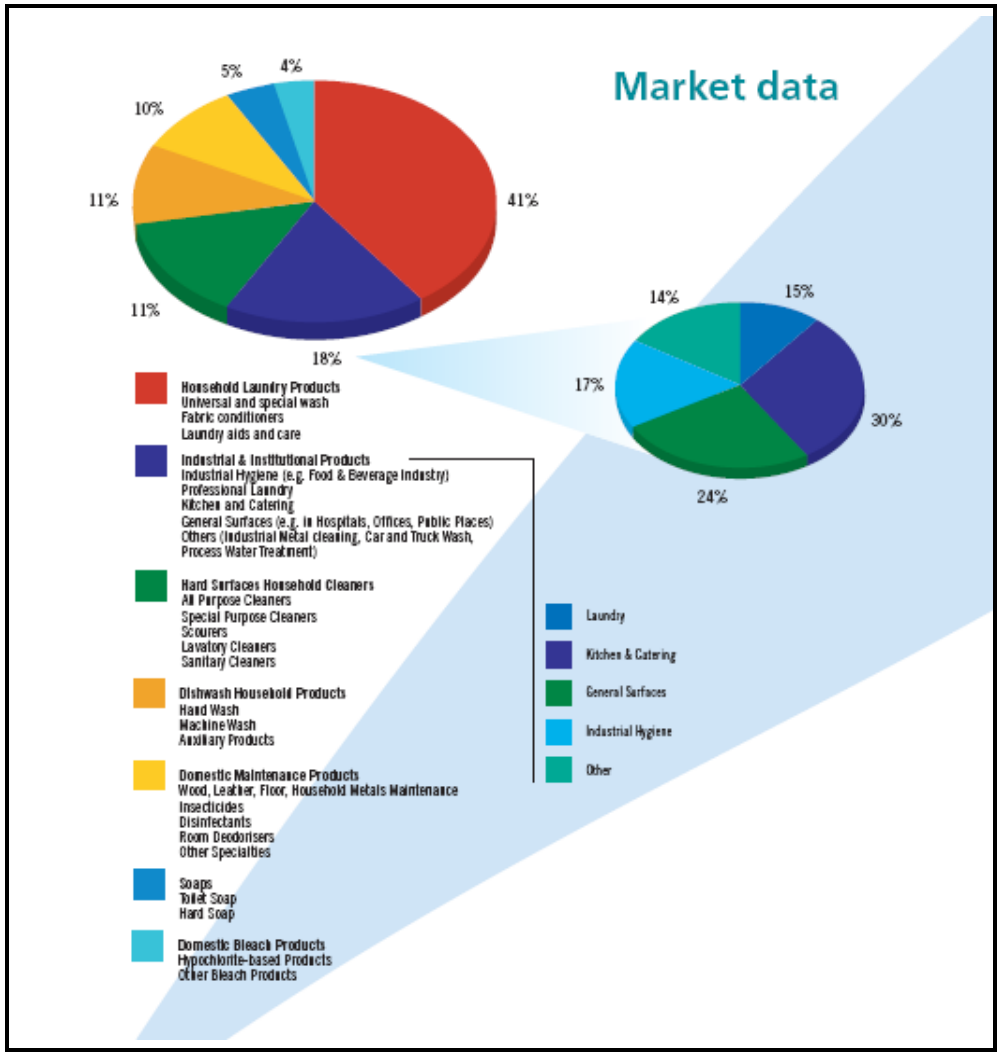
European brands (French Axion and Gama; Italian Dinamo, Swedish Ajax and Danish Dynamo) bringing their combined market share to 36% in Europe[11].

The sector is highly competitive with product differentiators mainly driven by marketing, e.g. product appearance and packaging. The products are relatively low tech, with a short lead time, meaning that "new" products has to reach the market fast to have any pay-back. The industry is further characterised by a mix of players, large multinationals as well as small local manufacturers. Increasingly true green manufacturers offering purely ecological products are emerging but it is still regarded as a niche market, e.g. green customers willing to pay a higher price.

*Table 4-3 Detergent sector - key numbers*

| Detergent sector - Key numbers (EU) |
|---|
| • More than 900 companies, ranging from SMEs to multi-nationals, active in the consumer goods and/or the industrial & institutional (I&I) markets.<br>• Total turnover for 2002: 29.7 billion euro, based on the EU 25 +Norway and Switzerland. |

[11]http://www.euromonitor.com/Procter_and_Gamble_expands_its_laundry_detergents_portfolio




Source: A.I.S.E

The detergents industry continues to experience tight profit margins. Attempts to extend product lines and boost profits by adding additional features such as concentrated packaging are being resisted by the consumers, who are rather conservative when it comes to washing powder and are in general reluctant to change their laundry habits and embrace the new concentrated detergents.

Product differentiation in response to washing habits

Detergents as such differ very little from one to another, but differences in washday habits between countries are often significant, and detergent manufacturers need to take account of these differences if they are to be successful in capturing their share of the global market. The main reasons for differences in washing habits include:

- Type of laundry machine (front loaded versus top loaded) and water capacity;
- Differences in wash cycle, e.g. European machines have a 90 to 120 minute whereas US machines cycle in about 20-30 minutes;
- Water temperatures, e.g. Europeans tend to wash at higher temperatures, while in other countries the washing machines do not heat the water, so the

powders need to work at lower temperatures, and still in other countries hand-washing is common;

- Prevailing types of fabrics (synthetic fabric versus cotton) and preferred colours.

Such differences in washing habits determine formulation, packaging and marketing of the products. Detergents mainly come in powder, liquids and concentrated tablets.

Eco-label

The industry has experience with the Eco-flower, which have not had any impact on eco-innovation as the Eco-flower has not managed to be appreciated by the consumers. According to AISE, the current eco-labels, e.g. Eco-flower has not really impacted positively on Eco-innovation for the following reasons:

- too much administration and bureaucracy;
- the detergent industry is highly competitive and new product has to reach the market fast to have any pay-back, the process of getting the eco-label approval takes months and is therefore not worth it and not attractive for the manufacturer
- the Eco-flower has no brand flavour to it, the consumer does not know it and they lack awareness for what it stands for;
- the Eco-flower in its current format does not address the right things: it is to product focused (e.g. ingredients) rather than taking the holistic approach addressing the entire production and life-cycle chain

### 4.6.2 Factor influencing demand expectations

The industry as a whole are aware of the green wave but eco-innovations has been concentrated around process innovation, e.g. the creation of an Industry Charter, rather than on the product itself with the exception of minimising packaging by offering concentrated products.

Some manufacturers with a strong green image, e.g. EcoVer offering truly ecological products, have difficulties in getting to the mass market due to lack of eco-awareness in the market.

Drivers of eco-innovation

The main drivers of eco-innovation are primarily related to corporate strategy and future expectations to stricter regulation or compulsory eco-labelling schemes.

Talking detergents and the ingredients of detergents, there is actually not very much innovation to be gained. When considering normal household detergents in fact, all products on the market are rather similar (standard product) in terms of ingredients. The main differentiators are the packaging and type of detergent (powder, liquid, tablets). The main innovation in recent years is the use of enzymes allowing for relatively lower water temperatures. For specific industrial detergents, these are different depending on the type of job they have to do (oil, grease, dirt, etc.). As mentioned above, diversification is mainly caused by marketing, branding and packaging. Innovative aspects therefore are more con-

cerned with concentrating the products, e.g. tablets, or pre-packed liquid balls, allowing for smaller detergent packages saving transport volumes, storage space and packaging.

Hence, the main development trend goes in direction of minimising the package and lowering the temperature. The selling unit are number of washes contained in a package rather than amount of detergent. However this causes some problems towards the consumer, that one small tablet is as good as a cup full of washing powder.

In summary the key drivers for innovation are product performance, price, product appearance, human and environmental credentials (this is of growing importance) and Corporate Social Responsibility.

### 4.6.3 Effects of demand on eco-Innovation

The industry as such is starting to react to the anticipation of future demand for eco products and the international Association for Soaps, Detergents and Maintenance Products A.I.S.E.) is currently promoting their sustainable cleaning concept through an Industrial Charter.

*Textbox 4-17 AISE Charter*

1. AISE introduced in 2004 a voluntary scheme concerned with sustainable cleaning.
2. Currently 45 companies have signed up, these are a mix of multinationals, retailers and SMEs.
3. The companies commit themselves to report on 10 key performance indicators (as below).
4. Implementation of the charter has already resulted in decrease in $CO_2$, tons of packaging used, water usage, etc

**A set of Procedures for implementation across the whole product life-cycle**

The Charter itself consists of a set of eleven Charter Sustainability Procedures (CSPs) that companies are invited to implement in their management systems. Six 'essential' CSPs have to be checked by an independent external verifier during the Charter Entrance Check (see Annex 2); the other five, which are additional, have to be implemented within three years of the company joining the Charter.

(Note: Charter comparison vis à vis ISO 9000, ISO 14000 and EMAS can be found in Annex 4.)

| ESSENTIAL CSPs (FOR ENTRANCE CHECK) | ADDITIONAL CSPs (AFTER THREE YEARS) |
|---|---|
| Raw material selection and safety evaluation | Raw material and packaging suppliers selection |
| Resource Use Policy | Packaging design and selection |
| Occupational Health and Safety Management | Distribution Risk Assessment |
| Environmental Management System | Consumer and User Information (on product) |
| Product Recall | Product Performance and Product Review |
| Finished Product Safety Evaluation | |


Source: A.I.S.E

Best in class on Eco-innovation

Addressing still a niche market, the Belgian company EcoVer are offering true ecological products manufactured with very high environmental standards.

*Textbox 4-18 Case study EcoVer*

Founded in 1980 in Belgium, EcoVer (B) is an international company that is active in the production of ecological detergents and cleansing agents. Ecover has developed into the world's leader in its market segment by achieving an average annual growth rate of 25% since the turn of the century to reach a turnover of € 55 million in 2006, still a minor player in the overall market accounting for a market share less than 2%. The products, which innovate by replacing petrochemical-based washing product components with renewable organic substances, are currently distributed in 22 countries on four continents. The environmentally conscious innovations introduced in the running of the company have led to many articles in the mainstream press and several prizes and awards from international, national and regional authorities for EcoVer's contributions and achievements in the field of environmentally sound development.

Even among innovation leaders, EcoVer stands out as an unusual enterprise in delivering innovative products. EcoVer innovates in its approach to production and marketing. It also innovates in its approach relating to other key parts of its business, including its choices of transport modes, its production environment, its creative processes and its relationship with suppliers. In fact, its entire business model is geared towards changing the conceptual framework within which individual consumers make purchase decisions.

Ecover's managers insist on one point: the company is not "market-driven", yet it is profitable.

The basic assumption made by EcoVer is that all other factors being equal, the consumer will choose the product with the least negative impact on the environment. As such, this does not differ from the strategies identified as "green marketing" or "ethical marketing" adopted by a small number of players across a widening range of "consumer goods". However, with a strong growth rate and a growing stream of free advertising through interviews and feature articles across a wide variety of news media, Ecover's approach may be touching on something more fundamental than a successful niche marketing strategy.

Source: Technopolis (2008)

The EcoVer case represents almost the full cycle of eco-innovation: relatively radical changes to products (including a number of patents), innovation in production through factories and office buildings corresponding to high environmental standards, innovation in "marketing" aimed at driving consumer demand for more ecological products, etc. The main driver in this case, is a corporate belief that green pays off in the long run.

### 4.6.4 Sector recommendations

The main recommendations from the detergent sector with respect to increasing impact on demand pull instruments towards promoting eco-innovation with in the sector can been summarised around the following main points.

- more recognition towards what industry can do on their own (not distorting the market);
- focus and influencing consumer demand;
- information campaigns on sustainable consumption towards the broad public; and
- promotion of the holistic approach of Eco labelling rather than product specific promotion.

# 5 Synthesis of findings for all sectors

This chapter aims to draw conclusion on the key study questions based on the finding of the literature study, sector studies and the workshop. The key questions to address are:

- The extent to which increased demand for eco-innovative products has resulted in changes in innovation in those products (design, manufacture and performance) and the nature of such innovation.

- The extent to which demand pull policies (eventually leading to future demand for eco products) influence the company's innovation decision, e.g. how strong that market signal is perceived compared to other signals or drivers (internal as well as external drivers)

- The extent to which increased demand for eco-innovative products may lead to greater diffusion of that innovation into related products (for example lower specification products) or to other geographic markets.

## 5.1 Difference in sector characteristics

The sectors investigated in the course of the current study are very different in terms of basic characteristics both in relation to the sectors themselves, the companies and the products. The main sector characteristics of relevance to innovation and response to market pull mechanisms are listed below in Table 5-1.

*Table 5-1 Sector characteristics of relevance to innovation*

| Characteristics | | |
|---|---|---|
| **Product level** | | |
| Technology complexity | *Low* | *High* |
| Innovation level | *Marginal* | *Radical* |
| Eco potential | *Low* | *High* |
| Product competition | *Standard* | *Differentiation* |
| Branding | *Low* | *High* |
| Level of specification | *Low* | *High* |
| R&D Lead time | *Short* | *Long* |
| R&D investment | *Low* | *High* |
| **Company level** | | |
| Placement in value chain | *Up-stream* | *Down-stream* |
| Size | *Large* | *SME* |
| Green Corporate Strategy | *None* | *Dominant* |
| **Sector level** | | |
| Level of maturity | *Emerging* | *Mature* |
| Market uncertainty | *Low* | *High* |
| Level of regulation | *Low* | *High* |
| Dependency on other sectors | *Low* | *High* |

Electronics/IT

**The consumer electronics and IT industry** is a highly competitive industry with constant and rapid advances in technology, which are quickly made available to customers. Customers (and manufacturers) primarily differentiate products on price with the level of technical performance and appearance within a price range being the most important secondary characteristics. In virtually all products in this sector the natural process of continuous improvement drives a reduction in energy consumption. The R&D lead time for products is short, 3-4 years being considered long term. Eco- innovation has largely been driven by both natural improvements in energy efficiency and legislative drivers to remove harmful substances. There are a number of global (mainly European and Japanese) companies active in this field but they have seen significant market share reduction, particularly in high volume products, over the last 4-5 years as very low cost products have become available from mainly Chinese sources.

Household appliances

**The household appliances industry** is a rather mature industry, with relatively standardised products competing primarily on price and energy efficiency, though branding (in terms of image and desirability) does play a role for high-end products. R&D lead time is relatively short; while the life time of the product is long (10-15 years for large household appliances). The sector has experienced the introduction of the Energy label since 2002. The industry is highly competitive with overcapacity in production capacity and ever increasing competition primarily from Chinese manufactured goods.

| | |
|---|---|
| Transport | **The transport industry** is dominated by a relatively small number of global players. Competition in the car market is particularly high. The brand image and the differentiation opportunities it offers are therefore important competition parameters. It is a highly regulated industry and regulations concerning emissions, safety etc, have been significant factors in steering the direction of innovation. R&D lead time can be long, as much as 10-15 years in aspects of high technology complexity. The life cycle of the products can also be long, 10-15 years for cars and even longer for trucks and buses. The transport sector has a high potential for eco-innovation. There is a large degree of dependency on other sectors |
| Construction | **The construction industry** is a very important economic sector accounting for 10% of EU GDP, for 50% of fixed capital formation and directly employing more than 13 million people. It is further characterised by being locally and nationally oriented, very fragmented with few large players and a large number of small firms. There are many actors involved (users, service providers, owners, architects and engineering firms, contractors, product distributors, product manufacturers and material suppliers) and different types of market to serve, e.g. private housing, offices as well as public building. Most of the construction industry serves national and local markets and is not in competition with suppliers from outside Europe. There is large scope for eco-innovation in the build sector, but the responses to these opportunities differ significantly between companies of different nature, size and place in the supply chain concerned. |
| Paper | **The paper industry** is one with a bulk product whose manufacture is dominated by a small number of multinationals. The low tech nature of the product is such that its main environmental impacts are centred on the energy used in its production, the source of the raw materials and its ability to be recycled. As such innovation has largely focussed on process improvements. Paper has a short and relatively integrated supply chain. The relative simplicity of the product means that its environmental impact has become a common differentiating factor. Product price is also an important factor as much of the product is purchased in bulk by businesses such as printers. |
| Detergents | **The detergent industry** 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 take advantage of marketing campaigns etc. The industry have worked with the Eco flower scheme, which was reported as having had no impact on eco-innovation as it never achieved high levels of consumer awareness. The industry is further characterised by a mix of players, large multinationals as well as small local manufacturers and increasingly true green manufacturers offering purely ecological products, albeit to a niche market, e.g. green customers who are willing to pay a price premium. |

## 5.2 Factors influencing demand expectations

Expectations of future demand are driven by views of the future which are influenced by a number of factors spanning from observed mega and market trends, expectations of the likely impact of policies (e.g. demand pull instruments), consumer demand and purchasing power.

In all sectors companies reported that a key source of data on future demand expectations is current demand levels of each of their own products and those of their competitors. If a product, which is differentiated with regard to 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.

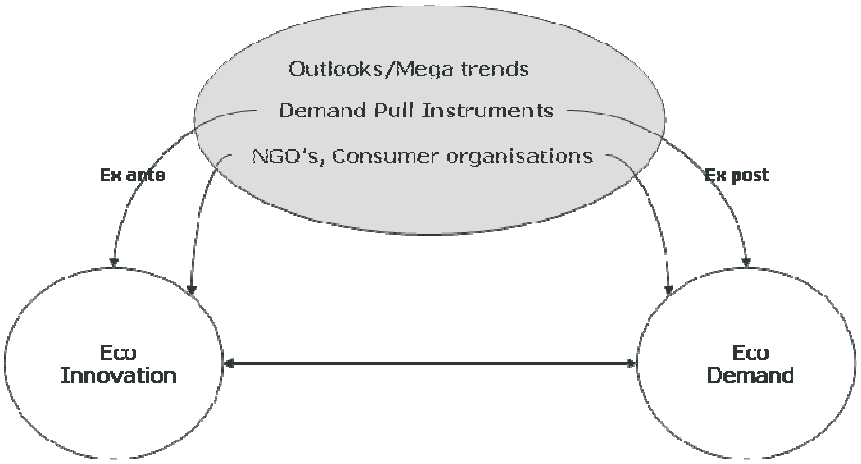
In some product markets, particularly those within the supply chain, i.e. component suppliers and those of a business to business nature the consumer is very well informed as to the specification they require. In these markets the customer is clearly the key information source on future demand expectations.

Policies and initiatives to promote eco products, sustainable production and consumption, energy efficiency etc. are clearly having a high impact on how companies perceive the future market potential. In response to this "green" mega trend most companies are seeking to promote their green profile.

Perceived future market 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. It is interesting to note that in 2002 companies were not in a position to predict with confidence the consumers' reaction to the energy labelling in terms of demand shift. Instead, they had to have faith that eventually energy efficiency would be a main product differentiator. This faith in the ability of the energy labels to influence demand led to an increase in the supply of energy efficient appliances, secondly consumers started to show a purchase preference for energy efficient appliances and were convinced enough to pay a higher initial price.

*Figure 5-1 Factor influencing demand expectations*



Ex ante versus ex post

The ex-ante and ex-post distinction is also relevant when considering the car sector. Until very recently the consumer trend exhibited an increasing preference for large four wheel drive cars. This trend was in contradiction to the fact well known to car manufacturers that such a demand could not be sustained due to the need to address global warming and increasing fuel prices as demand increased with no corresponding growth in supply. This need to act has seen the development of numerous policies designed to address the externalities of car transportation and requirements to reduce $CO_2$ emissions, etc. However consumers will only change their demand preferences when there are clear reasons to do so.

The point is that companies cannot wait to observe the shift in demand after it has happened. They have to react years in advance in order to have the products ready when a certain instrument (or event) comes into to play to impact consumer demand. In other words they have to perceive the likely impact of such instruments and take account of the general situation in terms of other demand factors, competition, positioning, etc. If they wait to react until the demand actually does shift it will be too late. They need to demonstrate a degree of proactive behaviour.

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 on shaping future demand but also directly on company decision making. For example, Greenpeace publish a guide to Greener Electronics[12], where *"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".*

Risk and uncertainty

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.

Certainty of future policy directions and concrete instruments are appreciated by companies and reduce their uncertainty with regard to future market prospects and hence investment in innovation. Clarity of future policy direction therefore has an influence on the strategic decision making of companies in relation to eco-innovation.

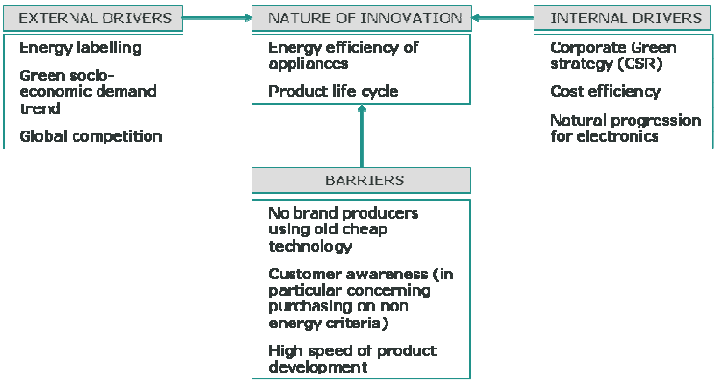
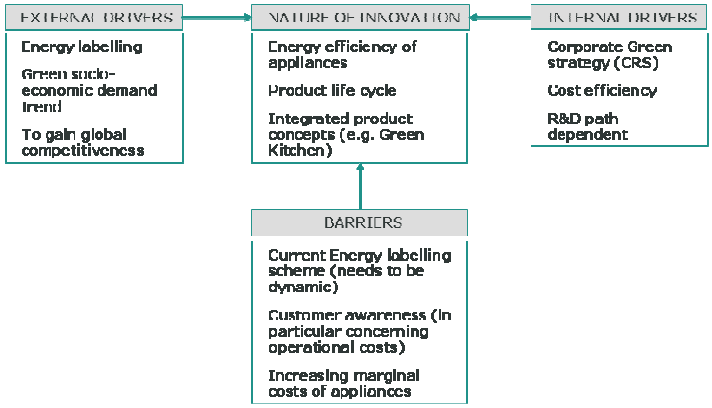
## 5.3 What influences the eco-innovation decision

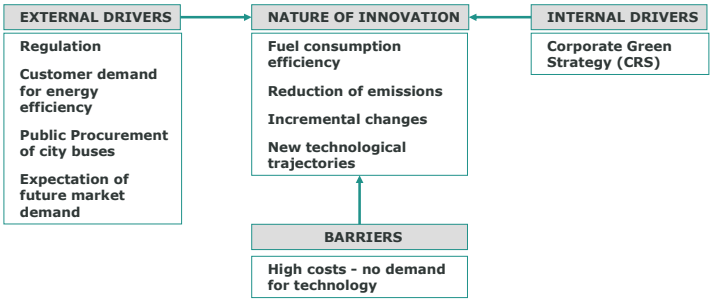
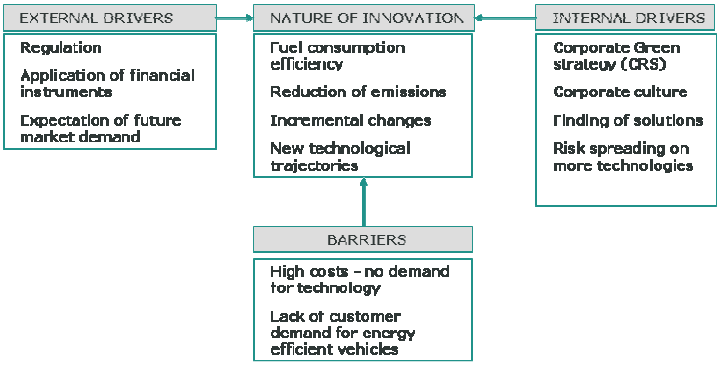
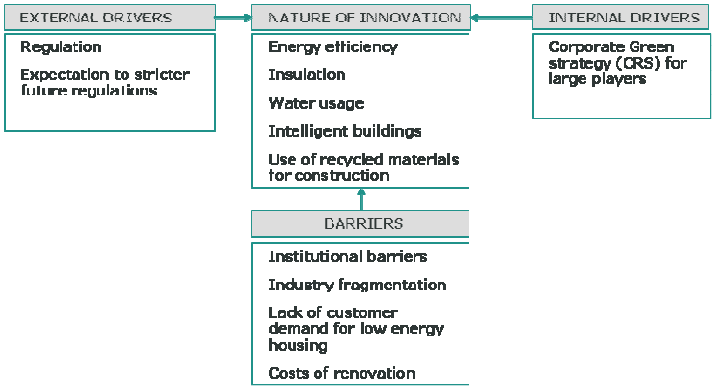
This study has investigated how firms change their innovation in response to changes (or expectations of changes) in market demand.

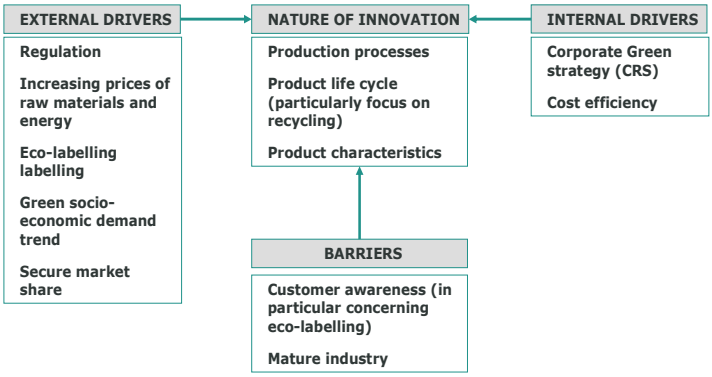
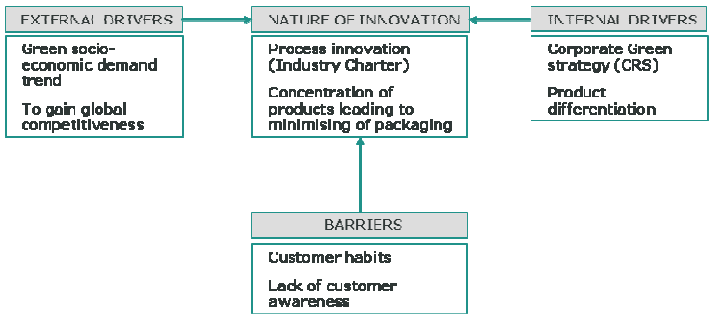
[12] http://www.greenbiz.com/news/2008/07/02/green-electronics-scores-fall-greenpeace-adds-criteria

The clear and unsurprising finding is that firms focus their R&D efforts on what customers want and what they think customers will want in the future. However, this is only one factor out of many factors influencing innovation. The main other influences are summarised in the figures below, one figure for each of the sectors investigated. A distinction is made between external drivers, internal drivers and what has been identified as the main barriers to eco-innovation.

*Table 5-2 Synthesis of sectors investigated*

| | |
|---|---|
| **IT/Electronics** | |
|  | The consumer electronics industry is one in which rapid product innovation is an accepted fact. This has delivered products where energy efficiency has improved over time without intervention. However, some advances lead to increased energy consumption particularly in the early stages of products.<br><br>Consumers have traditionally selected products on the basis of a combination of price, technical performance and aesthetics with environmental impact not being an important factor. The rapid growth in the market share of products differentiated on low cost, though missing the most modern levels of performance, illustrates the continued importance of cost in most EU markets. Legislative drivers have seen reduced environmental impact via not using certain substances in the production and improvements of the recyclability of products.<br><br>As with all sectors the general levels of increased interest in environmental matters, in combination with increased energy prices are leading to an increased level of customer and company interest in producing products with lower environmental impact. |
| **Household Appliances** | |
|  | Due to a shift in demand towards energy efficient appliances largely triggered by energy labelling, the household appliances sector as a whole has invested massively in eco-innovation in recent years.<br><br>The nature of that innovation is first of all improved energy efficiency of the appliances. Secondly, and mainly in response to the WEEE Directive and in anticipation of a coming Eco label, innovative efforts are increasingly going into the product life cycle considerations and eco-design.<br><br>The innovation into energy efficiency has been successful to the extent that the current labelling scheme is perceived as outdated and needs revision in order to provide further incentives for the companies to innovate in order to be competitive. |
| **Bus and Truck Industry** | |

| | |
|---|---|
|  | Innovation has been mainly driven by regulation and future expectations of market requirements and has resulted in innovation directed towards efficiency in fuel consumption and reductions in emissions.<br><br>Demand pull instruments (public procurement) have been an important driver for innovation of the bus sector in particular towards emission reduction and fuel efficiency.<br><br>Due to the high costs of R&D, certainty of future market demand is a key factor in innovation decisions. |
| **Car Industry** | |
|  | Driven mainly by regulations. in particular the anticipation that much stricter regulation concerning $CO_2$ and other externalities will be put in place, the car industry is investing heavily in eco-innovation, fuel efficiency, green fuels, electric cars, etc. Corporate strategy and image also play an important role in deciding on innovation priorities.<br><br>The main barriers are high up front investment combined with uncertainty about future technologies and current lack of customer demand for eco vehicles. Demand pull instruments are therefore considered crucial to kick start market uptake and thereby reduce the risk related to eco-investments. |
| **Construction Industry** | |
|  | The construction industry is highly regulated mainly by national legislation, e.g. building codes. Eco-innovation has until now been rather limited and mainly in response to specific requirements regarding insulation, water usage, energy efficiency. The fragmentation of the industry is believed to be the main barrier to radical innovation.<br><br>For larger companies, however, like pump manufacturers, window manufacturers, etc. Eco-innovation is happening in response to expectations about future market requirements.<br><br>GPP has only been explored to a limited extend partially because of institutional barriers in terms of budget systems and constraints (investment costs versus operational costs).<br><br>Demand for eco-housing is still in its infancy and use of demand pull instruments could therefore have a high potential in this sector. |
| **Pulp and Paper Industry** | |
| | The paper industry is mature and highly competitive. This influences the focus on innovation in favour of reducing the cost of production. The importance of increased efficiency is amplified by the increased prices of raw materials such as recycled paper. |

| | |
|---|---|
|  | The introduction of environmental regulation has had a significant eco-innovation benefit as has regulation in other markets. The latter has stimulated research in the use of by-products and waste to cut costs and generate additional incomes.<br>It is important for companies to make their efforts in sustainability visible. Eco-labelling is widely used in the industry, and is to an increasing degree a requirement from customers. However, it is necessary to increase customer awareness of eco-labelling and how fashionable recycled products are in order to influence demand. |
| **Detergents** | |
|  | The detergent market has only been subject to strong regulations to a limited extent (e.g. removal of certain dangerous substances), with no experience of demand pull instruments. The industry as a whole is aware of the green wave but eco-innovations have been concentrated around process innovation rather than on the product itself, e.g. the Industry Charter, says more about minimising packaging by offering concentrated products.<br>There are manufacturers with a strong green image, e.g. EcoVer that offers truly ecological products. However despite rapid growth the company is still servicing a relatively small part of the market. |

Not all the sectors investigated have experienced the application of demand-pull instruments directly.

In the case of the household appliances, electronics, the pulp and paper industry, and the transport sector market pull mechanisms appear to have worked according to their primary objectives, i.e. increasing market demand for certain attributes. Companies see this demand (ex ante as well as ex post) and seek to meet it. In order to do this they try to differentiate their product more strongly on this attribute. Innovation efforts will thus be directed towards this. The exact mechanism for linking demand to innovation will vary from firm to firm, and not lest from sector to sector. It will also vary according to how extreme the market signal is.

**Corporate Culture and desired company strategy.**

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 the study work (e.g. SAAB (GM), SONY, 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 a confidence that it will pay off in the long run through sustained or increased sales of their products. However, it is clear that eco-innovation will not be commercialised if the companies feel that it would cause increases in product costs that consumers are unwilling to bear.

## 5.4 Diffusion of eco-innovation

Diffusion of eco-innovation usually happens through a trickling down effect along the value chain, diffusion into related products groups, and diffusion to other geographical markets.

### 5.4.1 Diffusion of eco-innovation into related products

In the PC industry trickle down of "good" technology happens when unit prices (of the "better" components) decrease due to economies of scale and it thereby becomes more cost-effective to use the "good" technology compared to the older technology. In the case of business PCs compared to household PCs, this process takes a maximum of 2-3 years. A similar pattern was reported in the television market.

Spill over of eco-innovations can also be seen to occur into a related sector, particularly when the original innovative manufacturer is active in that other sector as well. For example Mercedes-Benz took advantage of technological advancements originally developed within the truck section in their bus division. This spill over has more recently reversed direction with the bus section now leading when it comes to fuel-efficient motors, hybrids etc.

### 5.4.2 Diffusion of eco-innovation to other geographical markets

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.

*Textbox 5-1 Diffusion of eco-innovation to Chinese market for household appliances*

The Chinese market for household appliances is now 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 appliancies** | | | |
|---|---|---|---|
| 2006 | Production | Export | % |
| | *millions appliancies* | | |
| Refrigerators | 31 | 17 | 55% |
| Washing Machines | 30 | 11 | 37% |
| Air Conditioners | 75 | 26 | 35% |

By 2004 the EU became China's main trading partner, while for the EU China is the second largest trading partner. China exports appliances to the EU, while the EU economic involvement in China primarily consists of direct investments and 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 environment-friendly white goods in China 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 manufacturers' global competitiveness.

The main barriers facing Chinese firms 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.

The Chinese 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, therefore 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 (often the final appliances are exported back to the EU as a "made in China" product);
- Influencing the Chinese government to promote market uptake of energy-efficient appliances. In the first round this will create a competitive advantage for non-Chinese manufacturers, but in the second round when Chinese manufacturers have managed to improve their production lines (implementing eco-innovation) this might "backfire" and enable Chinese firms to increase their market share in the EU.

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 costs down. Hence, production and design tend to comply with the requirements of the most stringent market.

The same tendency was reported in the truck sector where SCANIA sells about half of its production to the Brazilian and Russian markets. These markets are currently regulated according to the Euro III standard, but since the SCANIA production line is set up to produce vehicles, which comply with the Euro VI standard it has proved more cost-effective to supply similar products to the export markets.

# 6 Methodology for identifying product markets with significant potential benefits from innovation due to market pull policies

This chapter will address:

- Whether an industrial sector is likely to respond well to market pull measures in terms of intensifying eco-innovation.
- Under which circumstances market pull measures would be effective in promoting innovation.
- The relevant factors to take into account and the potential data sources for estimating the potential environmental and economic benefits and costs from innovation resulting from market pull policies. This includes consideration of the magnitude of the impact on innovation.

The methodology is based on the synthesis in the preceding chapter and is scenario driven, i.e. given a sector with these and these characteristics then type A Instrument is more likely to work or not work.

## 6.1 Sector and product characteristics likely to respond well to demand pull instruments

Sector characteristics versus effectiveness of demand pull instruments

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 or a "best in class" can act as a new product differentiator in an otherwise "dull" market, and will provide a new incentive to compete and hence steer innovation investment into eco differentiation.

Many mass market products, such as electronics, household appliances and even the car market, are likely to react positively to simple labelling schemes where they are clearly understood by the consumer. The label will create awareness of certain environmental characteristics among the consumers such as energy consumption and $CO_2$ footprint in production, which in turn will stimulate innovation among the manufacturers to create the best products against such criteria. However, there are a number of more detailed market

characteristics that will affect the degree of innovation impact that market pull measures can have.

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 very many 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. This distance between manufacturer and end user means that the market signals have to travel a long way and quite possibly via other parties who may well have different incentives. For example, a house builder will seek to minimise the capital cost of a house whereas the ultimate house owner would rationally select the most cost-effective solution seen in relation to the period of living in the house. The challenge is therefore to design a market pull mechanism which affects all of those who make the relevant purchase decisions.

In product markets with relatively low technology products, such as the detergents market and paper, it appears that there is less potential for innovation to occur with regard to the product itself. Nevertheless, there is always the potential for incremental changes to occur and there remains a significant potential to improve the environmental performance of the manufacturing and distribution processes.

In markets where differentiation on eco-credentials already has some history, for example with the household appliances industry, additional demand pull instruments, e.g. eco-labelling to promote eco-design is likely to work well. Partly since the consumers are already aware of eco-credentials and in particular since industry already has experiences to the effect that eco-innovation pays off. Obviously there will be a limit where the marginal benefit of eco-innovation (in terms of increased or retained sales) exceeds the marginal cost of eco-innovation.

In markets where eco credentials have less or no history as a purchase criterion market pull mechanisms promoting them will stand less chance of succeeding and hence of increasing R&D efforts. There are many potential reasons why eco-credentials are not important purchase criteria. For example, with a television set it is logical that, after price, performance (e.g. screen size, picture and sound quality, and connectivity) and appearance are the most important criteria. These performance and appearance aspects would be easily apparent to the purchaser at the point of purchase and when ever the television is used, which involves extended periods of close proximity. For sectors where there is a great deal of variation in the functional performance levels of particular products (for example screen sizes of television sets or engine sizes for trucks) designing a market pull mechanism that relies on providing information on the relative merits of the products is difficult. This is because a simple "one size fits all" label will not provide a fair comparison between what are effectively different classes of products. This is not to say that market pull mechanisms cannot work

effectively in such markets but that simple labels will not provide robust information to consumers.

There are a number of sectors where product development implies high investments costs and long development lead times. This is often due to the complex nature of the technology but can also be the case because of the major investments already made in supporting existing approaches – with which the consumers have become familiar and happy. The prime example of such a sector is buses and cars. Market pull mechanisms have an important role to play in encouraging innovation here. The way in which they achieve this is to help reduce the uncertainties over the direction in which the future market will move that the companies in the sector face. The large cost of introducing new technologies to a market, which may well be happy with the existing products, is often another significant barrier to R&D. This is often intensified by the high production costs associated with the low volume production for new products. The key role for market pull mechanisms here is therefore to provide clear signals to manufacturers and the public that the innovation (and change from existing) is the policy goal which will be achieved. The other important role they have is to help speed up the uptake of a new technology to enable mass production and its associated cost reductions to start quicker.

In industries where there is a high dependency on complementary products or infrastructure, such as for cars, a dependency on the availability of fuel stations with specific fuel types, e.g. bio-ethanol, a combination of instruments are often needed to kick start market demand. The uncertainty as to whether these infrastructure barriers can be overcome constitutes a barrier to innovation in some sectors. In the case of SAAB (see textbox in Section 4.3) and their decision to invest in the development of bio-ethanol fuelled cars, this was supported by the Swedish government's actions in making it compulsory for the largest fuelling stations to offer bio-ethanol and by setting up financial incentive schemes to support the uptake of bio-fuel powered cars.

For sectors with significant parts of their demand in the public sector (e.g. the bus industry) Green Public Procurement is clearly a well suited instrument

In B2B markets, like sub-supplier markets, demand pull instruments tend to influence innovation by the original equipment manufacturer (OEM) passing on the requirements for improved components to their component suppliers. In the case of the car industry for instance the upstream players, the OEMs only account for about 25% of the parts used to manufacture the vehicles. The specifications for new innovative components to fulfil certain targets, e.g. emissions are passed on to sub-suppliers. Demand pull instruments therefore have a direct impact on eco-innovation of the upstream companies, which trickles down the value chains concerned.

## 6.2 When market pull instruments works best to promote innovation

This section considers the evidence the study has found of where demand pull instruments can be designed to help bring forward unexplored eco-innovations which are searching for a market, or bringing forward a product that offers a large potential for eco-efficiency.

The clearest example of this is in those cases where an OEM passes on the requirement for an innovation (as rewarded by a demand pull mechanism) to its component suppliers. In some cases, where the component is used in other products or markets this can be a way of attracting innovation from other sectors or products (as witnessed by the use of truck technology in buses and vice-versa ).

The study has come across some cases of technologies with a large eco potential where for various reasons commercialisation barriers are either stopping it, or delaying it coming to the market.

The examples that could be included in this are: "The Wheel" where bus manufacturers are following a fundamentally different solution to the propulsion of their units; and; The Green Laser where this low energy laser is attempting to sell to consumers who have never been offered a product (in this market) that has been differentiated on this basis.

The key point to understand here is that well designed market pull instruments should not be distinguishable from natural market signals that manufacturers receive and act on. When the instruments work they provide information to a manufacturer to the effect that a product with a high level of a particular attribute is more attractive to customers and hence more in demand than others. If they are behaving rationally (and other enabling factors such as availability of capital and a willingness to forego current profits to invest in the future are in place) they will focus their R&D efforts on maximising this attribute. On the additional assumption that this is calculated (and/or perceived) by the company to be the best way to invest their capital in the face of competing investments.

## 6.3 Factors to assess the potential benefit and cost of eco-innovation

This is an area the study has not found any firm or conclusive evidence. However, based on the findings 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.

- ***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.

- ***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 maximum 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.

- ***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 $CO_2$ and other emission savings.

# 7 Recommendations for enhancing market pull instruments

This chapter synthesises and discusses the recommendations arrived at through interaction with the industry sectors in the course of the study related to how market pull instruments can be enhanced in order to improve impact on eco-innovation.

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 manufacturer's propensity to invest in innovation to enhance this characteristic. What we have found little evidence of is companies somehow responding differently to different types of market signal of increased demand, specifically the demand increase implied by market pull mechanisms.

However on the assumption that market pull mechanisms do increase expectations of demand for environmental characteristic and increased expectations of demand do increase innovation efforts to improve that characteristic, the following conclusion can be drawn: a "good" market pull mechanism will increase innovation efforts to achieve that characteristic. Therefore this section describes all of the information discovered on what makes a "good" market pull mechanism. Where there is a specific link between these design features and innovation this is also described.

The information found on how market pull mechanisms may interact with other policy levers in order to enhance their effectiveness, particularly with regard to enhancing innovation, will also be described.

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

Fair scheme

Market pull mechanism needs to be fair with the same rules applying to all manufacturers and no obvious bias in favour of one group of companies, for example, a technology which is only used by only a few manufacturers. This also means that national interpretations of a given instrument must be as close to identical as possible. This quality is of relevance to eco-innovation because

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| | without it the market pull mechanism could be accused of favouritism ("picking a winner"), which entails the risk of 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. |
| 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. |
| Dynamic schemes | Mechanisms should ideally have a built-in incentive to continually strive for best performance. This calls for a dynamic scheme, for instance a dynamic label where the highest level moves up in line with the current "best in class", for instance on a yearly basis. The frequency of the updating needs to be in line with the speed of development that is evident for the product or sector in question. For example, in consumer electronics the best performance would probably increase quicker than for white goods. The link to encourage innovation is that without it 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 it is beneficial to involve the sectors concerned to ensure that this does not occur. A potential model for such sector involvement is the establishment of programme committees that are involved with setting sectoral research priorities in the Framework Programme |
| Minimum standards | Many respondents favour a minimum standard for eco-performance to be introduced in order to get rid of the 10-15% lowest performing products. This could in particular work well together with a "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) no longer become available. This can be helpful in convincing consumers to accept the often higher product prices that eco-efficient product tend to have. There are clear potential negative social equity consequence 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. with regard to $CO_2$ emissions 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 'Fair Scheme'. |
| Not disturbing the market | There is a mixed view among the interviewed on the use of direct subsidies (that the consumer receives a discount when purchasing a product with preferable environmental characteristics) as opposed to a tax return scheme or a white |

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| | 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 the consumers. Second that such direct subsidies are often only short term (frequently due to a dependence on national budgets) and will backfire when the scheme comes to an end - because the product price will then appear inflated. However, a subsidy scheme can be ideal for some product groups such as those requiring large up front investment in order to create critical mass in production and thereby to bring unit costs down. |
| Sustainable solutions | Creating or stimulating eco-awareness among consumers is perceived by industry as key to the long term shift in attitudes that is required in order for them to make eco-rational decisions without the need (or with less need) for market intervention. |
| Long term perspective to reduce uncertainty | Companies often react in advance to their perception of future market demand, e.g. that eco-innovation decisions are 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 to 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. |
| Developed with industry input | Mechanisms will benefit from this approach for several reasons. These include ensuring that any targets are not beyond technically impossible barriers, that the methodology is technologically neutral - to ensure no favouritism, that the timing (for example for any future upgrading) is in line with industry development cycles and typical speeds. |
| Minimum administrative burden | SMEs in particular are concerned about the possible additional administrative burden associated with any instrument or mechanisms. Relatively speaking SMEs will face a comparative disadvantage compared to large companies that have relatively more resources at hand to respond to new instruments. |
| Global perspective | There is no complete consensus on this issue but the widely held view is that industry favours mechanisms that 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. |
| | The above recommendations can be used when reviewing current schemes but also when considering introduction of new schemes |

## 7.2 Instruments to be used in combination

There are two areas of interest here. The first is what other policy tools can be used to specifically enhance the influence of market pull mechanisms on innovation. The second area is clearly related and concerns what other policy tools can be used to enhance the general effectiveness of market pull mechanisms.

In terms of policy tools available to specifically enhance the impact of market pull mechanisms on innovation the clearest suggestion is to clearly and explicitly directing existing (or new) innovation funding support at both EU and MS level at the same goals as the market pull mechanisms. For example, calls for action under the Framework Programme could be described as to fund research related to the achievement of the most far into the future standard of an energy label. This approach has a number of potential benefits, including: academic groups (who are among the most active in pursuing research funds) would be made directly aware of commercial product needs in their area of activity; companies could receive subsidies for research that may be further from market than they would normally consider investing in; companies who may not have considered involvement in research would be able to see the clear market need for the outputs from a research project; and the grant aid available would reduce the cost to them of pursuing it.

There are a number of policy tools which could increase the effectiveness of market pull mechanisms in general. They include:

***Education:*** Varying from general public information campaigns on the need to act to counter climate change, to teaching children, to technical information programmes targeted at specific groups - e.g. installers and specifiers of energy intensive equipment. The argument is that better informed consumers are more likely to make eco-rational decisions - the same policy goal as the market pull mechanisms.

***Emissions trading:*** As for education, the underlying policy goal of emissions trading (to reduce greenhouse gas emissions) has much in common with the policy goals of environmental market pull mechanisms.

***Combination of market pull mechanisms***: A number of scenarios may be envisaged where a combination of market pull mechanisms would be ideal. For example, in order to introduce a new technology onto a market it may be necessary to first offer direct financial incentives to consumers to cover the initially high cost of the technology compared to conventional alternatives. Once economies of scale have evened out this cost the financial incentive can be removed and a dynamic labelling scheme introduced.

***Regulations***: As has already been mentioned, in some sectors the best approach would seem to be a combination of market pull mechanisms and regulations. For example in the automotive industry the failure of the voluntary agreement and the apparent inertia (be it from the manufacturers or consumers) in changing to new products suggests that there is a need to force such change. There is also a number of products (e.g. consumer electronics) where legal minimum

standards for energy efficiency would be a useful addition to market pull mechanisms like energy labelling.

# Annex 1 References and information sources

*Table A Interviews*

| Company/organisation | Name and position |
|---|---|
| ***IT / Consumer electronics*** | |
| Philips Consumer Lifestyle | Theo J.M. Schoenmakers - Senior director sustainability, |
| Independent innovation Consult-ant | Charles Henderson |
| Fujitsu Siemens Computers | Dr. Wolfgang Gnettner |
| Riochem Ltd | Dr Sohail Hajatdoost, |
| Ecodesign Centre Wales | Dr Frank O'Connor Director |
| Independent (experience with Sony) | Peter Evans |
| Intellect (Trade Association) | George Fullam |
| Global Laser | Brian Kedward |
| SPRU | Joe Tidd |
| ***Household Appliances*** | |
| CECED, European Committee of manufacturers of domestic equipment | Luigi Meli |
| Electrolux | Victor Sundberg (Vice President), Onur Durmus |
| Miele | |
| Whirlpool | Christian Tarabbia |
| ***Transport*** | |
| Dinex | Lars Christian Larsen, Director |
| e-Traction | Arjan Heinen, Director |
| Honda Motor Europe | Chris Roger, Head of Corporate Affairs, Public Relations Division |
| Mercedes-Benz Buses and Coached | Michael Goepfart, Executive Managing Director |
| Roskilde University | Thomas Budde Christensen, Postdoc |
| SAAB | Anna Petre, Manager of government Relations |
| SCANIA | Urban Wastljung, Public and Environmental Af-fairs |
| Toyota Motor Europe | Stephen Stacey, General manager, Government and Technical Affairs |
| Toyota Motor Europe | Toshinari Nagai, Coordinating Executive |
| Volvo Buses | Ulf Gustafsson, Product Planner |

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| ***Construction*** | |
| Danfoss | Helle Gitz-Johansen, Department Head, Group Environment |
| ECCREDI / BBRI | Johan Vyncke, Researcher |
| Grundfos | Jürgen Süss, Vice President, Advanced Engineering & Technology |
| Rockwool | Claus Bugge Garn, Vice President, Group Public Affairs |
| ***Pulp and Paper*** | |
| CEPI | Jori Ringman, Recycling & Product Director |
| Dalum Papir | Dorthe Riis Sørensen, Manager of Energy and Environent |
| INGEDE | Axel Fischer, Public relations manager |
| Myllykoski Corporation | Erkki Peltonen, Group Director of Sustainability |
| Norske Skog | Howard Burwill, Vice-President of Research and Development |
| UPM | Päivi Rissanen, Manager, Environmental Affairs |
| ***Detergents*** | |
| A.I.S.E | |

*Table B Written sources*

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| ***Green marketing*** |
| Jacquelyn A. Ottman (2002): *Eco-Design, Eco-Innovation and the Customer: Lessons from the Green Graveyard.* |
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| ***Case studies*** |
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*Table C Internet Sources*

| Host | Address |
|---|---|
| Clean Production Action | http://www.cleanproduction.org/popup.ecover.html |
| Brand Strategy | http://www.brandstrategy.co.uk/issues/2008/July/Squeaky_green/Browse.view |
| CECED | http://www.ceced.org/ |
| CEPI | www.cepi.org |
| INGEDE | www.ingede.com |
| Brødrene Hartmann AS | www.hartmann.dk |
| Dalum Papir | www.dalumpapir.dk |
| Myllykoski | www.myllykoski.com |

*Table D List of Workshop Participants*

| Participant | Organisation | Position/Unit |
|---|---|---|
| Susanne Zänker | A.I.S.E. | Director General |
| David Walker | A.I.S.E. | Chairman of the Sustainability Steering Group |
| Kerstin Ochs | Henkel | Corporate Communications, Public Affairs & Governmental Relations |
| Xavier Leflaive | OECD | Environment and Globalisation Division Environment Directorate |
| Axel Fischer | INGEDE | Public Relations |
| Nicholas Hodac | General Motors | EU Affairs - Public Policy and Government Relations |
| Luigi Meli, | CECED | Director General |
| Viktor Sundberg | Electrolux | Vice President |
| Onur Durmus | Electrolux | EUP and energy related matters at Electrolux Europe |
| Toshinari Nagai | Toyota Motor Europe | Coordinating Executive |
| Steven Stacey | Toyota Motor Europe | General Manager |
| Andre Kuhlman | Miele | Marketing Department |
| Iain Cox | Eco Design Centre Wales | Operations manager |
| Thomas Budde Christensen | Roskilde University | cand.techn.soc. & ph.d. |

In addition to the above mentioned participants representatives of the Commission and the study team attended the workshop