

Proceedings : Refereed Sessions I

**Sustainable Consumption and Production:
Opportunities and Challenges**

**Launch Conference of the Sustainable Consumption
Research Exchange (SCORE!) Network**

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Framework of Programs on Sustainable Consumption and Production,
back to back with an invite-only policy meeting on SCP organized by
UNEP and the CSCP.



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Authors were provided a format and clear instructions for lay-out. Most authors followed these instructions very good, leading to a consistent presentation of most of the individual papers. Due to the large number of papers, the editors were unable to embark on the time consuming process of adjusting any lay-out errors in papers submitted. Papers had to be reproduced here in the lay-out in which they were submitted, and where authors did - or could - not follow our instructions this may have lead to slight inconsistencies in presentation.

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CBL I Creative Communities and Sustainable Lifestyles

Enabling platforms to support social innovation promising in terms of sustainability

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1 Introduction

This paper presents the main achievements of the EMUDE¹ (Emerging User Demand on Sustainable Solutions) European research project and in particular the notion of enabling platform². It concludes in presenting the goals and organization of a follow-up research project called: "Creative Communities for Sustainable Lifestyles" (CCSL) supported by the Swedish Tasks Force within the UNEP - UN DESA ten-year framework of programmes on SCP (Sustainable Consumption and Production).

The EMUDE research program focuses the emergence of diffused creativity in the society and collects a catalogue of cases of social innovation

¹ EMUDE (Emerging Users Demands for Sustainable Solutions) Specific Support Actions (SSA) Priority 3 – NMP research area: Increasing the “user awareness” / New Production Processes and Devices / Optimising the life-cycle of industrial systems, products and services. (NMP-2002-3.4.3.3-2)

EMUDE activities have been performed by a consortium constituted by the following universities and research institutes:

Politecnico di Milano, INDACO Department co-ordinator

National Institute for Consumer Research, SIFO

Netherlands Organisation for Applied Scientific Research, TNO

Strategic Design Scenarios, SDS

Doors of Perception

Philips Design

Joint Research Center, Institute for Prospective Technological Studies (JRC-IPTS)

Central European University, Budapest Foundation (CEU)

Consumers International (CI)

United Nations Environment Programme (UNEP DTIE)

² The paper, in general, and the section on the enabling platforms, in particular, are largely based on the EMUDE Executive Summary: a document where the main achievements of the different Consortium members are synthesised.

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across Europe. It allows to conceptualise the notions of "creative communities", "diffused social enterprise", "active welfare" and investigate new forms of sustainable local development based on user participation and self-organization.

Three types of results emerged: a list of technologies and organisation forms to facilitate the development and dissemination of promising social innovation, a scenario outlining at micro and macro scale the possible emerging vision; enabling platform as a system of tangible and intangible elements (such as technologies, infrastructures, legal frameworks and modes of governance and policy making) that seeks to generate a favourable context for creative communities and promising cases to develop and disseminate.

EMUDE investigation mainly focuses Europe with early considerations from the Central East of Europe and "Global South" points of view. Starting from these achievements, the CCSL program intends to enlarge and adapt the notions of creative communities, enabling platforms and promising initiatives for new models of sustainable lifestyles at a worldwide scale.

2 EMUDE Contents and outcomes

The EMUDE programme started by observing a phenomenon of social innovation: the emergence in Europe of groups of active, enterprising people inventing and putting into practice original ways of dealing with everyday problems (from childcare and care of the elderly to getting hold of natural food; from looking after green spaces to alternative means of transport; from building new solidarity networks to the creation of new forms of housing and shared facilities and services).

The initial hypotheses were that these cases of social innovation presented promising signals both from the aspect of environmental sustainability and, moreover, from that of social sustainability³. These signal might usefully point a new direction for technological and market research and innovation. For this reason it was thought that policies and tools of governance should be outlined, able to support existing cases and foster the development and orientation of analogous and equally promising activities.

2.1 Direct observation

2.1.1 *The emergence of diffused creativity*

The field study carried out by EMUDE has verified the validity of these original hypotheses and has shed light on the characteristics of these promising cases in the framework of contemporary society, the enormous transformations that is going through, and scenarios that outline ways in which it may evolve in future.

³ **Promising cases:** examples of initiatives where, in different ways and for different motivations, some people have re-oriented their behaviour and their expectations in a direction that appears to be coherent with the principles of social and environmental sustainability.

Work focused on the situation in Europe in general, but also looks at the specificities of Eastern European countries and considered the phenomenon from the point of view of “the Global South”.

It emerged from the study that there exists a dynamic new form of creativity: a diffuse creativity put co-operatively into action by “non-specialised” people, which takes shape as a significant though scarcely studied expression of contemporary society. More specifically, this diffuse creativity is one aspect of the design attitude each one of us must develop if we are to organise our lives in a highly turbulent and therefore unpredictable context.

For all these reasons it would appear legitimate to define these groups of enterprising people as creative communities: groups of people who invent new ways of living⁴

2.1.2 A collection of cases and a network of “antennas”

The direct observation of this emerging reality was carried out by building a network of observatories (Antennas) located in 8 European design schools. In this way more than 140 cases were gathered, from which 56 particularly significant ones were selected.

This collection of significant cases constitutes the basis of the following stages in the programme and is the result in itself, as a communicative instrument proposing a vast series of good practices that show how it is already possible, to live one’s own everyday life (or at least some of its activities) in a more sustainable way. The cases have been presented in a freely accessible on the web (www.sustainable-everyday.net) and constitute the main content of a display system used in numerous exhibitions.

2.2 Conceptualisation

2.2.1 From creative communities to the diffused social enterprise (DSE)

Particular focus has been put on the social and environmental value of the collected cases and the way they are taking shape as the initial stage in a new generation of social enterprise: the diffused social enterprise (DSE)⁵.

More precisely: as we said, to all intents and purposes creative communities are the invention of new ways of living and doing that must stabilise and consolidate their structure. This stage in the transition from a nascent heroic state, the true creative community, to a more mature, lasting state where they take the form of a social enterprise reaching into the everyday life of a large number of people has been identified as a “diffused

⁴ **Creative communities:** groups of innovative citizens organising themselves to solve a problem or to open a new possibility, and doing so as a positive step in the social learning process towards social and environmental sustainability.

⁵ **Diffused social enterprise:** this is diffuse enterprise that auto-produces social quality, where the term “diffuse enterprise” indicates people who, in their everyday life, organise themselves to obtain the results they are directly interested in; and the expression “to auto-produce social quality” refers to the process whereby, through actively seeking to resolve their problems, people enhance a project that has the side effect of (more or less deliberately) reinforcing the social fabric.

social enterprise" where people organise themselves to achieve the results that interest them, and in so doing produce sociality. In other words they regenerate the social fabric of which they are a part.

When read through the filter of DSE, the promising cases considered by EMUDE appear as forerunners of a new, promising idea of well-being, social justice and citizenship.

2.2.2 Creative communities, the DFS from the Central East of Europe

As previously mentioned, EMUDE's observations and reflections have mainly focused on Europe as a whole. However, special attention has been paid to the specificities of Central Eastern Europe (i.e the 8 Central Eastern European countries that joined the EU in 2004). It is clear that the difference in their recent history has its consequences in the way the phenomenon of creative community appears, or does not appear, in these countries.

The outcome of this observation is a reflection on how such differences make themselves felt. The first and most basic is due to a heritage from past regimes: in these countries civil society is still (re-)emerging and its manifestations are still (relatively) weak. A second specificity is the different mix of motivations that lead people into play: in Central Eastern European countries in the majority of cases economic issues are perceived to be more important and influential than environmental ones. Finally, a third significant specificity is the different mingling of tradition and modernity, between cases that present an almost linear continuation of the traditional ways of doing things, and cases that show a higher level of innovation. On average the influence of tradition is greater than in the rest of Europe.

2.2.3 European creative communities and the "Global South"

Though focusing on the European situation, the EMUDE programme also sought to find out whether, and roughly to what extent, the phenomenon of creative community could also be seen outside Europe and decided to concentrate on urbanised societies in the global south (the Global South).

What emerged repeats the some of the observations made for Eastern Europe: the predominance of economic need over social and environmental motivation, and the dominant role of tradition, i.e. cases that look like an adaptation of traditional ways of being and doing to new living conditions. As far as the latter tendency is concerned we must underline that the meaning of "community" and "creativity" in European countries, where traditions and conventions are considerably weakened, differs from their meaning in societies where such traditions and conventions are still very strong. On the other hand, the changing conditions of life effecting increasing proportions of the population in the Global South means that some European experiences may also stimulate analogous activities in their living contexts. Vice versa, it may be that the persistence of traditional ways of thinking and doing in the Southern metropolises will constitute an extensive reserve of social and cultural resources that give rise to new, sustainable ways of living, possibly adaptable to other contexts, among which the European one.

2.2.4 *Creative communities, the DFS and active welfare*

Creative communities and the DSE they can give rise to, could bring a notable contribution to welfare issues. In face of the growing demand for welfare and the crisis in ideas about this field dominant up to now, creative communities point to a possibility of a new path. They put forward a different idea of welfare, active welfare⁶ where people directly involved take direct part in achieving the results they want and in so doing, as we noted with reference to the characteristics of diffuse social enterprise, they “produce sociality”. However, since those directly involved become an active part in planning the service and then putting it into operation, they are also able to obtain the desired results in the way that is most economical and closest to their ever more changing and variegated needs.

2.2.5 *Creative communities, the DFS and new forms of sustainable local development*

The complex nature of creative communities and diffuse social enterprise opens the way to other promising lines of development. One of the most significant lies in considering them as forerunners of sustainable production models.

As a matter of fact, creative communities have invented unprecedented cultural activities, forms of organisation and economic models that are characterised by the balance between localisation (they are rooted in a place and in the community related to that place), and connection to the larger networks, i.e. to the global flows of ideas, information, people and things. All this indicates sustainable ways of valorising existing resources and proposes production and consumption networks based mainly on direct and neighbourhood relationships: a new economic model based on a strong social fabric and on a low ecological footprint.

2.2.6 *Bottom-up strategy and top-down actions*

The consolidation and diffusion of creative communities and diffuse social enterprise, is put forward as an original way of attempting to experiment intrinsically more sustainable ways of living and producing “from the bottom”. To be more precise: ways of living and producing that are able to merge social justice, environmental quality and a new sense of active citizenship, in the framework of a new idea of welfare and local development.

At the same time, observation of these cases tells us that, to be successful and bring about the great changes in orientation required, this bottom-up strategy also requires suitable “top-down” intervention: the cases realised by creative communities are in fact as fragile and difficult to repeat as they are promising.

⁶**Active Welfare:** a welfare system where people directly involved, take direct part in the definition and achievement of the results they intend to reach. A welfare that extends into our everyday lives, responding to the currently emerging, widespread new demand for well-being and citizenship. A welfare where the role of public bodies is that of fostering the capacity of individuals to face up to and resolve their problems, or more precisely, to favour the balanced development of citizens’ ability to “be enterprising”, and to “produce sociality”.

2.2.7 Participation as self-organisation

The issue of developing tools of governance that leave space for citizen participation is not in itself new. However, what is new in the case of EMUDE, is that in referring to creative communities and DSE rather than participation we are talking about self-organisation and changes in everyday being and doing.

However, these forms of enterprise appear and can be promoted and repeated only in precise conditions: a very strong and clearly orientated motivation; availability of a set of tools that make the project really feasible; communication that makes it recognisable and attractive to those who must set it up; existence of an in-depth knowledge of user-actor.

2.2.8 Interdisciplinary and strategic design approach

EMUDE is an highly interdisciplinary programme but clearly based on a strategic design approach when dealing with cases of social innovation . It does not mean that social phenomena in themselves can be designed. It simply means a particular way of looking at them: to look at cases of social innovation to identify what could be done to improve their potential, to maintain and/or re-new their qualities and to reduce their limits. That is, in our specific case: to look at creative communities and to imagine a strategy to move from them to the diffused social enterprise. And to do that maintaining the (most of the) qualities and values that triggered the original creative communities' ideas.

2.2.9 New policies and market opportunities

The reflections developed by EMUDE clearly have an immediate first interlocutor in policy makers, in local welfare and social service institutions, in non-profit associations operating in this area, and obviously in creative communities themselves and in whoever is prepared to follow their example. But these issues may also rapidly become very important for private enterprise and, in general, for all economic operators interested in developing products and services (and product and service systems) specifically conceived and developed to promote and support creative communities and diffuse social enterprise.

2.3 Proposals

2.3.1 A list of technologies and organisation forms

The first contribution that EMUDE brings towards this strategy is a better understanding of how creative communities actually work and what they require to work better and to become more easily replicable and/or upgradable. This research has led to the identification of certain prevalent organisational typologies, and to the explicit or implicit demand they voice for support technology.

So, the concrete result of this part of the EMUDE project is a list of technologies and organisation forms that, if developed in the direction

indicated, could serve to facilitate the DSE application and diffusion. And its orientation towards social and environmental sustainability.

This list is at the same time both an immediate result of the EMUDE programme, in so far as it is functional to the building of specific operational tools (scenarios, solutions and enabling platforms), and a final result, in that it indicates possible, promising lines of research and development for new technology and new families of products and services.

2.3.2 The micro and macro scenario

The second operative tool that EMUDE has developed is a scenario: the scenario of the diffused social enterprise and its articulation in a series of proposals (solution ideas) and experiences (on the part of different hypothetical users). This scenario offers an overview of what everyday life could be like in a society where the idea and practice of the DSE is widespread and where the proposed activities are supported by appropriate enabling solutions⁷. In other words conceived integrating the technology for which there was found to be demand.

This “micro” scenario, on an everyday scale, was then integrated with a “macro” scenario that offers a dual overview: it both describes what the general economic, social and political conditions should be like to make the development of the micro scenario more probable and effective, and gives an overall vision of what the wider economic, social, and political context might be like in a society where creative communities and the DSE are widespread.

The micro and macro scenarios together should be seen as facilitators of strategic conversation, i.e. as tools that make the meaning and implications clearer of creative communities and diffuse social enterprise possibly proliferating. They facilitate dialogue on these issues and the convergence of different social actors towards shared ideas about what we can do and how.

2.3.3 Enabling platforms

The third operative tool developed by EMUDE are enabling platforms⁸: systems of technologies, infrastructures, legal frameworks and modes of governance and policy making.

Considered as a whole, their role is to create a favourable environment for creative communities, to facilitate their evolution into diffuse social enterprises and to direct them towards more sustainable social and environmental solutions.

The enabling platform idea arose from various stages of the EMUDE process. First of all the roadmapping activity generated a number of ideas on

⁷ **Enabling solution:** a system of tangible and intangible elements (such as products, services, communication and procedures) that seeks to support a specific typology of promising cases, and to make them more accessible, effective, replicable.

⁸ **Enabling platform:** a system of tangible and intangible elements (such as technologies, infrastructures, legal frameworks and modes of governance and policy making) that seeks to generate a favourable context for creative communities and promising cases, i.e. to facilitate the emergence of creative communities and their evolution into lasting social enterprises and in so doing facilitate the transition towards a sustainable society

what kind of “demand for support” the creative communities have and how these could be translated into more stable enabling platforms. Secondly, it has been understood that, a crucial success factor for all these measures would be their alignment and coordination. And here the platform idea came to life as one of the major results of the EMUDE programme.

3 Roadmaps and enabling platforms

The DSE alone is not a panacea. However, as the EMUDE results indicate, if the weak signals are taken up, strengthened, connected and spread, their benefits can be greatly enhanced. Above that, if they are actively complemented by coherent targeted policy measures they will become strong enablers of wider socio-technical transition towards a sustainable society.

The policy measures to support this process could operate on three different levels:

- direct support to creative communities to realise their ideas and become DSE (strengthening the promising signals)
- measures to enable more people to start creative communities and DSE initiatives and to connect them to each other (spreading the promising signals).
- complementing measures creating framework conditions for transition using the diffused social enterprise as enabler (activating the social enterprise for transition)

These three levels of policy action could create a pathway from weak signals of creative communities towards an active civil society with a wide range of diffused social enterprises finally leading to a society that is incorporating the principle of sustainability in its social, environmental and economic dimension. To enhance this strategic perspective we introduce the concept of enabling platforms.

Enabling platforms are framework conditions supporting the diffused social enterprise transition pathway outlined above. They consist of various elements from different realms such as technologies, connections, spaces and legislation. They need to be implemented through a set of coherent measures from various policy fields.

3.1.1 Legal and economic framework

There should be a legal and economic framework that accommodates the DSE activities. In fact, they raise questions that have to be discussed and solved at two levels:

The positive changes in the financial support, taxation and juridical matters that have to be done in order to open up for bottom-up initiatives. What kind of political and financial support is necessary to expand the DSE within the European countries? What kind of juridical changes are necessary at European, national or local level in order to protect the bottom-up initiatives, and secure that they don't clash with other EU priorities? What

kind of tolerance is needed to open opportunities to creative communities and DSE initiatives?

The nature of the legal and economic “grey” zone where many of the initiatives promoted by the DSE operate. In fact, the same tolerance that could be considered as necessary for some of DSE initiatives could also be seized by “illegitimate” actors. Already, some of the cases raise this kind of questions like, for instance, legal and economic matters linked to use of public spaces in cities, and taxation related to both goods and services on the one hand labour on the other.

These questions, related to both opportunities and risks of this “grey zones”, could be discussed and solved at the political or administrative level. A first step in this direction is to better define how to clarify its economic and legal nature.

3.1.2 Enabling Working environment

To be able to participate in the DSE people need to have the possibility to flexibly shape their engagement into working life according to their needs. New possibilities are needed to switch between different levels of engagement in working life, community life and private life as well as training and education phases without putting at risk workplace security.

3.1.3 Participatory Governance

Social enterprise will reweave the social fabric by creating new social and physical spaces. Thereby they will become major stakeholders in governments’ activities operating on those spaces from another direction. For this reason they could have a role to play in putting into practice the active engagement of civil society into governance.

3.1.4 Citizens Agencies

Citizens’ agencies are meant to be enablers for any kind of DSE initiatives to be started but also as a facilitator for existing ones to grow, multiply and flourish. Instead of searching for solutions for various demands such as spaces, people, equipment etc. in negotiation with various governmental and non governmental actors the citizens agency would provide the first point to contact for people to embark into a diffused social enterprise.

3.1.5 Collective spaces

Facilities that can be used by communities for mixed public private functions thus addressing the meta-demand on “sheltering”. Collective spaces are not completely public but jointly managed by a group of people either living closely together or driven by a common interest.

A number of the solution ideas in different realms rely on the availability of such spaces for their realisation. Therefore they can be considered as a powerful enabler for more DSE initiatives to emerge.

3.1.6 Connecting platforms

Connecting people to people, people to products and services and even products/services to products/services is a very important demand within the DSE. The connecting platform consists of technological innovations and policy measures to offer the possibility to fulfil these demands as good as possible.

3.1.7 Multi-Use(r) products

These are products that allow for various forms of shared use. Such products address the meta demands for sharing, synchronizing, personalizing, payment, tracking and tracing and, depending on how much private information is needed to fulfil these demands also the meta-demand, privacy-guaranteeing. They are relevant enablers in many of the solution ideas.

3.1.8 Semi professional equipment

Semi professional equipment is used in a non professional environment often even in private spaces to provide a service for a larger group of people. A number of the Emude cases are characterised by this type of situation. The challenge is to have products that fit into this environment which lacks many of the preconditions of professional environment such as ample space, provision for safety, waste disposal etc. and where non professional people might be around but can still be used on a larger scale with some professional characteristics.

3.1.9 Complementary product service systems

These are professional product service systems specifically designed by companies to complement the social enterprise activities. For instance: flexible mobility services; fluid payment systems; customised an intelligent booking and ordering system, as well as tracking and tracing technologies.

3.1.10 Experimental Spaces

The experimental space is meant to facilitate socio-technical experimentation. In fact, to achieve real changes of paradigms in current modes of production and consumption, technological and social innovation has to be aligned. However, it is difficult to find adequate experimental space for both technological and social innovation at the same time. The DSE initiatives could become such socio-technical micro-experimental spaces.

4 CCSL project (Creative Communities for Sustainable Lifestyles)

4.1 The project

Creative Communities for Sustainable Lifestyles (CCSL) is a project promoted by UNEP, DIS-Indaco Politecnico di Milano in Italy and Strategic Design Scenarios (SDS), in Belgium⁹.

The CCSL aim is to discuss the emerging phenomenon of grass roots social innovation in everyday life and its implications for sustainability, in relation to different socio-cultural and geographical contexts. It will focus in particular on three aspects: (1) the nature of the groups of people who generate these innovations (the Creative communities); (2) their role in promoting new and sustainable ways of living and doing (the promising cases) and (3) the possibility of developing systems of products, services and communication to make these promising cases more accessible, effective and replicable (the enabling platforms)

4.2 Objectives

Based on the EMUDE results, approach and methodology, the CCSL project intends to compare creative communities and cases of social innovation in Europe with similar grassroots social innovation for everyday life appearing in other parts of the world (with a special focus on the emerging urban societies of the South and the Far East).

In particular, the CCSL project raises the following questions:

What is the nature of this kind of social innovation in emerging countries?

In what way is it different from that observed in Europe?

Who are the actors involved in such cases and how are the solutions carried out?

Can the local cases be improved? Could the ideas for enabling platforms developed for Europe be applied here?

Could there be different tools and platforms from those in Europe?

What can Europe learn from non-European cases of social innovation?

The CCSL proposes to approach these questions through the collection of significant cases of grass roots innovation and the organization of a series of workshops to be held in China, India and Brazil.

These workshops will target local organisations (NGOs, institutions and associations) and will compare the creative communities and social innovation cases pinpointed by the EMUDE research with cases and experiences found in these 3 countries.

⁹ CCSL is a project promoted under the Marrakech Task Force on Sustainable Lifestyles within the ten-year framework of programmes on SCP (Sustainable Consumption and Production) of the United Nations Environmental Programme (UNEP) - United Nations Department of Economic and Social Affairs UN DESA. CCSL project is funded by the Swedish Government, Ministry of Sustainable Development.

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CBL I The role of households in SCP agenda.

A one-man show or concerted action?

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1 Introduction

It has been demonstrated that environmental gains achieved by eco-efficiency strategies at company level leading to improved production processes and more environmentally sound products are being offset by trends on the demand side - population growth and increasing levels of affluence in many countries – leading to increasing consumption levels. Most of the growth was stimulated by advancing economic prosperity, which was made possible due to increasing production efficiency. In its turn, production efficiency should of course be supported by consumption efficiency and we all are witnessing how consumption is fuelled by enormous pressure through the advertising industry, which in 2002 had a global spending of \$446 billion – a nine-fold increase from 1950 (Worldwatch Institute, 2004). The number of individuals who can be called consumers is growing dramatically. According to the Worldwatch Institute, the global consumer class (users of TVs, phones and the Internet along with the culture and ideals these products transmit) is about 1.7 billion people or more than a quarter of the world. Between 1960 and 2000, private consumption expenditures (household spending on goods and services) increased from \$4.8 to \$20 trillion (Worldwatch Institute, 2004).

That is why new approaches to satisfying the needs and wants of a population are needed that can support the same or in many countries higher standards of living, but with significantly reduced levels of resource consumption and pollution. Sustainable consumption is therefore receiving increasing attention, but there is yet no consensus as to what sustainable consumption actually means, what strategies it should contain and who should take the action. In the discourse on sustainable consumption, some associate it with requesting consumers to do without or to purchase fewer products and services. Others anticipate that sustainable consumption will provide consumption possibilities for the vast majority of the world's population that cannot currently satisfy their basic needs. Yet third group of discussants advocate for sustainable consumption to provide alternative consumption choices, allowing consumers to satisfy their needs with products and services that are made with and use fewer resources, cause less pollution and have positive social impacts. In other words, the debate centres on whether it is sufficient to change consumption patterns or if there is a

need to also address consumption levels. In either case however it is clear that the shift towards sustainable consumption involves individuals and households and implies changing consumer behaviour and adjusting lifestyles not only by “them”, but also by “me personally”.

The question however is: what exactly individuals and households can do to stimulate the shift towards more sustainable lifestyles. Recent documents from national governments, e.g. Finland and UK, and international non-governmental organisations, such as UNEP, provide some suggestions for how the question could be answered. Firstly, private consumers can directly influence the market of eco-products through their purchasing decisions. If consumers demand environmentally sound attributes in products, companies will respond to environmental issues as a market opportunity. Secondly, individuals and households can contribute by getting involved in waste minimisation and especially waste separation activities that promote recycling in society and reduce overall load on the environment by reducing land use for landfills. Thirdly, consumers are suggested to favour repair and reuse (DEFRA and DTI, 2003). And finally, the consumers are encouraged to reconsider their reliance on the most polluting forms of transport, to rethink their travel needs and to shift towards more sustainable mobility solutions.

These suggestions, though undoubtedly relevant, lead to a question of whether there is sufficient supporting institutional frameworks and infrastructure in our society to make sure that consumers are actually able to follow these paths. Since consumers are often held responsible for the slow progress towards sustainable consumption, this article investigates whether households are really the culprit in this case. In the article various initiatives of individuals and households towards sustainable consumption are studied, barriers for households to get involved in the suggested by policy activities are investigated, and the current activities of numerous stakeholders in sustainable consumption are analysed. The ultimate goal is to understand how households and individuals can be triggered into more sustainable lifestyles.

2 Household actions

Households indeed have an important role to play in the quest towards sustainable consumption since household activities are responsible for 40% of overall environmental impacts. Among these activities, especially energy use for house heating/cooling, transportation and food consumption are responsible for 75% of environmental load from households (Tukker, Huppes et al., 2005). To some extent, it is consumers who can reduce their impacts in these and other need areas, and to some extent, these impacts can be reduced by producers who deliver products to the market. Let us first consider what consumers are doing to reduce environmental impacts from households despite the common belief that they have low awareness and willingness to act in comparison to the stated preferences and bounded rationality that prevents people from making sustainable choices.

First of all, studies demonstrate that consumers are willing to pay more for environmentally sound and fair products and they do buy more of these products (Sammer and Wüstenhagen, 2006). Growth in sales of sustainable products and services is starting to be visible. For example, the global

market for organic products was estimated to be \$25 billion in 2004, and growth rates between 5 and 40% in different countries. In Denmark, Sweden and Switzerland organic vegetables comprise over 6% of the total market share (Organic Monitor, 2005). Fair trade products in the period of 1997-2003 increased in sales from 25,972 MT to 83,480 MT. However, two countries, UK and Switzerland, account for 57% of 2003 sales (Fairtrade, 2005). Sustainably managed forestry market is also growing, reaching over 4% of global forest area (Borregaard and Dufey, 2005). A promising sign of consumer growing environmental awareness is the appearance of ecological shops and entire retail chains that have 100% of ecological or fair trade products in their range, as well as a clear trend towards including environmentally sound products in their product range by companies or retail chains that several years back considered ecological products to be a niche market that did not deserve their attention.

Other areas of clear consumer interest in environmental and social features of products is the increasing number of farmers markets where people have a chance to buy local and often organic produce and meet farmers who actually produce food stuffs sold on the market. In addition to these, studies show the general growth of interest and requests from consumers in organic food (Nilsson and Hansson, 2006).

Another area is the slow living movement and simplicity ideas (Segal, 2003), such as the New American Dream (Center for a New American Dream, 2001). Examples of sufficiency solutions are numerous in Nordic countries and include, for example, common practices of renting out cottages to several people throughout a year. The same time-sharing principle is applied to the hotel sharing programmes with the difference being that people are buying shares of a hotel. Laundries are widely used in many communities instead of individual washing machines installed in each apartment. One more example of sufficiency solution that leads to reduced impacts from households is the cohousing initiatives. Cohousing communities, pioneered in Denmark in the early 1970's respond to the basic needs of today's households—childcare, social contact and economic efficiency—by combining the autonomy of private dwellings with the advantages of community living. The Cohousing concept re-establishes many of the advantages of traditional villages within the context of late twentieth-century life. Every household has a private residence and also shares extensive common facilities with the larger group, such as a large commercial scale kitchen, dining hall, children's playroom, workshops, guest rooms and laundry facilities. Although individual dwellings are designed to be self-sufficient and each has its own kitchen, the common facilities, and particularly common dinners, are an important part of community life both for social and practical reasons. By redefining the neighbourhood concept to better address contemporary lifestyles, these resident-involved, co-operative neighbourhoods create cross-generation communities composed of singles, couples, families and the elderly. This kind of diversity encourages social interactions and allows individuals to experience and relate to groups with different lifestyles. Shared use of household equipment and facilities minimises the material intensity of the use phase.

Not the least important area that has been addressed by households is mobility. Car sharing and especially its variation – car sharing cooperatives - is an example of households organising mobility function in a different way

than by using individual cars. Some non-commercial cooperatives are rather successful as they survived on the market for more than a quarter of a century, e.g. the first car sharing cooperative in the world was organised in Sweden in 1979 (Jacobsson, 2002). These cooperatives are usually small and operate in neighbourhoods. The majority of them fulfil the needs of their members and do not aim to grow in the future. The number of people who take part in car sharing commercial organisations and less formal car sharing cooperatives is reaching 300 000 members in the world (Britton and World Carshare Associates, 2000).

Community-based rental or sharing services of power tools represents another example of how people and households can organise themselves and develop a service which fulfils their needs and in which products are shared instead of owned by individuals (Mont, 2004). These schemes can be found in tenants' organisations, especially in villa areas, or in multiflat houses with several tens of households. The initiative for the organisation of services can either come from tenants themselves or from the board of the tenant association. Workshop rooms that can be found in the multi-flat houses may also function on the same premises, or small rental service can be sometimes arranged by a caretaker or an enthusiast (Mont and Plepys, 2004).

Eco-villages are also an interesting and quite advanced way of simple living which reduces environmental effects and creates positive social outcomes. Eco-villages are alternative small-scale communities in which people chose to live in accordance with environmental and social principles in mind. They are spread throughout the world and seek independent infrastructures, including housing and roads, and a sustainable lifestyle, e.g. simple living, for inhabitants that are built on local and seasonal production of primarily food produce.

Local Exchange Trading Schemes (LETS) are local community-based networks in which people exchange goods and services without using money. People earn LETS credits by providing a service and can buy services of other people with these LETS credits. Services can include childcare, cooking, transport, or home repairs and renovation. LETS can be found in the UK, USA, Canada, Australia, New Zealand and Ireland. In the UK, for example, there are about 450 LETS schemes with 40,000 people.

All these examples demonstrate that there are other ways for people to enjoy life than being consumers or quite often shopaholics, who are in desperate need of “retail therapy”. Of course, many of these examples are niche markets and the real question is: what prevents other people from joining these types of initiatives. This question is discussed in the following section.

3 Barriers for households

In order to realise the shift towards sustainable consumption, presented above activities undertaken by households and individuals that contribute to more sustainable consumption have to become mainstream markets. So far, there is very little evidence to suggest that this shift is actually happening. In this section, several barriers for households to engage in activities towards sustainable consumption and to exercise more sustainable lifestyles are outlined.

To start with, the sustainability agenda in its most basic form has not yet penetrated the mass market, mass culture and has not become a part of

everyday life for people neither in more industrialised countries, nor in developing countries with much more pressing everyday needs, such as food availability, access to fresh and clean water, health and safety, and basic housing. If we now take into account only individuals and households in more industrialised countries, which in essence are service economies, then the following barriers can be identified.

The low people's awareness about environmental problems has been identified in many studies as one of the most important barriers towards sustainable consumption. In the period of 1993-1998 there was a standstill in expansion of environmental behaviour both in recycling and in purchasing labelled products, as well as in more elaborated and planned aspects of behaviour, such as energy and water saving programs and in the mobility area (Lindén and Thelander, 1998). Although environmental issues are slowly entering media and schools, understanding of how everyday activities of households are linked to the large and long-term environmental impacts and what steps they can undertake to reduce their own impacts on the environment is clearly insufficient. In addition, even if knowledge level is adequate, there is a large gap between people's general awareness about environmental problems and people's attitude towards addressing them and between taking the responsibility and actually acting on the knowledge and attitude.

In addition to these more individual or cognitive barriers, consumption choices are also to a large degree depend on existing and available infrastructure and on regulatory and normative institutions in the society. Very often, even if consumers are willing to make sustainable choices, they often find themselves locked into unsustainable practices, unsustainable infrastructures and unsustainable choices of products and services (Sanne, 2002).

The type of infrastructure has a direct effect on individual consumption patterns and associated environmental impacts (Jonsson, Gullberg et al., 2000). Actors need to ensure that there is an infrastructure in place that shapes household behaviour into a more sustainable direction, whether it is a waste collection system, parking spaces for shared cars, refurbishing or recycling facilities or infrastructure for safe final disposal. If the infrastructure does not exist, there is no point of stimulating consumers – they cannot do it even if they wanted. On the other hand, it is important to ensure that once infrastructure is in place it is used properly. There are examples when infrastructure is not used properly. For instance, households may report that waste they have separated is brought into one compartment on a truck that picks up the waste. These actions greatly undermine people's trust in authorities who provide infrastructure and public services and willingness to participate in such activities in the future.

In addition to infrastructure, there are also established regulatory frameworks that often work counterproductive to sustainability goal. A simple example is the regulation that prevents customers from sharing products, a good example of it being the Napster problem. Although this is the case of sharing files on the Internet, the way the problem is dealt with sends a signal to public that sharing also material products may not be favoured by established regulatory institutions. In addition to this problem, there might be a potential conflict between existing frameworks and the

regulations that support sustainable consumption practices, which leads to provision of contradictory signals to the public.

In addition to regulatory frameworks, which are not so numerous in sustainable consumption area anyway, current household practices are also based on both individual cognitive capabilities and on the pattern of norms accepted and embedded in society and in everyday life of individuals. A growing body of research suggests that a person's sense of well-being is based not only on one's own consumption, but especially on the consumption relative to a reference group (Howarth, 1996). "Keeping up with the Jones" often serves as a barrier to initiating more sustainable lifestyles, but could also potentially be a factor that would move forward larger populations towards sustainable lifestyles. What is clear is that strategies that were targeting individuals without taking into consideration that these individuals belong to a certain social group or have a group of peers they strive to, are insufficient and additional strategies should be developed directed at collective level (Jackson, 2005).

Looking at the choice of products and services in shops and at their prices identifies another barrier. Price premium for environmental features of products puts these products out of reach of the majority of population. Only environmentally aware people or those for whom green lifestyles is the main way of living can allow themselves to buy these products and in that way distinguish themselves from the crowd. In order to increase the market for environmentally sound products producers and retailers apply for eco-labels and social labels to distinguish products with specific characteristics corresponding to the developed by third party criteria. The problem reported in recent years is the proliferation of these labels the sheer number of which instead of providing information to consumers and assisting them in making informed choices, creates confusion and mistrust in any kind of label associated either with an environmental or a social issue. For example, there are 107 different food-labelling schemes in the EU alone (Nilsson, Tuncer et al., 2004). In addition to the number of labels on some products, the problem is actually the time consumers have for their decision-making process during shopping. Research indicates that in their everyday purchases people spend 4 seconds per product on making the choice. It is hard to imagine that provided on packaging information about environmental or social features of products can be read and understood in such a short time.

One can find numerous examples of how people, consumers and households are given conflicting messages all the time. For example, travel by car is often compensated by employers, airlines encourage plane use by bonus and membership schemes, tobacco industry is facing a huge image problem and at the same time tobacco farmers are subsidised by the EU, and while environmental issues are gaining importance in the eyes of broad public, environmental taxes are no match to labour taxation.

In addition to the identified above barriers, another obstacle is of crucial importance – advertising industry and marketing strategies of firms. The main message of the advertising industry is that "there is a product for every need" (Durning, 1992) and consumers demand material products to satisfy their needs and wants and help them reach a certain social status or a sense of belonging to a certain community of people. So the question really is: how come that some people, despite the continuous advertising and

marketing efforts, still do prefer car sharing to car ownership, buy environmentally sound alternatives and support “Buy nothing” campaign.

4 Stakeholders and their contribution to sustainable consumption

This section looks at some of the main stakeholders and their current efforts in sustainable consumption discourse.

4.1 Governments and public sector

Public authorities at all levels have a key role to play in facilitating the shift to a more sustainable world, as rulers by setting the regulatory, economic and institutional framework in which industry can apply its skills to make sustainable development a reality and as consumers by fostering the demand for cleaner products and services through sustainable and responsible purchasing practices. Public bodies have significant purchasing power, overall consumption of various levels of governments amounts up to 15% of GDP (OECD, 1999), and therefore, green procurement is a way to promote the development of green products and technologies. In this view, government purchases provide an earlier and larger market for green products, thereby allowing firms to lower costs through scale economies and learning-by-doing. Authorities and governments especially play an important role, because, in addition to obtaining needed products and services, they can promote specific social and economic objectives through their procurement policies, such as encouragement of local produce, support of SMEs, revitalising growth in selected sectors, e.g. car sharing, and supporting fair trade labelled products. With all these possibilities it is important that households and general public is informed about the choices that public procurers are making, so that their efforts also serve the educational and awareness raising purpose.

Among the governmental instruments addressing sustainable consumption and production, administrative or regulatory instruments are usually applied to producers (e.g. pollution control, product standards). Many examples of economic instruments (tax reforms, product charges), although affecting producers, are also directed towards final consumers. Informative instruments are being used for both consumers through e.g. awareness raising campaigns, education and eco-labels and for producers through labelling schemes or voluntary initiatives. Regulatory framework has been developed to evaluate the types of marketing claims made by producers and in this way protect consumers from untruthful or confusing information.

Having said that, there is still a noticeable lack of strategies that challenge the assumptions of economic systems based on material growth and that could conceive ways of shifting from material-intensive consumer culture to a society with less materialistic aspirations. Certainly, such strategies should address not only the production side, but also the consumption dimension, propagating not only efficiency approaches, but also sufficiency strategies.

4.2 Businesses and retailers

A large number of companies utilise and benefit from the eco-efficiency concept, both in economic and environmental terms. Fewer companies can boast a contribution to increasing the knowledge of consumers about environmental features through environmental declarations or eco-labels. Even fewer can provide examples of strategies employed to provide life cycle financial and environmental information to stimulate more environmentally sound consumer choices. Electrolux is an example of a company that uses life cycle cost information to facilitate purchases of its more environmentally sound products, the initial price of which is higher than similar products of other producers, but the life cycle cost is lower due to the reduced use of electricity and water. A recent concern regarding the area for development that contributes to social sustainability is the Corporate Social Responsibility that advocates actions to ensure that social considerations are part of the business decision-making process. Another growing area of attention is the so-called sustainability marketing that aims at reaching sustainability and business goals (UNEP, 2005), (Belz, 2006). So overall, it is possible to conclude that some pioneer companies are moving towards cleaner production practices and towards developing better products and services and in this way contributing to greening the markets – addressing consumption patterns. When it comes to changing consumption levels, this issue appears to be much more sensitive and almost inappropriate to mention. However, example of actions toward companies that sell tobacco, alcohol or genetically engineered food can provide some insights to how consumption of certain products can be moderated. Another way to change consumption levels is by shifting from selling material products that create environmental impacts to charging for using these products instead (Mont, 2004).

Retailing is a \$7 trillion worldwide industry and has an increasing market power to influence the products that consumers buy (McIntosh and Valerio, 2005). With such power, retailers have the potential to create a greater market for sustainable products and there are a number of them who have started to promote environmentally sound products or even developed their own brand name to distinguish products with environmental or social attributes in their shops (Wallace, 2006). Retailers have already proven to have a role in increasing sales of sustainable products. For example, retail sales of organic cotton are expected to have a 116% average annual growth rate by the end of 2008 (Organic Exchange, 2006); sales of FairTrade in the retail food sector had a turnover of 17.62% (Gepa, 2006).

4.3 Advertising

Since there is not many initiatives of companies to be found in terms of reducing consumption levels of material products, advertising agencies at best can promote sales of more environmentally sound products and services. Even these kinds of advertising are quite rare, although one can perhaps notice a slight increase in the number of green advertisements in recent years on TV and in media. Unlike in late 1980s, when general green statements were typically made in advertising, today green advertising tends to refer to single issues such as design for recyclability, energy efficiency or less toxic materials. Responding to consumer demand, advertising is shifting the focus from process related information to product related claims (UNEP,

2005). Very few examples exist of green campaigns organised by advertisers themselves and therefore, there is a huge untouched territory for advertising industry to contribute to sustainable consumption.

A positive sign is few environmentally oriented communication and advertising agencies, i.e. Dahlskog Kommunikera, who see their major role and expertise in promoting environmental issues. However it is not known what share of their work relates to directly facilitating markets for green products. Some consultancies, however, promote green and innovative design of products and services, i.e. J. Ottman Consulting (J. Ottman Consulting, 2001). There are few interesting example of NGOs, Adbusters (Adbusters.com, 2006) and the Center for a New American Dream (The Center for a New American Dream, 2001), which through the web highlight the most egregious examples of environmental irresponsibility in advertising.

4.4 Financial institutions and insurance companies

Corporations need financial support to continue operations, support expansion plans and direct new ventures. As capital markets are beginning to press environmental performance criteria as part of their loan granting procedures, environmental performance is translated into cost-of-capital considerations within the company. As one of the major sources of capital, banks were slow to pick up on the environmental considerations of their lending practices. However, currently more than 170 companies from over 45 countries have signed the 1992 UNEP "Statement by Financial Institutions on the Environment and Sustainable Development" (UNEP, 2001). Beyond examining the merits of individual proposal, some banks started to look at the practices of the applicant, equating poor environmental performance with high financial risk.

Insurance companies are now also equating environmentally risky activities with increased financial risk and are beginning to apply environmental criteria to minimise risk in their underwriting practices. To express their position on environmental problems, in 1995 insurance industry developed a Statement of Environmental Commitment with the support of UNEP (UNEP, 1995). Primarily attention was allocated to reducing environmental risks from operations and handling of hazardous materials. Later the scope extended to include requirements about products' environmental profiles. Climate change and risks associated with it increase the environmental awareness of insurance companies about potential risk magnitude of an environmental calamity. Policies of many insurance companies include lower premiums for activities and products with lower environmental risks.

Besides indirectly influencing green markets, banks and insurance companies can directly stimulate the development of a market for green products by developing their own in-house procurement policies for environmentally apt products and perhaps eventually indirectly address the issue of production and consumption volumes, as is currently the case with toxic substances.

4.5 NGOs, consumer groups and agencies

Having the power to affect demand side of green product markets, private consumers can exercise more pressure if organised in consumer groups. There are numerous consumer organisations and NGOs that demand and

lobby for less toxic, less hazardous products on the market. Examples of such campaigns can be found in the activities of Global Action Plan, Environmental Home Guard (Norway), Miljøhjemmevernet (Norway), The New American Dream (USA), Sustainable Do-It-Yourself (The Netherlands), Solar-Na Klar! (Germany). These organisations are working on improving environmental literacy and facilitating behavioural change and are considered to be quite successful in information provision activities to inspire households for voluntary contracts to reduce environmental impacts through the change of consumption habits. For example, the Environmental Home Guard attempts to change consumer behaviour by taking an optimistic solution-oriented approach, using simple and direct language, including humour and linking action with cultural activities such as theatre, music and sports (Robins and Roberts, 1998).

Non-governmental organisations have also been active in the area of sustainable consumption at a policy level, although they have significantly less power in influencing global political agenda on sustainable consumption compared to international organisations, such as the UN or OECD. However, the work of NGOs is also important, especially because different political agendas and power groups hold less influence over these organisations. Differing from inter-governmental or business organisations, many contributions from these NGOs pursue strong sustainable consumption by discussing patterns and levels of consumption, social values and the adoption of alternative lifestyles. To strengthen their voice in the sustainable consumption debate, NGOs have organised themselves into different international organisations, such as the Consumer International (CI) and International Coalition on Sustainable Consumption and Production (ICSPAC).

5 Future outlook

As was discussed in the previous sections, private consumers often have a rather constrained capacity to change their behaviour, which is strongly influenced both by the existing institutional settings and infrastructures and by societal factors. In other words, private consumers act within social, technological and market boundaries, as well as the boundaries of their own knowledge. Therefore, it is hard to claim the individuals and households are really a culprit behind mediocre progress towards sustainable consumption. It was demonstrated that existence of regulatory or legislative frameworks that directly or indirectly stimulate more sustainable practices in our society are very important. These frameworks may legitimise and even give the priority to these areas by stimulating research and investment into their establishment, leading to further dissemination of sustainable consumption practices and their embeddedness into society and everyday life.

Obviously, no single tool or approach can change the framework conditions in society. Therefore, a National Sustainable Consumption Strategy and an Action Plan could be the first step to a more integrative approach in dealing with consumption-related problems. Policy interventions combined with other instruments can facilitate the creation of economic frameworks that promote more sustainable lifestyles.

Public sector should practise what it is preaching through governmental procurement policies that favour environmentally sound alternatives, prefer services and less material products, local and organic produce, repair, reuse

and recycling, as well as choose alternative consumption systems, such as sharing, pooling, renting and leasing. These choices should be widely reported to the public and serve as awareness raising mechanism. In addition to procurement programmes, governments and public sector should initiate, support and advocate sustainable consumption values via education and information programs for consumers and especially kids and teenagers. Individual consumers are a stakeholder group that is the most difficult to address directly with governmental policies. However, governments can still stimulate sustainable consumption practices in the society by supporting and stimulating the creation of alternative or the revival of traditional family and community values and stressing the value of sufficiency and eco-efficiency; by investing into educating consumers about the impact of their choices on the environment, health and social aspects and reveal their hidden private and social costs; as well as by helping in the creation of alternative lifestyles based on mutual support and sharing, in contrast to the currently prevailing culture of consumerism, individualisation and material aspirations.

Businesses, advertising industry and retailers can also contribute to sustainable consumption progress by practicing eco-efficiency and developing new business models that profit from innovative combinations of products and services that provide higher value-added to consumers and encourage sufficiency principle in consumption of material products. Businesses together with advertising industry, media and retailers should provide information about life cycle costs and the environmental and social impacts of products to give a fair and sufficient basis for informed consumer choice. In addition, advertising industry can help create appealing and flashy images of more sustainable lifestyles that are more environmentally and socially sound and are not necessarily based on owning material goods. Since advertising industry together with other actors succeeded in creating current culture of limitless consumerism, now it is high time for it to help conceive ways of shifting towards a society with less materialistic aspirations.

6 Overall conclusion

In the current understanding, consumption is one of the cornerstones of social welfare and an important part of people's lives, serving as a measure of success and a way of defining personal identities. At the same time, increasing consumption is one of the main contributors to the continuing environmental degradation threatening the idea of sustainable development and the survival of the planet. Therefore, developing socio-economic systems ensuring high quality of life and sustaining environmental impacts in line with nature's carrying capacity should be perceived as the contemporary societal goal.

It is obvious that eco-efficiency strategies are insufficient en route towards sustainable development and they must be complemented with changes in consumption patterns as well as reduction of the levels of material consumption. Unfortunately, the latter not only requires personal moral commitment from private consumers and households, but also threatens a variety of vested interests clashing with current political and economic strategies of promoting economic growth. Therefore, dealing with the environmental issues of consumption requires balancing between sustainable development, socio-economic goals and political agendas and a

concerted international action from government, businesses and private consumers and integrated system-level solutions. So far, the most active stakeholders leading the debate of sustainable consumption are inter-governmental and non-governmental organisations (NGOs) even though the former seem to lack the political commitment to take radical approaches, such as reduction of consumption levels. NGOs are more radical, but lack the power to induce changes beyond marginal cases. Therefore, actions by governments are needed that would change the existing institutional, infrastructural and economic frameworks and create conditions for more sustainable lifestyles. The new consumption-oriented policies must be developed in consultation with all relevant stakeholders and aligned with the existing policy framework.

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CBL I The interface between technological innovation and non-technological innovation

when radical environmental innovations become emerging industry

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1 Introduction

Innovation is essential to realization of sustainable economic growth in today's global knowledge economy. However, incremental innovations such as end-of-pipe technologies as well as products and processes adaptations in order to reduce waste and pollutants discharged to environment and to save the resources used in production are not enough for reversing the tendency of increasingly ecosystem depletion under the existing industrialization and consumption pattern. It is believed more radical environmental innovations should be facilitated, and, ultimately radical system changes need to be pursued. A rang of new philosophies have being developed in different regions in the world, which introduce new paradigms, hence paradigmatic innovation (Gallouj and Weinstein, 1997), spurring the development of new technological trajectories and novel management and service approaches towards environment problems.

However, one of the major problems in the process of innovation for environment is that radical new technology or novel environmental management methods invented or created may not be used in a society easily or immediately as expected, not to mention the realization of a radical system discontinuity.

Radical technological innovation is not an easy matter as they are characterised by a mismatch with the existing system (Hofman, 2003). "Technology does not function independently, but that, in order to work, technology is part of a larger configuration that consists of mutually attuned elements such as infrastructure, knowledge, skills, industrial organization, regulatory standards and cultural norms, through which the technology can be handled productively" (ibid) . The mismatches on any of those "mutually attuned elements" are traditionally analyzed as non-technical barriers in addition to technical barriers for technology adoption, diffusion and industrial transformation.

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Attention and propositions, no surprise, have been paid to how to overcome those barriers. For example, Hofman (2003) proposes heuristically to create new paths, which encompass macro and meso level institutional changes as well as micro level changes on different aspects, through mobilization of actors for a new idea. In sustainable consumption and production literature, a concept of system innovation is established, which advocates conducting innovations simultaneously in technology, infrastructure and wider institutions (Andersen, 2006).

Nevertheless, there is neither empirical support justifying the proposed approach in terms of system innovation, nor practical implementation guidelines, which can be got from existing innovation researches, for how to conduct system innovation. Moreover, the recent debate around the concept of system innovation suggests some defects on the concept and implicitly reveals that the concept could be led to be interpreted differently that may cause problems for practices. For instance, based on findings from the Sustainable Office research project, Tischner and Verkuijl(2006) conclude that the system innovation concept was too inflexible for practical use and system innovations are not automatically sustainable. Andersen (2006) questions on the concept on that it tends to focus on singly innovations and the concept is problematic to align evolutionary thinking. Policies focus on singly innovations may lead to early picking of environmental winners, thus lock-in suboptimum options. These reveal the theoretical gaps.

However, the defective but heuristic idea of system innovation implies that the success of a radical technological innovation is linked with a range of innovations another than the technical ones, which have been somewhat referred as changes required for the function of the radical technology. Thus, this paper suggests that we may look at things from a different angle, so that the confusion will be solved and it will pave a way towards an advance on innovation theory which can guide practices.

Exploring the emerging waste-incineration-for-energy (WIE) industry in China, this paper draws the attention to the interface between technological innovation and non-technological innovation. From a systems of innovation perspective, it addresses how a radical environmental technological innovation can be successfully conducted and diffused in a society, based on a multi-level approach in considering relevant non-technological innovations, which influence, interact with, and enable the success of given technological innovation. Extending and linking up analytically with existing literatures as well as constructing based on the findings from the empirical part of the study, this paper proposes a meta-coupling innovation process model (Figure 1).

The model enriches our understanding of innovation process, at least, on four aspects as follows: 1) the innovation and diffusion of a radical technology or solution, which is developing along a new trajectory, is to form a new social-technical system. The core technological development and transition will be encapsulated (influenced, facilitated and enabled) by a range of non-technological innovations at micro, meso and macro levels. 2) The invention, innovation and diffusion is one continuum and fused process, but will have to pass five critical transition points or stages, which are the result of the development rather than presetting gates for sequences of the development. The innovation process is non-linear (illustrated by the nested

feature on stages for development). If the given technology or solution in developing fails to pass a critical transition point, this, to relevant developers, usually means the abortion of the development, thereby the technology may cease to reach the vertex of its lifecycle as it could. This also means that the

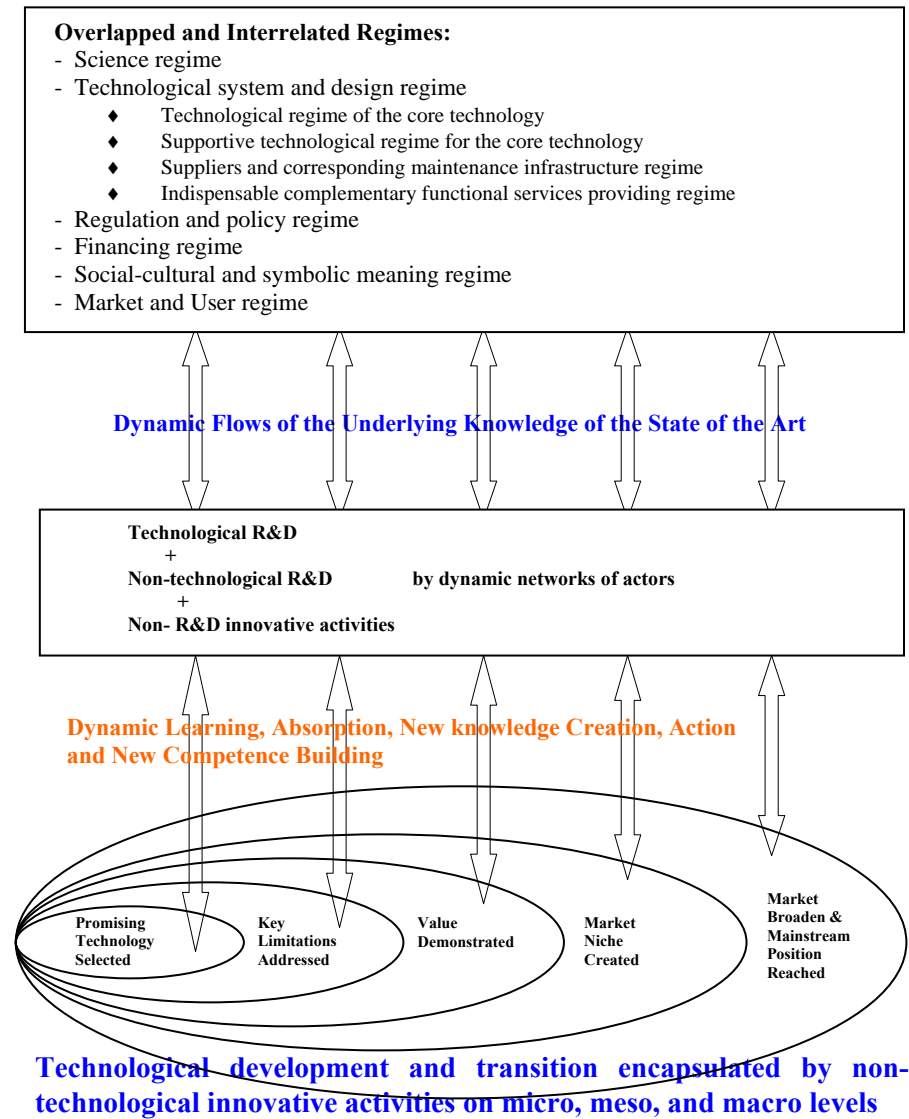


Figure 1: A meta-coupling innovation process model

technology will not finally be embedded in the society and become the dominant design or one of the mainstream choices. A range of non-technological innovative activities as well as complementary technological innovations interweave with the core technological innovation in the whole process. 3) Those non-technological innovations are conducted by different actors or actor networks as well as by the actors for the given technological

innovation. When, up to a stage, a range of actors start to champion relevant technological innovations and non-technological innovations to support the development of the core technology in question, the self-sustaining diffusion of the core technological innovation is started, thereby a new socio-technical system in which the core technological innovation is encapsulated is constructing. This may lead to an emerging industry which may encompass competing social-technical systems. 4) Meta-coupling and reconfiguration between different regime domains to form a new socio-technical regime is realized through the mechanisms of feedback, knowledge flow, and interactions and consequent actions between networks of actors.

It is suggested that the model can assist the identification or analysis of proactive actions and appropriate timing needed by networks of actors to formulate relevant non-technological innovation or innovative activities to facilitate the healthy development of the core technological innovation. It is the first explorative attempt that explicitly proposes that the success of a radical innovation that meets the needs of a society depends on interface management on technological innovation and non-technological innovation throughout the innovation and diffusion process. Due to the limited space of this paper, after a brief introduction of the research design, the focus of this paper is on the discussion of the explorative meta-coupling innovation process model and its implications, illustrated by the findings from the empirical part of the study.

2 The background of the empirical part of the study and the research design

2.1 The background of the empirical part of the study¹

The material-based economy, rising consumerism and urbanization in China has led to an accelerated pressure from exponentially increasing Solid Waste stocks and flows. From the year 1984 to 2002, the amount of municipal solid waste (MSW) produced per annual in China increased dramatically from 50 million tons to 150 million tons with an 8-10% annual average increasing rate. Up to 2002, only 54.3% of the waste has been transported for processes and the existing MSW management system has not yet covered the rural and some township areas. The accumulated stock of MSW in China has reached 6 billion tones, which occupies land more than 50,000 hectares, with more than 200 Chinese cities heavily in the surround of the waste. Under this pressed situation, waste-incineration-for-energy (WIE), one of technological solutions towards the MSW problem, has gradually been developed and, recently, been received as one of the primary

¹ The study is a Ph.D. project in University of Manchester with the title “Investigating the interface between technological innovation and non-technological innovation: the case of Waste Incineration to Energy Industry”. The fieldwork of the study is partially funded by a Worldwide Universities Network (WUN) Global Exchange Programme Award from University of Manchester, and partially funded by an on-going project granted by Zhejiang Provincial Science and Technology Bureau, China. The Zhejiang project titled: A Strategic Study on the Synergy between Environment Policies and Innovation Policies (2005C35012). The project is granted under the backdrop that, since 2002, China has promoted the vision of a ‘Circular Economy’ to encourage waves of environmental or eco-innovations and thus a new form of industrialisation, but there are gaps for formulating relevant policy measures.

practical solutions for MSW disposal in many Chinese cities. Grate incineration, fluidized bed incineration, and rotary kiln pyrolysis and afterburning incineration are the three general types of WIE technologies used in China. Grate incinerators are mainly adopted in big cities, while circulating fluidized bed (CFB) incinerators are more widely adopted in mid-sized cities with a proportion of near 50%:50%, grate: fluidized bed technologies at the end of 2003 (Cen et al 2004, 2006).

The starting point of the study is that the author has observed that, in the emerging waste-incineration-for-energy (WIE) industry in China (Figure 2), a range of innovations, as much as the technical one, are required to satisfy the function of the whole interdependent WIE system.

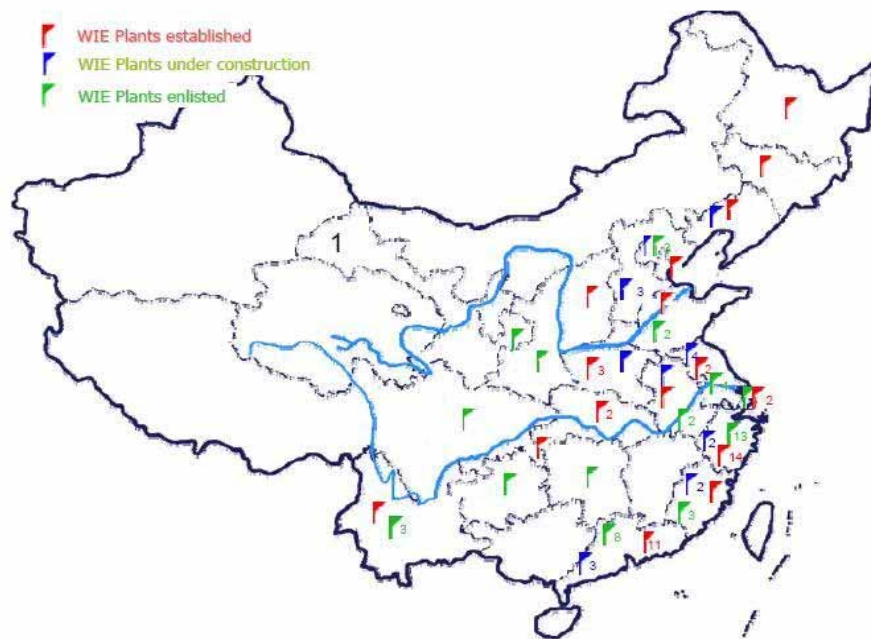


Figure 2 : WIE Plants in China up to the end of June 2005: an overview

Moreover, there are some interesting phenomena observed in the emergence of the industry. One of the distinct phenomenon in the development of the WIE industry in China is that among all the WIE technologies used in China, a number of domestic WIE technologies or domestically upgraded or re-engineered technologies based on imported WIE technologies emerges and have been received repeated applications in quite many WIE projects, while a diversity of imported technologies seldom get repeated projects. The other phenomenon is that the astonishing development of WIE industry was started after eleven gap years during which no WIE plant being put into operation since the setup of the first modern WIE plant in Shenzhen in 1988 using imported Martin stoker technology, supported by Mitsubishi Japan.

From the end of 1999, new WIE plants started to be setup into operation. Between 1999 and 2004, the other 32 WIE plants have been put into operation all over China in addition to the first WIE plant in Shenzhen, with still the other approximately 60 WIE plants listed in development plan,

among which two-third plants use technologies developed locally in China. One of the radical WIE technologies developed by a native university research institute occupied 40% market share at the time. The successful and quick diffusion of this radical WIE technology at the early stage when the industry starts to emerge, and the resistance it received in the follow-on process is another interesting phenomenon.

Usually, radical technologies take very long lead times to come to market. For example, the Post-it Notes took 12-year from the invention of the weak glue to mass production of the product. Nevertheless, it is found in the emerging Chinese industry that the technological successful and radical WIE technology developed by the native university research institute takes comparative very short lead time from invention to increased diffusion. The development includes taking two years from technological opportunity identification to invention, another two years from invention to the setup of the first demonstration plant, and in the following three years eight WIE projects have been setup with six scale-up manufacturing models being developed, and the technology won a market share of 40% of the total in 2004. Given that energy conversion facilities are characterised by high capital intensity as well as other conditions for energy technologies to function, the success is dazzling. Therefore, how this can be achieved considering a range of innovations required to make the interdependent WIE system function in China?

The key question for understanding the relations and the interaction between a given technological innovation and relevant non-technological innovations is put as *when, why and to what degree, and what kind of non-technological innovations have an influence on or are needed to facilitate the technological innovation in the development and diffusion process*. The detailed questions for the empirical study include:

- *In regard to each technological innovation case studied, what are the major types or modes of non-technological innovations or innovative activities? Why they are conducted?*
- *What are the main barriers to the development and diffusion of WIE technologies that are studied? What is the relation between the barriers and those non-technological innovations?*
- *What is the role of different actors, who are at different social power levels, in regard to the relevant technological innovations and non-technological innovations? And why?*
- *What is the general sequence of conducting different non-technological innovations on each stage of development and diffusion of the investigated WIE technological innovations?*
- *What are key lessons that can be learnt from the innovation and diffusion of the investigated WIE technologies for different actors in the industry?*

Because a full summary on the results of the study is out of the scope of this paper, this paper will only refer to the findings that relevant to the argument for the proposed innovation process model. The phenomena in the industry can be explained by the model, but it is believed that the suggested theoretical model can further help the improvement of the best practices found in the contemporary empirical study in China. It is because the model has attempted to aggregate and systemize the best practices conducted by

different innovators and technology developers found in the study, and has linked up relevant established views on factors contribute to innovative success in innovation literatures.

2.2 Research design

A preliminary study using historical analysis on the emergence of WIE industry in China and a brief review on relevant development in the world has been done before the study focusing on the interface between technological innovation and non-technological innovation. The preliminary study is based on relevant research results conducted previously, and further desk research on the topic, some telephone interviews, meetings and co-working with one important actor in the industry, and co-publication of a conference paper and a book chapter, which are Cen et. al. (2004, 2006). The preliminary study provides good foundation and has an impact for the design of study on the second stage.

Four temporary conclusions can be drawn from the preliminary study. Firstly, the emergence of WIE industry in China is a multi-faceted development process involving multiple classes of actors and changing relations, structures, patterns and processes encompassing consumption, government regulation, technological development, and market emergence and expansion. It implies a multi-level approach based on systems of innovation perspective is a better choice to analyze and uncover the 'black box' of such transition process.

Secondly, it reveals that environmental innovations are problem-driven. The pressure from problems offers 'windows of opportunity' to actors, who are the 'early birds' and who can entrepreneurially identify technology potentials or market potentials from challenges. Before 1988, landfill and composting are the two major practical solutions for waste disposal, but most of the projects did not use advanced, modern landfill or composting technologies which are underdeveloped in China. Exponentially increasing Solid Waste stocks and flows changes the conditions and context that a solution can be used in terms of economics and other relevant conditions. In coastal cities where there are highly developed economies and high population density and where advanced landfill technologies can be offered, landfill site lacks. The changing composition in the mixed collected municipal solid waste causes problems for available composting technologies. Thus, it paves the way for WIE solution to be chosen as one of the new paradigms for waste treatment in China.

Thirdly, the transition process is out of control of any individual organization, no matter how powerful it is, even in a historically planned setting as China. Waste problem and hygienic issues raise great pressure for government. It leads to a range of policy response. However, considerable transition and the emergence of WIE industry only occur 17 years after the middle of 1980s. In 1988, the first modern WIE plant was setup in China invested by Shenzhen Government using imported Grate Bed (GB) technology from Japan. The project shows that imported WIE technologies, which are not developed for Chinese market, did not suit to be used in China, because there are great differences on conditions for use². Great

² In developed countries, the calorific value of MSW is generally around 8375KJ/Kg in average. But in China it is around 4180KJ/Kg or lower with high moisture of 45-60%

efforts on re-invention or adaptation are needed and have been conducted. In the second and third phases of the Shenzhen project the imported Martin stoke technology is used under a technology licensing agreement. The licensee, a state-owned Chinese Boiler Work, could hold the property right of the technology after it had promoted and used the technology for ten incinerators in China within the stipulated years. However, it becomes an unachievable goal for the Chinese Boiler Work, and now the licensing agreement has expired. On the other hand, the second WIE project in China but the first WIE plant using domestically developed technology (CFB technology) was setup and operated in 1999, almost 10 years after the first WIE plant³.

Fourthly, the tactics and strategies used by actors for innovation are important for the success of relevant technological development. The first WIE project in ShenZhen has a far-reaching influence. It suggests a new and potential market in China. After that, more than 30 actors, including research institutes, universities and manufacturers conduct R&D in the field. Nevertheless, only a few of them are successful, and among those the commercial success and the innovation performances of the technologies they developed have great differences.

In order to understand the role of non-technological innovations in the adoption and diffusion of typical technological innovations in the emerging WIE industry in China, the study uses a qualitative multiple cases study with an embedded design. Particularly, the design adopts one real-time longitudinal case in comparison with four relatively short cases and two mini cases in China and four illustrative mini cases abroad, which are only used to compare some aspects on non-technological innovations due to the issue of accessibilities. Case study research method is used because it is particular suitable for an empirical inquiry that investigates a contemporary phenomenon within its real-life context and when the boundaries between phenomenon and context are not clearly evident (Yin, 1994). Moreover, case study helps researchers to attribute actions to specific stimuli and values (Naumes, 1999). The unit of analysis is a well-defined single WIE technology development and its socio-technical system. The concept of a socio-technical system will be explained in section 3.1.

Based on literature review, a temporal framework called ‘the encapsulation model of technological core and non-technological outerlayer’ (figure 3) is established to look at the interface between a technological innovation and a range of relevant non-technological innovations⁴.

A data collection triangulation, including the methods of semi-structured open-ended interview (it is later developed by using creative interview), unstructured positive observation, and high structured posted questionnaires, is used to check the consistency of information and findings of the cases. Direct observation through technical tour in incineration plants is used for the cases where positive observation could not be used.

water content. Moreover, there is considerable fluctuation in terms of calorific value over a year. For some detailed analysis on the comparison between imported and native developed technologies and the phenomenon of segmentation of Chinese WIE markets, please refer to Cen et al. (2006).

³ The first WIE plant in ShenZhen was setup in 1988, but went into operation in 1992 due to considerable renovation required on the function of the whole system.

⁴ Howells (2004) has firstly proposed an encapsulation model for the relation between services and goods production and consumption.

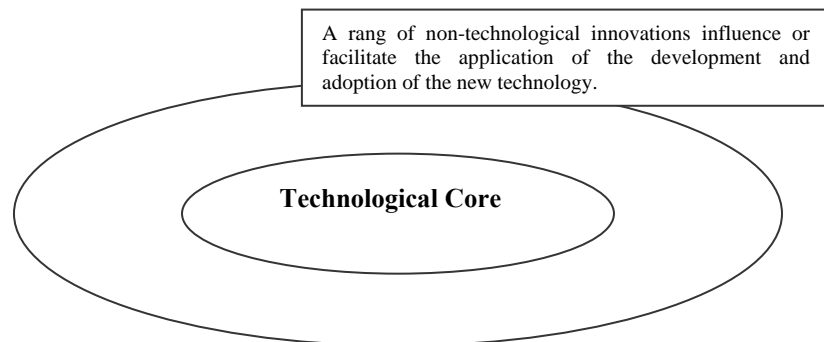


Figure 3: The encapsulation model of technological core and non-technological outer layer

Because some detailed information and tacit knowledge about certain aspects of the chosen cases can only be got through working together with the actors in the industry. Another parallel research project is conducted with a partner in the WIE industry. Therefore, this study can adopt positive observation, which is achieved through partnership research and participating regularly in meetings relevant to the development and diffusion of the studied technology as well as working together with the actor on other relevant activities. This makes the researcher to immerse into the situations and get access to relevant but different information sources and different informants in the partnership research process. Meanwhile, cross check on findings with experts from different organizations of WIE industry become possible, as the researcher has participated many events and seminars in the process. Moreover, the findings and information are purposively exchanged or discussed in conferences, seminars, workshops or are published to evoke debates for their credibility.

3 The interface between technological innovation and non-technological innovation

3.1 Technology, socio-technical system, socio-technical regime, and the search heuristics for innovation

The United Nations centre on Transnational Corporations (UNCTC, 1983) defines technology as that "...Technology may be embodied in the form of capital goods, such as machinery, equipment and physical structures: or it may be disembodied in such forms as industrial property rights, unpatented know-how, management and organization, and design and operating instructions for production systems..." The concept acknowledges a technology involves the two facets. On the one hand, technology is embodied in a range of physical devices; on the other hand, there is disembodied part of a technology which consists of particular expertise,

skills, competence, and certain rules or norm and associated organization structures.

The norm, rule or 'grammar', the disembodied part of a technology, is captured by the concept of 'technological regime' or 'socio-technical regime'. The term 'technological regime' is firstly invented by Nelson and Winter (1982), referring to the coordinating 'rule' or cognitive routine shared in a community of engineers that guide their R&D activities. Rip and Kemp (1998) widened the concept on that rules are not just shared and carried inside engineers' heads, but also are embedded in artefacts and practices by other relevant actors. Berhout et al (2003) further summarizes 'technological regime' as 'patterns of artefacts, institutions, rules and norms assembled and maintained to perform economic and social activities'

Geels (2004) proposes a concept of 'socio-technical system' (ST-system) as the unit of analysis for innovation study. This concept extends the approach of sectoral innovation system so as to encompass diffusion and use of technologies in addition to production of technologies. Socio-technical system is defined as a system that involves interlinked elements of artefacts, knowledge, capital, labour, cultural meaning etc. that can fulfil certain societal functions. Production, distribution and use of technologies are sub-functions of socio-technical system. The concept of socio-technical regime is proposed as the 'deep structure', rules, or grammar of ST-systems carried by specific social groups, such as users, societal groups, public authorities, research institutes as well as firms and industries, of a socio-technical system.

The analytical dichotomy between socio-technical system and socio-technical regime is useful and significant. Thus the disembodied part of a technology (socio-technical regime) can be abstracted from the physical part of the technology (embodied socio-technical system, such as supportive infrastructure, devices, equipment etc.) for detailed examination under 'microscope'.

Geels (2004) has a detailed discussion on different rules and regimes for different social groups as well as how he constructs the proposed concept of socio-technical regime. This paper argues that part of the inferences of those analyses should be more explicitly elaborated, which have not been revealed in Geels (2004). This paper will use the concepts of regimes as some of the elements of the framework and socio-technical system as unit of analysis to analyze the interface between technological innovation and non-technological innovation in the later part of this paper.

Regimes are semi-coherent sets of rules which coordinate activities within the social groups of their members (Geels 2004). It is the activities and the hidden sets of rules that distinguish one group from another. Members of a group share particular 'jargon', telling similar stories of the group's past and future, holding particular perceptions, norms and preferences. They share and enforce the understanding of the aims, values and problem agendas of their group through reading the same journals, meeting at specialised conferences or fora, and having professional associations etc. Because different social groups share different rules, different regimes may be distinguished. For example, there are science regimes, technological or design regimes, policy regimes, financial regimes and societal or user regimes and so on.

Different groups also interact with each other. The inter-group coordination results in networks with mutual dependencies. This is termed as a phenomenon of 'interpenetration' by Stankiewicz (1992), which depicts the overlapping of groups in some forms without losing their autonomy and identity. Geels (2004) uses linkages between regimes to explain the alignment of activities between different social groups. The resulted concept of socio-technical regimes involves the rules that align relevant regimes but not encompass the entirety of those regimes.

An important inference that can be got from above discussion is that, along the trajectory of a technology development, the technology and relevant cumulative developments, including the embodied and disembodied parts of the technology, construct an evolving socio-technical system of the technology. In such sense, an incremental innovation, which is to innovate along existing trajectory, is to add on new elements or novelties to an existing socio-technical system. A radical innovation that is to create a new trajectory, if it has to create a complement new socio-technical system, it will not only involve high investment and efforts, but also may involve high switch cost to make other relevant socio-technical system obsolete. Therefore, it will confront much more difficulties and may not contribute to economic growth much if they cannot finally lead to a combination of radical and incremental innovations and connected to organizational and managerial innovations to give rise to new industries and services (Freeman & Perez, 1988).

However, if analyzing on the level of regimes, such as science regimes, technological, policy regimes, financial regimes and societal or user regimes, the relative autonomy of each regime suggests there are trajectories within each regime, which are the outcome of accumulative steps in particular path dependent directions within the regime. When those trajectories are aligned with one another, it may form search heuristics of actors in particular directions for innovation.

3.2 System perspectives on innovation process, and technology life cycle models

There are three basic innovation process models, namely: linear models, feedback models, and systemic models. The chain-link model (Kline, S. and Rosenberg, N. 1986) is generally a feedback model, in which the feed back mechanisms between different phases of technological innovation process are taken into account. System models involve much more complex perspectives on innovation. The models introduce a distinction between different categories of "factors" such as actors, structures, and strategies and integrate this with feedback mechanisms. Innovation occurs within so-called "innovation systems", where many elements influence the innovation process. Knowledge is generated in an interactive process between many actors springing from multiple sources (Lundvall, 1988, 1992, OECD, 2000). The innovation process is a search and learning process. It is generally understood that knowledge is gathered and utilised in new ways to develop technologies, products or service products. Therefore, coordinate and collaborate with each other among the specialized knowledge producers to effectively use multiple knowledge sources, feed back and parallel sequences in the states of the innovation process are crucial for efficient innovation. In the process, interactive learning plays a central role.

The system perspectives or models absorb and surpass the linear and chain-link feedback models. The analysis transcends the analysis on innovation process that focus generally on individual firms and over emphasis supplier and users inter-relationships. Especially, the framework condition analysis implies that firm strategies are socially embedded and are not “free choice”, and innovation activities are emerging in a wider institutional setup. However, the environment or the wider institutional setup is evolving and may change rapidly.

Environmental innovations usually are not naturally induced, but problem-driven and policy-induced and are not self-sustained at least at initial stage due to the double externality problem (Rennings et al., 2003). This leads to the importance on macro and meso or regime level analysis. Therefore, an evolutionary multi-level perspective and associated analysis is important for this study.

As a chain-link feedback model are only special case within a more general systemic model, this implies there do exist some sequences on conducting innovative activities for a single technological innovation. A general understanding is that technology development will follow a general sequence of invention, innovation and diffusion and it has been understood that these do not follow a linear process and innovation and diffusion are related rather than separable (Turkenburg 2002). However, how closely the three parts are related are not clear. Based on technology life cycle models, Fowler and Levine (1993) have developed a technology transition model as a framework for a case study on how a specific academic analysis theory was developed into a practical analytical technique and software technology and then adopted for commercial use, which looked at the whole process of invention, innovation and diffusion. The transition model consisted of five stages: 1) Promising technology selected; 2) Key limitations addressed; 3) Value and transitionability demonstrated; 4) Self-sustaining transition; 5) Widespread use in target population. The model is supported by the empirical evidences that the detailed activities conducted through out the process of 7 years. However, they failed to further abstract and conceptualize an interesting phenomenon that they documented in their case and only concluded that there is concurrent transition with stages. Actually, the developer has done some important innovative activities in the same period which should be sorted out to be done on a later stage. For example, in the first year, the developer had done an important activity which contributed to self-sustaining transition; in the second year, a range of activities are conducted simultaneously, including those for key limitations addressing, value and transitionability demonstration, self-sustaining transition, and widespread use in target population (Fowler and Levine 1993: 27).

However, the study by Fowler and Levine (1993) is heuristic, a modified five critical transition stages are developed and constructed in conjunction with the findings from empirical study (figure 4).

The five transition points and stages are distinguished as follows: 1) Promising Technology Selected; 2) Key Limitations Addressed (Core technology invented); 3) Value Demonstrated (technology system and function demonstration, complex system product innovation); 4) Segmented market niche created (those new market niches are created and coordinated by different actors) (Meso-level non-technological innovations are mobilized, different actors innovate to serve for the use and adoption of the technology leading to self-sustaining diffusion); 5) Market broaden and

mainstream position reached. It refers to widespread adoption through stretch beyond the

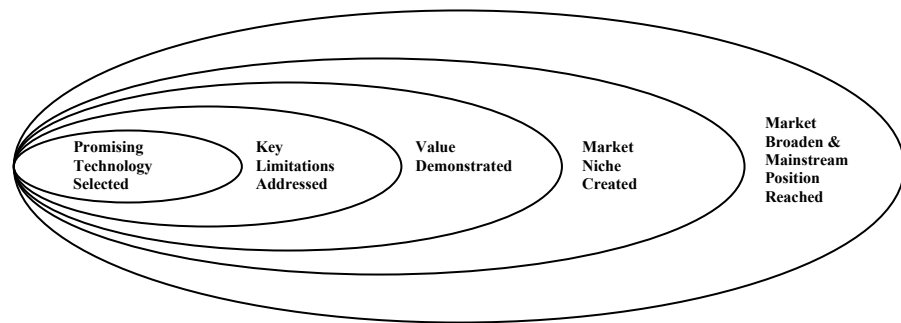


Figure 4: The five transition points in the process of innovation and diffusion of a core technology which is going to form a socio-technical system

niche market, the knowledge and the image of the new technology have been wide accepted; new user behaviours and habits established; economy of externality has been enjoyed.

3.3 A new definition on non-technological innovations

Differences on definitions reflect the different emphasis by the people who make the definition. Generally, innovation can be understood as the implementation of a new idea which leads to some usefulness. For example, when emphasizing the concept as an economic term as in the innovation literature, innovation is usually defined as a novelty leading to value creation on the market. When considering the usefulness or value innovations bring to firm, an innovation is defined as the implementation of a new (for the enterprise) solution aiming at enhancing its competitive position, its performance, or its know-how.,

Technology usually is considered embodied in physical artefacts, namely in products. In Oslo Manual 1997 technological innovation was defined as the implement of a new idea or a novelty leading to ‘an objective improvement in the performance of a product or in the way, in which it is delivered’, while non-technological innovation was defined in the Manual as changes that occur within organizations that are not directly attributable to products/services and production methods. The implementation of a new idea may lead to new method, new procedure, or new ways of organising work, and so on, all of which are not embodied in physical artefacts. Those disembodied changes may be within the scope of non-technological innovation, if they bring value.

Based on the multi-level perspective and the systems of innovation point of view, it is suggested that non-technological innovations that associate with the core technological innovation are to be defined at micro-level, meso-level and macro-level.

- On the micro-level, i.e. firm-level

Non-technological innovation on micro-level for a firm or organization may involve management of interrelationships (inside the organization between different divisions and outside the organization between firms), leadership based on foresight of the relevant development, as well as

management of new ideas and knowledge from potential different feedback sources, presentational innovation on new knowledge, and so on. All those are efforts to make the innovation and diffusion of a particular technology more success, in other words to improve the innovation performance of the technology. In summary, non-technological innovations on micro-level could be defined as the process of introducing new ideas to the firm/organization, which lead to the success of technological innovations and increased innovation performances.

- On the meso-level, i.e. socio-technical system-level

Non-technological innovation at socio-technical system-level or can be defined as the process of introducing new ideas to a socio-technical system to realize or improve individual functions or to integrate functions which result in increased performance of the existing system/industry or formation of a new system/industry out of the existing one. The functions in the definition may refer to financing mechanism, rules or principle of organization on different dimensions associated with a specific technological innovation (organizational innovation, business model innovation), ways to facilitate information dissemination and knowledge creation, building of new skills, competence and capability building along supply chains and value chains (including user practices), establishing infrastructures, industrial and regulatory standards and so on.

- On the macro-level, i.e. on an aggregation of different regimes

Non-technological innovations refer to those rearrangements and changes on (social) philosophy, political economic system, wide range policies, institutions, social behaviours and cultures (e.g. changes on consumption pattern), in other words changes on social elements.

3.4 How to look at the interface

The inter-relations among technological innovations and non-technological innovations could be explored at least in four dimensions if considering different ways in which innovation occurs. In the first way, a technological innovation is facilitate by a range of non-technological innovations; in the second, a technological innovation is also facilitated by other technological innovation such as the case of inter-link between the development of different components in an technical system, or the development of enabling technologies/general purpose technologies; in the third or fourth way, non-technological innovations or, sometimes, technological innovations may facilitate an important non-technological innovation. For example, industrial ecology as one type of eco-innovations itself is not a technological innovation. It refers to the closing of certain materials and ecological cycles at the industrial park level or the regional level (Butter, 2002), which need to re-design and to establish the new relations between firms and organizations in the park or the region. Obviously, a set of technological and non-technological innovations needs to be developed to facilitate this organizational or value chain innovation. Generally, the out layers of a technological core or a non-technological core using the encapsulation model may not be purely non-technological innovations or technological innovations in the real world (figure 3). Therefore, the analysis, generally, will have to include both parts for an empirical study. This study will, however, focus on how a hard technology could be developed, adopted and

widely used with the support from a range of non-technological innovations with the reference to the direct impact of other technologies and technological innovations. The development of a typical non-technological innovation, sometimes could be called a soft technology, for example a novel environmental management method such as industrial ecology, is not the focus of this project though it may be referred to.

3.5 A hypothesis

Based on the above theoretical analysis and a preliminary observation on the Chinese WIE industry as a whole, a hypothesis is proposed here. On establishment of a new socio-technical system (for a radical technology or solution), non-technological innovations are needed/mobilized to breakthrough the alignment within and between different regimes of existing socio-technical systems in a society, while to compete and to align with other new socio-technical regimes, which are forming. The resulted significant changes or rearrangements on elements in those regimes, which are not directly attributed to the implementation of a specific technological innovation, are non-technological innovations.

4 Findings from empirical study and discussion

4.1 Sources, actors and examples of technological innovations and non-technological innovations in WIE industry in China

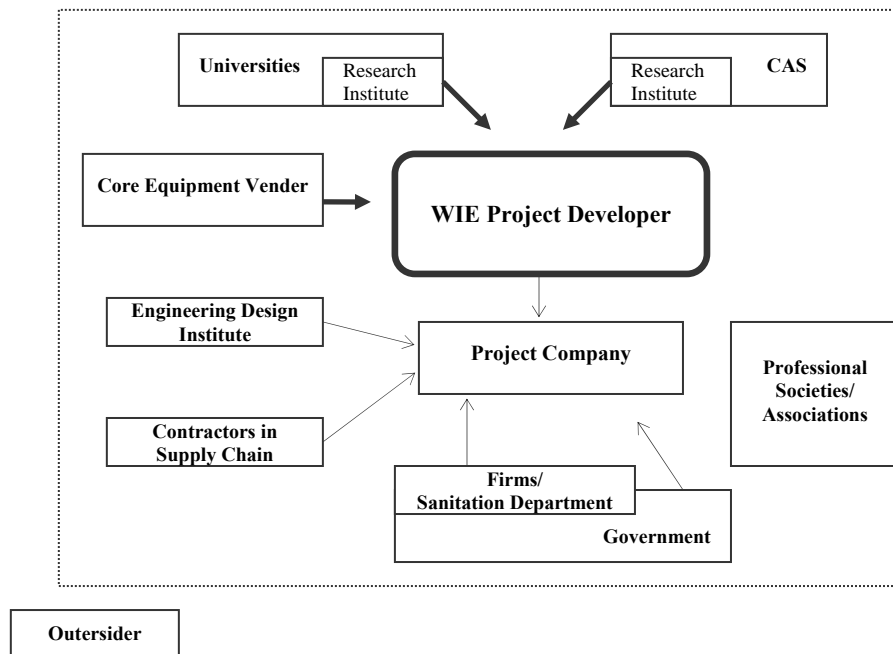


Figure 5: The sources and actors of technological innovations and non-technological innovations on meso-level in WIE industry in China

Constrained by the length of the paper, only several non-technological

innovations will be discussed in this paper, as evidences to support the suggested model.

Figure 5 introduces a major meso-level organizational innovation or relational innovation found in this study. Outsider in the figure refers to those who outside the industry but have some contributions and relevance to the industry.

There are special relations between the firms that are involved in the development of WIE technological system. It is classified that three types of firms exist: core firms (entities), collaborative firms, and suppliers. Alliance by different forms is the relation between core firms and collaborative firms, while market relations distinguishing the suppliers from the collaborative firms and core firms.

The core firms/entities take the leadership role to develop a WIE technology and its systems. A network of firms, including a variety of collaborative firms and contractors in the supply chain, has been formed. The commercial success of the WIE innovation and its following diffusion are depended on how this group of entities will construct a positive force and form a momentum. More important, if the core firm/entity fails on its strategy, it may lead to the fail of a WIE technology.

Core firms may be research institute of a university or a research institute of Chinese Academy of Sciences (CAS), or Core equipment Vender, or a WIE system developer and WIE plant project developer. Though WIE plant project developers take a very important role, they may not be the core firms. The WIE plant project developers in China usually have certain limitations. They are not knowledge-intensive and most of them do not have strong technological capability. As a user, they may not always understand what they really want. In many case, the limitation for a private WIE project developer and a state-owned WIE project developer are different. A core firm/technology supplier needs to understand what kind of performances of the WIE system do the WIE project developers really want.

Another non-technological innovation is that in each WIE plant project a project company is set up, so that business risk could be kept away from the mother WIE Project Developer. The mother WIE Project Developer will invest and seek for other WIE projects. This new business model innovation has been adopted and imitated by later entrants. It is now become a common business model for the new WIE industry.

Government and other organization, such as contractors in supplier chain, also take a role in non-technological innovations or technological innovations. Reform on waste management system⁵, and activities to induce investment are one kind, supplying of novel component or sub-system for the WIE system are the other kind. From 1999, six relevant policy documents have been issued by different ministries and governmental committees as guidance to form the market forces and involve investments from different channels to construction of WIE industry. The specific division of sanitary department of local government is required to transform into firm taking the role to deliver waste.

The WIE Project Developers are also the operators of WIE plant. They are the users of WIE plants. An important finding is that usually it is the core firm provides the core WIE technology, the incinerator, which invented by

⁵ The reform and transition of Municipal Solid Waste Management in China has been detailed discussed in Cen et.al. (2004).

itself, and the alliance – the user (WIE project developer) and the technology supplier (core firm) and sometime a core WIE equipment vender (boiler manufacturer) develop a novel integrated WIE system⁶. The important role of WIE project developer is that if they did not invest in certain WIE technology developed in native research institutes, the WIE technology will not be used.

In this sense, how a WIE project developer perceives the WIE technology and the market determines the birth of a new WIE system. Successful inventors/technology suppliers are those who understand the market and the requirements and difficulties of WIE project developers.

Five cases have been done with one or two more cases will be conducted. Table 1 summarizes the general information of the five cases.

The network relations of firms for a given technology have an important implication. For technology supplier, to understand market and the perception of WIE project developer and the limitation of a given WIE project developer are very important, which determines the commercial success and wide adoption of the WIE technology. Government has a role to play to facilitate the network and to overcome the barriers that could not be overcome by individual entity in the network. WIE project developers need to choose a partner (technology supplier), who hold strategic competence and capacity so that the whole network can be led towards the right direction.

Table 1: Information of Chinese Cases investigated

Tech.	Integrated Technological system Supplier and Core Entities	WIE project Developer (PD) (collaborative firms)	Projects run + projects listed in development plan(up to 2004)	Scale-up Model
mCFB Native Tech.	(Domestic)University Research Institute + a JV with the dominant WIE PD	1 dominant WIE PD/ WIE system investor (private company) +5 individual WIE PD (some PDs are private, some are state-owned)	8(total 21 units) + 10	6
tCFB Native Tech.	(Domestic) CAS Research Institute + a JV with a WIE investor	5 five individual project owners	2+3	2
mGB Imported Tech.	WIE project owner/ imported technology	1 Mixed ownership	1	1*
tfGB Native Tech.	WIE system Investor/inventor/WIE project Developer	Itself Private company	3+3	2
hlGB Imported Tech.	WIE project owner/ imported technology	1 State-own company	1	1*

Note: CFB refers to circulating fluidized bed incinerator; GB refers to Grate bed incinerator; JV refers to joint venture.

* Only one model is used in Chinese market.

⁶ One technology inventor confirms that, as for a complete WIE system, according to his experiences, contributions to the whole technological innovation is a proportion: technology inventor: WIE equipment vender: WIE project developer, 50% : 40% :10%.

4.2 Technological innovation performances of some of the Chinese Cases investigated

Before 1999, there is no foreign WIE technology other than the first one used in Shenzhen could be used in China. One reason other than that have mentioned is that those technologies and the equipment embodied those technologies are too expensive in terms of the lump sum investment and operational costs, to be afford by Chinese people. In Netherlands, people would like to pay \$400,--/year for waste disposal, where family income is around \$40, 000,--/year (Decistor 2006). However, in a developing country like China, family income is very low. The personal income is only around \$1,000,--/year. How much would a Chinese family like to pay for waste treatment and disposal?

The considerable efforts on R&D and innovations pull down the costs and improve the cost-efficiency. When a municipal government chooses to use a foreign technology, only the core equipment or systems are imported with all other system to be re-invented or adapted using local equipment, thereby lower the cost. Therefore, the economic performance of a WIE system is a very important criterion. Tangibly, the income for a WIE plant comes from three sources: 1) the sale of electricity to grid; 2) sale of heat if there is a demand for heat in the area, and sale of bottom ash or other by products from a WIE plant; 3) disposal fee collected by government but charged from households. The specific problem is that it is very difficult to charge disposal fee from households, either in terms of how many it can be charged as well as the way to collect the fee. Considerable researches have been done on this issue.

The economic performances of each technological innovation investigated are illustrated in table 2. Because the price of electricity is the same within one Province in China, the economic performance of each technology can be compared on unit investment and disposal fee required relatively.

Table 2: Disposal fee for some WIE plants located in Zhejiang Province

WIE Plant location	Technology used	MSW Disposal Capacity (ton/day)	Unit Investment Cost for a plant (RMB/ton MSW disposed)	Disposal Fee required*
		Power Capacity (MW)		
Hangzhou QiaoShi	mCFB <i>Native technology</i>	800 ton/day 12MW (it has been designed to supply heat as well as electricity, but it is cancelled because of no demand due to the change in local development plan.)	\$30.9k	RMB 45
Hangzhou XinShiJi	mGB <i>Imported technology</i>	450 ton/day 10MW (Due to lack of waste and other issues, the capacity has not been reached)	\$55.5k	RMB 85
Ningbo Fenglin	hlGB <i>Imported technology</i>	1050 ton/day 12 MW (the capacity has not been reached.)	\$42.625K	RMB 130
WenZhou LingJiang	tfGB <i>Native technology</i>	600 ton/day 12MW	\$37.5k	RMB 70

Note: \$1 = RMB 8.0 RMB

*Those numbers are calculated by WIE plants to ask for disposal fee from local government to compensate overall cost of a WIE plant.

4.3 The mCFB case: micro level technological innovation and non-technological innovations by the research institute

Why the integrated WIE system using differential-density fluidized bed (mCFB) technology developed by a university research institute is so cost-efficient? Is it the only reason that the technology is widely adopted at least in the first stage when the WIE industry emerging in China? On the other hand, why the lead time for this technology development is so short?

A range of non-technological innovative activities are found in the institute.

- Keeping on renewing *Strategy focus* and future-oriented.

The institute is a learning organization. Its innovation strategy is to focus on national and social demand. Technology developments are based on the understanding of the resource endowments and constraints in China.

- R&D procedures:

(1) Identify a potential technological opportunity, i.e. technological feasibility studies (characteristics of Chinese MSW, comparative study on technologies) → (2) Fundamental researches and experiments, i.e. experiments on relevant mechanisms and science principles → (3) Experimental researches (experiments on test rigs in the laboratory) → (4) pilot-scale plant → (5) demonstration plant → (6) diffusion

Features: Multi-loop feedbacks with sporadically technical development throughout the life cycle of the technology, e.g. different mechanism experiments are conducted throughout the life cycle, even in the diffusion stage.

- Innovative on organizational restructure.

When a new idea is evaluated as valuable and a promising technology development direction is selected, a small research team will be setup to solve the key limitations on the use of the technology. If the problems are solved, a goal-driven project organization might be setup conducting a range of pilot scale tests. Up to this stage, usually all the in-house development is invested by the institute itself. When a new technology is invented (patent applied), new collaborative R&D center usually will be setup with an industrial partner to attract more investment on the development of the technology. When the market for the new technology is emerging, usually a joint venture will be setup for industrial demonstration.

- Equipment and Instrumentation:

Combustion is science with high requirements on engineering experiments. When new directions of R&D and technological developments are identified, the institute will invest in new instrumentations, equipment, and test rigs/facilities associated with it using the income/profit from previous successful innovation.

- Inter-disciplinary research collaborations:

The institute has a wide range partners: universities, institutes and Laboratories, (both national and international), Multinational Companies (MNCs), national manufacturers.

The collaborations are in various forms: Sandwich Ph.D. project, exchange of researchers/visiting scholars, research contracts, research alliances, collaborative research, hosting/chairing international conferences, providing work positions for overseas experts/professors/scholars, and participating in relevant international networks.

Multi-disciplinary and trans-disciplinary collaborations are over 10 disciplines. The examples include thermal power engineering, mechanics, material science, organic/inorganic chemistry, computing (computer) science, automatic control and instrumentation (e.g. the application of CT, ultrarapid picture, laser measurement, fluid mechanics, environmental science, chemical engineering, innovation and management.

- The institute has a distinct organizational culture:

Emphasis on collectivism and teamwork, hard working, work efficiently and innovatively, self-discipline, scientific attitude, and patriotism.

Researchers are required to conduct several research projects/work simultaneously and to accomplish the projects/work through innovative methods, in other words to pursue synergy deliberately.

- Mode 2 knowledge production

Researchers are required to conduct both basic research and applied research. The way they create new knowledge fits to Mode 2 knowledge production as Gibbons et al (1994) defined, which has following features:

- Focusing context of application rather than only cognitive context;
- Problem-oriented in a specific and localized context rather than only curiosity-oriented in a non-specific context;
- Trans-disciplinary;
- Non-hierarchical, heterogeneously organized and close interaction of many actors;
- Socially accountable and reflexive;
- Wider set of socially determined criteria for quality control

- Practice on identify technology opportunities

Every half year the institute organizes an institution meeting in which all the researchers and Ph.D. students in the institute will participate. Representatives of each division of the institute will present their visions and research proposals; discussions will be followed.

- Creative acquisition of competencies and resources

When a technology opportunity or a direction of technological development is identified, the institute will invest by itself in relevant studies and mechanism experiments using accumulated revenues. Based on the research results, new research proposals will be made to apply research projects and grants from different governmental resources. Widely collaboration with MNCs and overseas research organizations become another important channel for sponsor technological development. New postgraduates (Master students and Ph.D. students) are recruited for participating in the work of R&D projects. Their dissertations and thesis are associated with research projects. There exists a network of previous staffs and students who now work overseas and other universities or research institute in China. New collaborations or projects usually will be established through those people because of established trust and understanding.

- The institute has strong capability for engineering retrofit project.

Many new technologies, including the first WIE plant, are firstly conducting industrial scope test and demonstration on a retrofitted plant. Thus, the problem for the high capital investment on the first demonstration is lightened.

- The development of fluidized bed technology is based on many years' experiences.

In the process, the institute has provided many R&D services under research contracts. For example, they have 5 international project contracts which employ and develop fluidized bed incineration technology though they are

not for incineration of MSW but for incineration of other toxic industrial wastes or inferior fuels.

By using the unit of analysis of single technology development, which is beyond single industry as well as single firm, it can be spotted that technology development is incremental and follow an accumulative steps in particular directions within the technological regime. New technologies are born out of certain existing technology through applying the existing technology in new application domains, which result in radical technological innovation.

This transition and development is more than renewal of a technology. Because in the new application domains problems with different natures must be dealt with, the re-born technology should be regarded as a totally new technology though in a given period of the transition process it shares same core scientific principles in the core component of the technology. Moreover, by looking at the whole transition and development process even the core scientific principles employed by those technologies are developed in the process. Furthermore, the complete technological system (architectural innovation) including the core component, the incinerator (modular innovation), developed for each application domain are totally different. Fluidized bed incineration technology, which can be used in a series of application domains, in this sense, enjoys a generic feature, and, thus, it has and will influence many industries. Therefore, it is possible that for certain industry there maybe more than one dominant design (competing but overlapped socio-technical systems co-exist for long time). However, one technology becomes generic technology used in many different markets in a society. This could also be considered that the technology development reaches the fifth transition stage of the proposed meta-coupling innovation model – ‘market broaden & mainstream position reached’.

Technology development in ITPE illustrates this transition. All the technological developments shown in table 3 are responses to different social needs, which may not have a real market at the time when the relevant R&D is started. The role of ITPE determines that their mission is to develop the discipline of combustion. The science of combustion and technologies of combustion are developed in the process of application when different application domains provide new technology opportunities.

The empirical study confirm that the mechanism of dynamic learning, absorption, new knowledge creation, action and competence building are very important for radical Change.

Table 3: Technology transition and development: circulate fluidized bed combustion technology development in a University research institute from 1972 to 2005

Year (research started)	Application domain	Characteristics of the fuel	Social needs and potential market	Achievements:
1972	Bubbling bed and, then, CFB incineration of stone-like coal	Heating value: about 1000Kcal/Kg soft	Lack of coal of good quality in Zhejiang Province resulting 95% of coal are imported from other provinces though Zhejiang is abundance in stone-like coal.	The Second Class Awards of Zhejiang Province for Scientific and Technical Progress "Clean Combustion and High Efficiency Utilization of CFBB Fired Low Grade Coal"
1976	CFB incineration of coal gangue	Heating value: about 1000Kcal/Kg rigid	Coal is the primary energy in China (accounting 70%). Many coal gangues produced in coal excavate and production, which need to be treated. Exploitation the energy contained in it is a good method.	Many plants in China using the technology;
1981	CFB incineration of coal washery tailings (Coal-slurry)	highly moist and very soft	Every year around 10 million coal washery tailings is production in China, which is toxic and leads to pollution.	Creating a new industry in China and take up 100% market in China (all constructed or constructing coal washery tailings incineration power plants using this technology)
1978	CFB incineration of coal washery tailings and coal in one power plant	Coal is rigid as stone, while coal washery tailings is highly moist and very soft	There is shortage of supply of coal washery tailings in certain period of a year when temporary shut down of washery tailings processing factories in one area. Use one power plant to incineration both inferior fuels instead of the setup of two power plants will save sunk cost.	Many plants in China using the technology;
1995	CFB Incineration of Sewage Sludge from waste treatment plant	High water content	An order from Korea Industry Many waste water treatment plants are started to be built in China	The Second Class Awards of Zhejiang Province for Scientific and Technical Progress "High Density Organically Waste Liquid and Sludge Incineration in Fluidized Beds"; An complete plant using the technology has been exported to Korea;
1997	CFB Incineration of Municipal Solid Waste	Involving many complicated components and Comprise much pollution; High moisture (45-60%) and changing with cities and seasons; Low calorific value (750-1500kcal/kg);	2/3 of Chinese cities have been surrounded by garbage with annual MSW production of 150 million tones currently	The Second Class Awards of MOE for Scientific and Technical Progress of 2002 "MSW Clean Incineration in Fluidized Beds"; 8 WIE projects using the technology, with another 10 WIE projects under construction;
2002	CFB Incineration of Medical Waste	Involving special components	The SARs crisis in 2002 led to a planed establishment of medical waste treatment centers all over China	One demonstration plant setup

5 Discussion on the proposed model and on some of its implications

The proposed meta-coupling innovation process model is to reveal that invention, innovation and diffusion is one continuum and fused process, in which the core technological development and transition are encapsulated by a range of non-technological innovative activities on micro, meso and macro levels. The proposed model draws the attention to the interface between technological innovation and non-technological innovation and underlying mechanisms of dynamic learning, knowledge sharing, absorption, and creation to feedback or to stimulate relevant non-technological as well as technological innovations by networks of actors. The nested feature of the transition stages suggests that careful attention need be paid to appropriate timing and proactive actions by networks of actors towards non-technological innovative activities to facilitate relevant core technology development.

On the other hand, because there are non-technological innovations on meso level conducted by different actors or actor networks supporting competing technology development, the influences of those non-technological innovative activities on the given technological innovation may be negative. The given technological innovation may be shaped or transformed in the diffusion process under the influences. Therefore, adaptation, reinvention or renovation in certain forms may be inevitable for the success of wide adoption of the given technological innovation. The result hybridization on the technological system may become an optimized version of the original invention that can meet the needs of the targeted society. Policy interventions that distort market towards individual innovation solutions are not advisable.

One important lesson is that the learning through meta-coupling between different regime maybe very challenge. As already discussed in section 3.1, knowledge sharing is an uneasy task. It is because each social group shares particular 'jargon' and holds particular perceptions, norms and preferences, the knowledge gap and different perception and norms will be a huge barrier for them to communicate and to interact with each other. Presentational innovation, therefore, is important to solve the problem. Radical innovation involves many complex challenges, like knowledge gaps and highly unpredictable processes, individual actors are usually not capable of overcoming all these issues, there is a role for public policy to facilitate the knowledge flow and network formation.

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CBL I **Sustainable consumer services: Putting happiness to the picture**

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Why have only a few eco-efficient or sustainable services or product-service systems penetrated to the consumer markets? In spite of that there is plenty of evidence pointing to that these services would concurrently correspond both with modern marketing philosophy and environmental thinking most eco-efficient service concepts remain on the shelves of proponents. With this question in mind, in years 2002-2004, we studied sustainable household services of 67 providers in a European study 'Sustainable Homeservices', with the aspiration of finding answers to the question, and exploring ideas for making eco-efficient or sustainable services more attractive for consumers. For some years, the evidence had been mounting that services designed for sustainability could be one of the feasible ways to reduce the environmental burden caused by the affluent societies, without people having to sacrifice the fulfilment of their needs. While this approach has worked relatively successfully in business-to-business services, consumer services keep staggering. It appears that the present infrastructures and institutions often tend to favour material-intensive forms of consumption, many symbolic values are related to the ownership of products, and many times even those consumers who would be interested in using services for sustainability are unaware of them. This list of obstacles sounds rather desperate, but on the other hand there are also positive trends that can support the sustainable consumer service approach if correctly utilised, as we could see in this project. It takes a fair amount of time and effort to change institutions, infrastructures and dominant consumption mentalities, and such a shift will not come from one single source but from many little streams. Some steps are possible already now.

There are already providers and users of sustainable consumer services – and many more opportunities for different types of providers to discover. However, there is a need to rethink *who the potential providers are*, as well as *what the main incentives are for consumers* to use services enhancing sustainability. The dominant approach is to try to persuade large companies to offer sustainable consumer services and to expect that consumers will be convinced to use them because of environmental concerns or the economic

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rationale of saving money. This is not a comprehensive understanding of the situation. What, then, would be more accurate conceptions and how and with whom can sustainable service promoters continue to work for a more sustainable future? In this paper, we highlight three selected findings and ideas based on the project: the constellation of providers of sustainable household services, easiness of service use and happiness in sustainable service discussion. Before that, however, the data of the study is briefly described.

The evidence

We studied services that are offered to consumers at their homes, because one of the preconditions for the realization of eco-efficiency promises is that consumers should be able to use such services as easily or conveniently as the products they own themselves. Based on this idea, we coined the term 'sustainable homeservice' to refer to services that are offered to consumers at their home and contribute positively to sustainable development in its environmental, social and economic dimensions.

After screening potentially sustainable services offered to homes of consumers in 12 European towns (in six countries), we ended up with over 200 innovative service examples of 67 service providers. We were keen on real-life service examples that are in operation in the market, not hypothetical concepts that sometimes drive the eco-efficiency research. In essence the studied services relate to and support our everyday lives. A large part of them are relatively simple concepts. They are social rather than technological innovations, although creative use of ICT is characteristic to a number of the best examples (the services and the analyses are described in detail in Halme et al. 2005 and Halme et al. 2006, www.sustainable-homeservices.com).

The possibilities of the services to enhance sustainable development were assessed with a Sustainability Evaluation Tool that consists of 18 indicators of ecological, social and economic sustainability, and a related ordinal rating scale, with which the impact of the homeservice is compared to the situation where the service would not exist. The indicators seek to provide information on the following questions:

- Environment – What is the influence of homeservices on environment?
- Social – How do homeservices influence the well-being of consumers and the liveability of neighbourhoods?
- Economic – How do homeservices affect the economic situation of both the providers and users, as well as society at large?

The main strength of this method is that it is simple but yet it incorporates social and economic sustainability – which have tended to be bypassed in systematic analyses – with an equal weight as the ecological aspect. The choice of individual indicators is based on studies of (Spangenberg and Lorek 2002, Lorek and Spangenberg 2001, Gatersleben 2001, Scharp et al. 2000, Hohm et al. 2002, UNDSO 2002, UNDP 2001, Bentley and de Leeuw, 2003, OECD 1999, OECD 2001, the Daly-Cobb Index of Sustainable Economic Welfare (ISEW), Sen 1999).

For the first steps of starting to integrate all sustainability elements into service evaluation, we found a simple assessment device sufficient. It should

be emphasised that the suggested contents for the indicators are not exclusive, but should rather be treated as indicative of what issues to consider when assessing the service according to the particular indicator. The indicators in Table 1 are most probably easiest to understand when considered in combination with the method used for their operationalisation in Table 2.

Table 1. A set of indicators for sustainable homeservices

Environmental aspects	Social Aspects	Economic Aspects
1 Material use	7 Equity	14 Employment
2 Energy use	8 Health	15 Financial situation of the residents
3 Water use	9 Safety and security	16 Regional product and service use
4 Waste	10 Comfort	17 Profitability for the provider
5 Space use	11 Social contacts	18 Profitability for the region / community
6 Emissions	12 Empowerment	
	13 Information and awareness	

Table 2. Operationalization of sustainability indicators (example of one indicator in each sustainability dimension)

Material use (environmental): The effect of the service on material use compared to status quo (status quo = situation without the service)		
	-2 -1 0 1 2	
Increases material use		Decreases material use
Empowerment (social): The effect of the service on residents' ability to influence decision-making that affects them		
	-2 -1 0 1 2	
Decreases the ability to influence		Increases the ability to influence
Employment (economic): The effect of the service on the employment		
	-2 -1 0 1 2	
Less jobs/job opportunities lost		More jobs are created

Explanation. 2 = a major positive change; 1 = a substantial positive change; 0 = the service does not make a change to status quo; -1 = a substantial negative change; -2 = a major negative change

The analysis of the services sheds light on the missing links in creating competitive sustainable household services. In total the evaluated services contributed most to social sustainability. Comfort, closely followed by information and awareness, were the main sustainability effects resulting from the services. The social effects were followed by two economic effects, employment and profitability to the provider. Even the best-scoring environmental indicators, ‘emissions’ and ‘energy use’, scored lower (Figure 1).

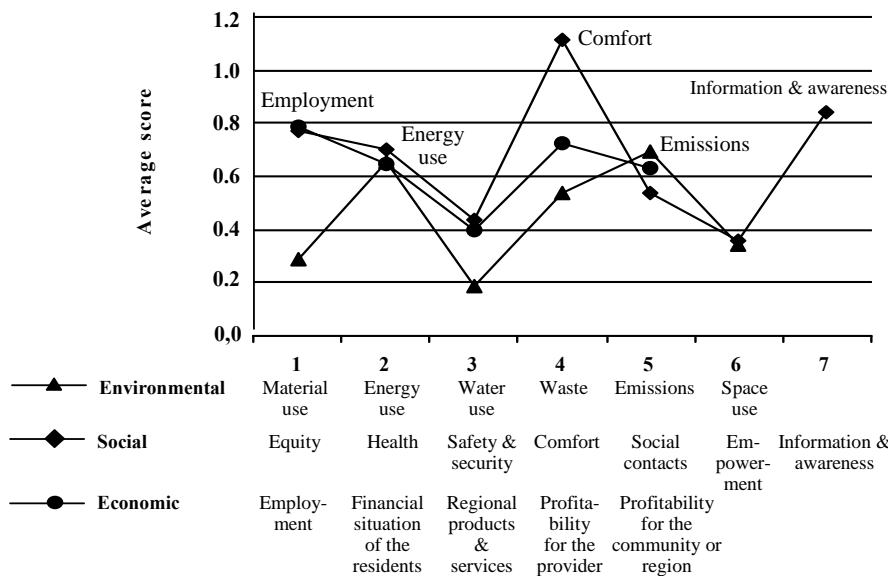


Figure 1. The relation of ecological, social and economic sustainability indicators

As most of the social sustainability indicators related to quality of life, it can be argued that a pronounced contribution of the analysed homeservices was to the consumers’ quality of life. What can be gathered from this result? Firstly, it can be argued that services offered directly at home or on the premises improve the quality of life of the residents in general. There is, however, another, more noteworthy argument that can be made. It is based on the fact that all evaluated services are already existing, real life examples, not prototypes or hypothetical concepts. So the observation that social sustainability overrides the ecological effects indicates that the quality of life aspects of the service need to be good in order for the service to succeed in the market. Details of the evaluation and its results have been reported and discussed in detail in Halme et al. 2005 and Halme et al. 2006. In this paper we focus on one of the implications of good-practice real-life service examples. Namely, social sustainability, first and foremost the ability of services to improve the quality of life of their users – ‘user pleasure’ – appears a crucial determinant for the competitiveness of services in the market place (Halme et al. 2005, Halme et al. 2006). Before a further discussion on that matter, however, let us look at who are and can be the providers of household services enhancing sustainability.

Business for multiple providers

“Having a car can be such pain in the a-- for a woman. First your exhaust pipe breaks down, then a tyre goes flat or the engine just won't start. I don't like to feel like a helpless woman, because that's not me, I'm not helpless. The very day my housing organization contracted a car-sharing company's car in the front of my building, I went for the service. I'd rather outsource these problems to my car-sharing organization and move instead of getting stuck in my very own steel box.”

The evidence in this project shows that the quality of consumers' everyday life deserves more attention in the eco-efficiency research and design practice, and moreover, that the provider questions need to be understood more profoundly, if realistic solutions are to come about. If consumers are to use services compensating products, they need to be as easily accessible as owned products. One of the implications is that services ought to be offered directly at home or near to it. But how to accomplish this in a cost-efficient fashion? For whom does it make sense to offer sustainable services to consumers at their home or in the vicinity?

Often when thinking about sustainable services, we tend to assume that new enterprises should miraculously appear to provide such services, or we try to persuade large corporations to adopt product-service systems that enhance sustainable development. These assumptions are not incorrect but they are incomplete. The array of sustainable consumer services is vast. Different services attract different providers just like service needs and wants differ between consumer segments. Sustainable or potentially sustainable household services are offered by a variety of providers from SMEs, non-profit organizations or public sector service providers to housing organizations, housing management companies and large companies, and they all should be adequately taken into account in eco-efficient service research and development.

One relevant actor group is completely missing from the sustainable service discussion. Housing organizations are in many instances a natural agent to provide services or act as an intermediary for homeservices – and the pioneering ones actually already do so. They provided one-fifth of the 200 services studied under the auspices of this project (Halme et al. 2005). Housing organizations and housing management companies bear close proximity to the consumers, the residents, and hence have the opportunity to provide services directly to the residents in their homes. From the consumers' viewpoint, proximity means that services can be acquired as easily as products fulfilling the same need, which is one of the main conditions for consumers to replace or supplement their product-based consumption with services. The business benefit for housing organizations is that services increase tenant loyalty, which in turn promotes longer tenancies and reduces negligence and vandalism, both of which lead to indirect cost savings for housing organizations. Housing management or maintenance companies, on the other hand, offer additional services if they can use them to generate new business.

“Did you ever drag your broken bike on the bus and metro to a repair store? I'm all sweaty and have just about had enough of the angry looks, too. Why is it always others that have the nice things around, like... can you imagine

this, a housing organization that arranges a mobile bicycle mechanic to visit the building and do a spring repair of the tenants' bicycles? I'd gladly pay a couple of more euros to a bike mechanic who comes to my place than take this annoyance."

Often it does not make sense for the housing operators to produce household services by themselves. Housing organizations and housing management companies are at present an under-utilised marketing channel for services. Various service companies could win new business opportunities by cooperating with them in service provision.

Apart from housing organizations, there are other considerations concerning service providers. As contended above, for some providers it makes more sense to provide certain services than other ones. What service types are feasible for which providers? One of the service clusters identified in the was 'ordinary services with eco-features' (delivery of organic food, eco-gardening etc, in Halme et al. 2005). These services appear to be most often provided by relatively small business enterprises. More complex service concepts call for collaboration by a variety of providers spanning from business enterprises to public sector organizations. This is the case for services that require information, knowledge, contacts, access to certain infrastructural resources or other forms of support such as capital input from other than the central provider. For instance a number of energy saving services or 'multiple services from the same counter' introduced earlier in this project are such concepts.

On the other hand some services in some situations are best and most (eco-)efficiently provided by the public sector or non-profit organizations. This is the case especially when the infrastructures and institutions, such as for instance municipal libraries or free school lunches in the Nordic countries, already exist. Unsexy, isn't it? But it is about time that we analyse efficiency objectively case by case and see that it is not the sole domain of business enterprises. When well-organized, public provision can be efficient, too.

Social enterprises for their part are suitable particularly for homeservices that are labour-intensive, but do not require high technical skills. They are an excellent vehicle for offering unknown or untested services that are considered too risky or uninteresting by commercial enterprises because of the difficulty to foresee whether there will be a profitable demand. From the sustainability perspective, more often than not, social enterprises offer environmentally conscious services. As to social sustainability, they offer employment to people who would not otherwise be able to enter the job market. This is economically beneficial because society saves money by not having to support unemployment. Instead, it gains employment opportunities and the ensuing benefits with lesser financial support.

But whoever the provider of the service, the business model of the service deserves careful attention. This means scrutinising the benefits that customers can derive from the service (compared to more material intensive ways of fulfilling their needs), the competitive advantage that pertains to it, the capabilities and resources needed by the provider or providers, and the financing arrangements (Halme et al. 2005). The above is not to say that all services by definition are sustainable. It is always a matter of the service design.

Making service use easier

“I’m busy. I have the money, but no time at all. I use services for every possible domestic task that you can name, but there is one problem. Finding reliable providers easily eats up my few free moments – let alone if someone causes trouble, which I must deal with later on. But as I always say, when there is a problem, there is also a solution. In my case it is the virtual homeservice marketplace. It’s my cup of tea: one click, and in two seconds you are among 400 service providers from mobile catering and cleaning to repair services making house calls. Swindlers sorted out.”

The ability of services to improve their users’ quality of life of– “user pleasure” – is a crucial determinant for the competitiveness of services in the market place. Both the consumer survey as well as the evaluation of real-life sustainable household services conducted in the project indicate that especially the ability of a service to add comfort for the users has been given inadequate attention in eco-efficient service research and development. In this context ‘comfort’ does not primarily refer to luxury – rather, it materialises for ordinary people in such things as time saving or smoother running of everyday life.

Potential markets for household services are offered by trends such as the aging population that needs services to continue living at home, time constraints of working families and a segment of single people wishing to outsource some of their domestic tasks. From the supply perspective, developments in ICTs have made it possible to offer some services at a lower cost. This potential is, however, counteracted by lack of information about homeservices among the potential users and, secondly, the fact that those in need of services are often not used to using them, or cannot afford them. To reach these potential customers, different strategies are called for. For customers who could afford to pay for services, but for attitudinal reasons do not use them, strategies aiming at attitude change are called for. Attitudes can be changed to some degree by making homeservices available so easily that pioneering customers start to use them, setting a model for others to follow. This is likely to pave the way for more service-based consumption patterns. One way to promote availability is to bundle the offer of several household services together. If a potential customer can get services via one phone number or a well-designed website (such as some Austrian housing organizations’ service centres, Buenos Dias/Buenas Noches, the ELIAS virtual market place for homeservices in Halme et al. 2005), it is more likely that services will be used. For instance the fact that repair services for household appliances are so difficult to find means that consumers are much more inclined to just buy a new appliance rather than have even minor faults fixed. It is also possible to specifically craft eco-efficiency into these concepts (Halme et al. 2005).

On the other hand, for those who are in need of homeservices, but cannot afford them, strategies should primarily aim at finding suitable financing structures. In the latter instances, co-operation of the public sector and NPOs or social enterprises may offer feasible solutions.

“My wife kept nagging about the heat. She went on and on telling me that I’m no man if I can’t fix a couple of radiators. I admit that 26 degrees

indoors sort of makes you nervous, but what could I do? Then my wife spotted that our housing organization had appointed an 'energy expert', one of my neighbours. First I was suspicious about the 'know-it-all energy expert guy', but he did plenty of good stuff in our flat. No more tipping taps or leaking radiators, and new thermostats... Besides, who'd think that your wife fancies you better in a lower temperature?"

Individual people or households are seldom perfectly free to choose their consumption forms. Depending on the consumption cluster (such as nutrition, mobility, housing), households alone have only limited – greater or lesser, but still limited – possibilities to influence their patterns of consumption. There are always other actors who are relevant in setting the frame for consumption choices. For instance with regard to housing and construction, property owners (housing providers), local authorities and service providers influence the housing framework (e.g. form of heating and the like are seldom a free consumer choice). Or as regards mobility, local authorities and service providers have a lot to do with the transport infrastructure (such as public transport or bicycle lanes), and therefore they set the limits within which consumers are able to decide how to fulfil their housing and mobility needs. Therefore it is important that housing and mobility providers, for instance, arrange the conditions so that it is as easy as possible for households to organize their daily lives as sustainably as possible.

Happiness solutions

"It's funny, really, to enjoy doing the laundry. I take my kids down to the house laundrette on the ground floor, set them playing with toys in the kids' corner and stuff the dirty laundry into the washing machine. When I close the washing room door behind me, the voice of the machine becomes like a humming at the background. Then I go to the coffee machine, and take a cup. In the best case one of my neighbours is there, and I can have a few adult words with someone. These are the peaceful moments of the day, gazing out at the garden from the laundry room window, seeing the kids play out of the corner of my eye, sipping coffee."

The above vignettes are not here only to amuse us. They remind us that most people do not use services in order to protect the environment. They may not even use them to save money or for other evidently rational reasons. All kinds of unexpected motives may lie behind (sustainable) service use, and these reasons may strongly vary between individuals. Understanding the different motivations requires a fair amount of more knowledge than we have yet. There is, however, one common denominator in our behaviours. We all seek for moments of happiness and pleasure in our everyday lives.

Recently happiness has been (re)discovered even within economics (Layard, 2005). Economists are now able to show with empirical evidence what many of us know from experience or by intuition: After a certain basic level, material wealth does not make people any happier (Layard, 2005), but perhaps the contrary (Hamilton, 2003). And economists are not the leading idealists. If they are ready to admit that material wealth does not equal happiness, then a good part of the materially saturated Western world probably is ready for that message. The question for sustainable service

promoters then is, whether to connect the service approach to the happiness discourse more compellingly, making use of the emotional leverage which at present is commonly treated as an unavoidable problem in the eco-efficiency and product-service-systems discussions. Perhaps the often-used 'customer is emotional' notion of the product-service systems discourse can be turned into a solution rather than a problem, as it is often currently framed. The ecological and efficiency facts are known, but they do not seem to turn the heads of many. Rather than following the beaten track of rational argumentation, should sustainable consumer services be portrayed as sources of pleasurable every day life? And how to accomplish that?

'Poetry may work where facts fail'. Techno-utopias or future scenarios will not hit most people's emotional cords. Understanding the ways in which sustainable services may help or be in line with the pursuit of happiness – and communicating it, 'telling the good stories of everyday life' – may just be the next step for sustainable service providers, designers and researchers to take.

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CBL I Evidence Base and Policy Making: Applying SCP Research.

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1 Abstract

DEFRA is the UK Government department with responsibility for the environment. Whilst the overall picture is huge, one part of Defra's work relates to sustainable consumption and production (SCP), the importance of which is highlighted by the high profile inclusion of this topic in 'Securing the Future' (UK Sustainable Development Strategy, 2005). This paper presents one of Defra's current research projects, the Environmental Action Fund Review, and highlights the links between the expanding SCP evidence base and the development of SCP policy.

The Environmental Action Fund (EAF) is an ongoing programme of action based research. Defra partially funds groups sector which may have a direct input to identifying community type projects which may expand knowledge on a bottom up approach to SCP. A review of these projects is underway and results of a preliminary evaluation are presented in this paper.

Linking the SCP evidence base and SCP policy is a crucial role. The SCP evidence base incorporates 'hard' science research to identify products and services which have greater or lesser impact on the environment (e.g. through a Life Cycle Analysis approach), and behaviour change and consumer response research in order to understand the public reaction to various behaviour goals identified as important to achieving sustainable living. This paper describes one example of this linkage. Defra has an extensive research programme focussing on SCP providing a robust base for policy development. The collation of a policy making evidence base inevitably identifies gaps in knowledge, as does the ongoing, and fast moving, policy and strategy development in this area. Defra commissions research projects to respond to these gaps (reviews, fundamental research or

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action based research). Under the SCP banner there are various projects currently being undertaken which are at various stages, including¹:

- Critical Review of Data for Environmental Impacts of Household Activities (2006, report to Defra by BRASS)
- Mapping of evidence and trends in the sustainable development aspects of tourism (work in progress)
- Innovative approaches to achieving sustainable consumption (work in progress)
- Mapping of evidence on sustainable development impacts that occur in life cycles of clothing. (work in progress)
- SCP Evidence Base: Environmental Impacts of Food Production and Consumption (2006, report to Defra by Manchester Business School)
- Qualitative Research Projects to explore Public Understanding of Sustainable... food; energy use in the home; leisure and tourism; transport; finance and investment (work in progress).

2 Introduction

Following the World Summit for Sustainable Development (2002), the UK Government's Department for Environment, Food and Rural Affairs (Defra), identified Sustainable Consumption and Production as a key area of interest on the road to sustainable living (Defra and DTI 2003). Government was rightly recognised as a key player in shaping and creating the necessary markets to achieve One Planet Living. At this time it was also understood that to achieve those markets consumer behaviour, attitudes, values and aspirations was of primary importance. Indeed it goes further to argue that:

“Policy interventions will not be fully effective unless the drivers for consumer behaviour are better understood and taken into account.” (pp.16)

This strand of work to understand consumer behaviour has been further developed since its high profile nature was further highlighted in the Government strategy document 'Securing the Future'. Here the concept of a 'One Planet Economy' started to emerge until 'One Planet Living' has become an overall goal for SCP in Defra.

The next step from here was to consider the recommendations made by the Sustainable Consumption Roundtable (SCR, 2006) which were translated into behaviour goals for One Planet Living. Defra recognise through its SCP programme that One Planet Living requires a two pronged approach – addressing production techniques and consumption trends. The behaviour goals for sustainable living all relate to actions that could be taken at a household level to work towards One Planet Living. They include basic, well known actions achievable by all (e.g. turn off lights; waste less food) and more challenging goals such as reduce flying and install electricity micro-generation. This paper will now describe the process by which these behaviour goals are being translated into strategic action plans.

¹ Further information and a full list of projects is available through the Defra website at www.defra.gov.uk

3 Applying Research

3.1 Policy Development

Firstly Defra determined that One Planet Living is potentially best achieved through a Social Marketing Framework. This means that marketing techniques are applied to increase take up of a social or public good (rather than a specific product or service which would solely benefit the individual).

Step one in this approach was to identify behaviour goals and to prioritise these. Behaviour goals from the SCR report were built upon from research commissioned for the SCP evidence base: the value of the evidence base came to the fore at this time, and motivators and barriers of behaviour (again from research known to the evidence base) were described for each. These behaviour goals were then distributed on a two-dimensional plot to show their impact (in terms of carbon as a primary, secondary or non-applicable measure) against the feasibility of these behaviours (figure 1.). This step was important to be able to identify priority behaviours (those with high impact and high feasibility) and also to ensure that other high impact behaviours with lesser feasibility were not simply discounted.

Step two in this approach was to take these behaviour goals and consider in what ways they could be linked to household behaviour. Using the same concept of a two-dimensional plot, these behaviour goals were re-positioned to show 'Willingness to Act' against 'Ability to Act'. For example, those behaviours thought difficult due to external barriers but of interest to the public (e.g. installing micro-generation) were positioned in the graph quadrant 'High Willingness, Low Ability'.

Recognition that the UK population is not a generic mass, was a key step in parallel to this identification of the behaviour goals. Social Marketing Practice commissioned research (Darnton, 2006) to further work identifying environmental segmentation models and potential audience segmentation approaches and models which may be appropriate for this strategy. Using this base, current research is exploring the extent of these segments (e.g. in what segment do the majority of the population fall; what are the psychodemographics for each segment) and their responses to the key behaviour goals. Early segmentation identified 6 sectors – strugglers; sceptics; mainstream recyclers; young conscientious consumers; conscientious consumers; green activists. Until the current research is completed, these population groupings have been positioned on the same 'Willingness to act/Ability to act' plot. For example, Young conscientious consumers were positioned in the low ability to act, high willingness to act quadrant, to reflect that there may be a high number of external barriers for them to hurdle (e.g. lack of money). Lastly, for each of these segments, a series of behaviour goals were clustered to reflect the time/money trade off for actions. So for example, those with low ability, behaviour goals not associated with increase financial outlay were priorities; for those with high ability behaviour goals reflected that perhaps people had more financial ability but less time commitment. Once the evidence base is expanded with

the findings from the audience segmentation research, this plot will be re-drawn to reflect emerging findings.

Next steps for this approach are to attain key stakeholder agreement to the behaviour goals, the overall approach and, importantly, develop Defra's communication strategy: with whom should Defra communicate - directly to householders or through an intermediary; is there scope for mass communication and engagement; to what will people, everyday, ordinary members of the public respond?

3.2 Environmental Action Fund Review

The other half to this paper is to explain the Environmental Action Fund (EAF) Review (Brook Lyndhurst, 2006) This work is linked to the behaviour goals work, mainly by the EAF projects being conceptualised by Defra as pilot projects to test the feasibility of engaging, enabling and exemplifying pro-environmental behaviours to the public. The findings will therefore feed into the question 'With whom should Defra communicate?'

The Environmental Action Fund (EAF)² supports a programme of community based action projects aiming to encourage SCP at a grass roots level. The overall aim is to further the Government's sustainable development objectives within England. The current funding is split between 35 projects that:

- Contribute to the sustainable consumption agenda identified in the Government's Sustainable Consumption and Production (SCP) Framework;
- Influence more sustainable patterns of consumption within communities;
- Move away from *awareness* of consumption challenges into *action* for more sustainable consumption behaviours;
- Go beyond single issues and look at consumption issues across the board; and
- Attempt to make some leap of innovation in *social* or *market* activity (as distinct from innovation in technology).

Although the EAF is a long running programme, this funding round (2005-08) is the first attempt to move projects away from simply increasing awareness of environmental issues and to actually progress behaviour change. The review that is running along side the funding is evaluating the programme as whole and also identifying positive (and negative) learning from the community projects – for example has the approach taken been successful in achieving behaviour change; have projects identified target audiences and been able to reach them? Interim report at the end of the first year highlighted some crucial learning for Defra (as the funder and as the recipient of the information).

Firstly, at a programme delivery level, it has been necessary and useful to allow a degree of flexibility in the early stages of project lifetimes to allow some 'tweaking' when early plans were found to be problematic. As

² For further information go to: www.defra.gov.uk/environment/eaf/

a recipient of the information, the key messages for Defra have surrounded the issues of evaluation and monitoring.

Methodologies for measuring behaviour change in the community project arena are in their infancy and there are a number of general issues that needed to be taken into account when assessing how far EAF projects had progressed on evaluating behaviour change. These issues relate to the complexity of defining behaviour change, of devising appropriate impact metrics, of capturing spin-offs (e.g. enhanced social capital or community cohesion), and the usual evaluation issues of attribution, diversion and additionality. Clearly, project evaluation is absolutely critical should Defra gain from the project experiences.

Towards the end of the first funding year Defra were alerted to the very significant risk that many projects would not be able to demonstrate behaviour change impacts because evaluation was not being built in to project design early enough, or adequately enough, to produce robust evidence. Defra responded by offering evaluation consultancy support to each project. The key evaluation issues identified in this Year 1 review were:

- Few groups have set research based targets;
- There is (so far) heavy reliance on anecdotal evidence to demonstrate outcomes;
- Many projects do not differentiate clearly between outputs and outcomes, and there is evidence of confusion about what Defra means by 'outcomes';
- Outcomes are often not clearly reported in returns to Defra, and few projects (as yet) provide quantified outcome measures;
- Many are still not making the distinction between awareness raising and behaviour change;
- Few have plans to capture evidence on the wider social benefits of their projects;
- Some have thought about, but are struggling with, methods to capture the 'diffusion effect' within their target communities;
- Some projects lack the technical ability to evaluate behaviour change effectively (and may need on-going support);
- Few projects are yet in a position to monitor or measure *sustained* behaviour change;
- Few are using best practice guidance on evaluation or research techniques;

As a recipient of the learning, this is critical to Defra because data on behaviour change will therefore be heavily dependent on the quality and comparability of projects' evaluations. With this in mind Defra has actioned the following recommendations from the report in order to assure the quality of the learning that will result from this level of funding.

- Consolidate and simplify reporting requirements but ensure that outputs, outcomes and cumulative totals are provided.
- Maintain a light touch but ensure that (from recommendation 1) struggling projects are identified early on and assisted appropriately

- Consider means by which grant recipients could further learn from others' projects (and evaluation techniques)
- Assist in bridging the gap between the behaviour change literature and the project directions – if projects are intuitively following a behaviour change theoretical framework then further encourage their understanding of that model and ways by which behaviour change might follow
- Highlight the importance of monitoring behaviour *over time* in order to ascertain whether the approach taken results in a short lived temporal behaviour response rather than a sustained and sustainable shift in everyday behaviour
- Re-emphasise to projects the need to go beyond awareness raising and encourage testing of an array of behaviour change tools

4 Conclusions

Perhaps the primary conclusion here is that influencing behaviour is extremely complex and difficult. On a positive note, it is hoped that this paper has conveyed that Defra are not only committed to the goal of One Planet Living but are applying many different approaches to achieving this end – both a community, grass roots approach, a market transformation approach and a behaviour change programme. The Behaviour Change Strategy will be further developed using a social marketing approach and further iterations will incorporate research commissioned on an ongoing basis by the Evidence Base team. In positioning resource to link the evidence base and the policy development, Defra are clearly exemplifying not only the development of an evidence base, but its direct application to ensure robust and sound policy making which will work towards the ultimate goal of One Planet Living.

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CSR Changing Patterns - UK Glass Sector Pilot Pioneering Sustainable Consumption and Production Chains

With examples of further project work in the UK

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1 Introduction

The British Glass Manufacturers' Confederation (British Glass) and the UK Government Department of Trade and Industry (DTI) funded a pilot project in 2004/5 to explore the practical application of the Government's "Changing Patterns - UK Government Framework for Sustainable Consumption and Production" (SCP) initiative within the Glass Sector Supply Chain with a view to presenting the findings to the larger industrial sector. The project was conducted jointly by British Glass and Future Perfect Limited.

The initial project concentrated on two main areas:

- container glass manufacture and consumption, with particular reference to recycling;
- and the thermal glazing supply chain for use in construction.

The project followed on from previous scoping research, with the specific aim of identifying the key actors, barriers and enablers to sustainable consumption and production in the glass product supply chain, and to identifying specific points in the product's life-cycle where taking action could or would most make a difference in improving the environmental and social impacts of the product.

The project explored the structure of the glass supply chain from the point of production of the raw materials to the final disposal of the finished product at the end of its useful life. It aimed to identify at each point in the supply chain the key barriers to, and enablers of, the principles of SCP, and

to analyse them in terms of their political, social, economic and technological impacts. 50 areas were identified and commented on by stakeholders.

The findings were then incorporated as a set of Key Issues, identifying areas where specific action could offer opportunities for the better implementation of SCP, reflecting stakeholder views. These general principles were then refined into an initial, but non exhaustive, set of five project opportunities whose aim would be to explore and encourage further collaborative actions. The full report, Changing Patterns - Glass sector Pilot. Pioneering Sustainable Consumption and Production Chains, is available at http://www.britglass.org.uk/Files/Finished_version_compressed180305.pdf. There is also an executive summary on the same site. See the British Glass website industry/publications page for this and associated publications. <http://www.britglass.org.uk/Industry/Publications.html>

Ultimately the 5 projects proposals which passed the selection process and were highlighted in the report were tightly constrained by what was considered practicable, given the politics, economics, legislative and market environments at the time. This resulted in the original objectives identified for the flat glass stakeholder e.g. to increase national take-up of thermal glazing, being excluded. The issues were however commented on in the stakeholder responses.

It would appear that for the issue of sustainability to be properly addressed it is necessary to recognise early on that proposals and ultimate solutions may not necessarily fit comfortably within the existing national and cultural framework. For some, a certain level of boldness, courage and confidence is required to even acknowledge potential "road maps" and there is a danger that suggestions will be dismissed because they may initially be taken as a criticism of the point from which stakeholders are starting, unworkable or a "road to ruin". Proper investigation with an open mind is necessary.

It was further observed that strategies incorporating specific targets and area of work, for instance the use of taxation, carbon reduction or waste reduction or recycling, if not co-ordinated and continually re-evaluated with a "total sustainability" overview could lead to "solutions" with perverse and conflicting results.

It has not been possible to establish how much influence the original project has had on the setting up or funding of initiatives and it is suggested that evaluation should as a matter of course be built into such initiatives and made publicly available. Such a report should become a reference source material for future policy and strategy.

An update is included on how the proposed initiatives or ones similar to them have progressed in the UK since the report.

2 Background

Increasingly both Governments and society at large are becoming conscious that profligate use of energy and natural resources, particularly in developed countries is unsustainable; but what action should be taken?

At the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002 the UK Prime Minister and other world leaders committed themselves to “encourage and promote the development of a ten year framework of programmes ...to accelerate the shift towards sustainable consumption and production”. As part of this process the UK Government published in September of 2003 “Changing Patterns – UK Government Framework for Sustainable Consumption and Production”, which set out how the UK Government intended to translate these commitments into practical action.

Building on the WSSD definition, the UK Government defined the core of Sustainable Consumption and Production (SCP) as:-

“Continuous economic and social progress that respects the limits of the Earth’s ecosystems, and meets the needs and aspirations of everyone for a better quality of life, now and for future generations to come.”

It established the 4 steps given in Table 1 to accomplish this SCP vision.

Table 1: The key 4 steps identified in the UK SCP programme in order to accomplish the UK sustainability vision

Table 1 - Roads to SCP	
1	‘Decoupling’ economic growth and environmental degradation.
2	Focusing policy on the most important environmental impacts associated with the use of particular resources, rather than on the total level of all resource use.
3	Increasing the productivity of material and energy use, as part of the broader Government commitment to increase the productivity of the nation.
4	Encouraging, and enabling active and informed individual and corporate consumers who practice more sustainable consumption.

3 "Changing Patterns": The UK Sustainable Consumption and Production Initiative

3.1 - Methodology

As one of the first steps to delivering Sustainable Consumption and Production (SCP), the Department for Environment, Food and Rural Affairs (DEFRA) and the Department of Trade and Industry (DTI) made a commitment to establish a number of collaborative projects involving particular industry sectors or product supply chains as pilots to explore the practical application of the SCP approach. The glass sector was chosen as one of these pilots.

DTI set up an initial SCP workshop which gave the opportunity to a wide range of stakeholders to jointly explore barriers, enablers, opportunities and priorities for action in the glass supply chain. The workshop also provided the basis and a framework for this pilot and subsequently a methodology was developed concentrating upon the canvassing of stakeholder opinion and the soliciting of their formal input to the project. Table 2 outlines the various steps that were eventually taken in this particular project.

Table 2: The methodology used in the Glass sector SCP "Changing Patterns" pilot project.

Table 2 - Glass Pilot Methodology		
Step	Project Action	Details
1	Supply chain mapping	The detailed mapping of the glass supply chain in order to understand its structures, raw material sources, markets and disposal channels.
2	Stakeholder mapping	The development of a stakeholder map in order to identify those stakeholders with either a direct, or indirect, interest in the glass industry and its supply chain, who might have a view or impact upon relevant SCP issues.
3	Stakeholder letter	The drafting of a circular letter, addressed to all of the stakeholders identified in Step 2, with a view to inviting input, suggestions and comments on the project. A dedicated e-mail address was also set up. A copy of the letter sent, together with the list of organisations to which it was addressed, are given in Appendices 1 and 2.
4	Telephone contact with key stakeholders	A detailed review of the stakeholder list to identify key stakeholders for subsequent direct contact by telephone, either with a view to inviting comments over the telephone, or to arranging a formal interview or site visit.
5	Key stakeholder interviews and site visits	The completion of both telephone interviews and site visits to provide more detailed input into the project. Details of organisations visited or interviewed are given in Appendix 3.
6	Literature review	The review of existing reports and literature concerning issues applicable to the project. Details of the more significant documents reviewed are given in Appendix 4.
7	Regular project reviews	The conducting of project review meetings, with both British Glass and the DTI, in order to ensure that appropriate progress was being made with the project.
8	Preparation of written report (public draft)	The preparation of a formal draft report
9	Finalisation and presentation of the final report	Completion of the written report plus a presentation of preliminary findings at a workshop at the Environment Agency Conference (October 2004).

3.2 Key Issues and Indicators

The Government Framework Document identifies a basket of indicators for use with SCP and these were reviewed and further developed to make them directly relevant and applicable to the glass sector supply chain. Key issues addressed during this phase of the project were:-

1. Relative magnitude of the environmental impact of the indicator
2. Relative impact in socio-economic terms of the indicator
3. Potential cost benefits associated with the indicator
4. Ease of access to the data

The base indicators used during the course of the Glass Pilot Project are given in Table 3. The project utilized existing reports as it was not within its scope to collect new data.

Table 3: Base indicators used in the glass sector Pilot Project

Table 3 - Headline SCP indicators defined and utilised during the Glass Sector Pilot Project:
1 Raw material usage.
2 Energy efficiencies.
3 Carbon emissions [both direct and indirect].
4 Air pollution.
5 Water pollution.
6 Waste production.
7 Recycling rates.
8 Motor vehicle kilometres and related emissions.

3.3 Scope of the Glass Project

The project attempted to explore the structure of the glass supply chain from the point of production of the raw materials to the final disposal of the finished product at the end of its useful life. The intention was to identify at each point in that supply chain the key barriers to, and enablers of, the principles of SCP, and to analyse them in terms of their political, social, economic or technological impacts. The project was intended to concentrate on two specific areas, namely the glass container sector and the utilization of thermally efficient glazing.

3.4 Key Issues and Principles

The generic findings resulting from this research were then incorporated in the report as a set of Key Issues, identifying areas where specific action could offer opportunities for the better implementation of the principles of sustainable consumption and production.

3.5 Project Opportunities

As part of the "think-tank" process it was felt important to record all stakeholder views and recommendations, not just those that coincided with current government policy or legislative and economic infrastructure. Inevitably many proposals were considered to be impossible to implement without considerable national infrastructure changes. Although this did not invalidate them, it did lead to their being put to one side when it came to selecting a short list recommended for action and as agreed with the DTI.

4 Outcome of the project

4.1 Findings

The Pilot Project findings from the interviews with industry and supply chain representatives were tabulated in terms of the main barriers and enablers to Sustainable Consumption and Production. They were categorised as: raw materials production and quarrying, glass manufacture, downstream customers, waste stream and recycling.

Within each category the findings were broken down into political, economic, social and technological and the barriers and enablers in each area identified and discussed. An example is given in table 4 from the manufacturing category and political section.

Table 4: Examples of findings as given in the Changing Patterns - Glass sector Pilot - Pioneering Sustainable Consumption and Production Chains Report

Table 4 - Example of Findings - Manufacturing Category			
Type of Barrier/ Enabler	Barrier (B) or Enabler (E)		Comments
Political	E	Landfill tax encourages the use of cullet.	As the costs of waste disposal to landfill increases, so the incentive to find more cost effective alternatives to it likewise increases. The benefit, in financial terms, of utilising cullet as opposed to the land-filling of waste glass, is therefore composed of two elements:- Firstly, the unit price to the manufacturer of purchase of the cullet itself. Secondly, the unit costs of putting waste glass to landfill to the waste authority. The magnitude of the unit landfill tax can, therefore, have a potentially significant impact on this equation, and the related business decision making processes.
Political	E	Building Regulations mandate the use of low emissivity glazing systems	The most recent revision of the Building Regulation (April 2002) mandated the use of low-emissivity glazing for both new build and for the refurbishment of existing building stock, including both domestic and commercial properties. Approved Document L, which details the performance requirements for glazing systems, is due

Table 4 - Example of Findings - Manufacturing Category		
Type of Barrier/ Enabler	Barrier (B) or Enabler (E)	Comments
	(for both domestic and commercial building).	for a further review in 2005, as a direct consequence of the commitments made in the recent Energy White Paper. At present, it is unclear as to what effect, if any, this review will have upon the U-values requirements for glazing systems. The most recent review, reducing U-values to 2.0, however, had a major impact on both the glass and the glazing industries in terms of the operational processes employed.
Political	B/E The Climate Change Levy acts as a disincentive to expand production of products that improve energy efficiency in wider markets , e.g.:- Low emissivity glass. Fibre glass used in the manufacture of wind farm sails. Conversely some energy efficiency policies such as the Building Regulations increase demand for energy saving products.	Manufacturers believe that the Climate Change Levy potentially places a disincentive on the move to the manufacture of more energy intensive products in the UK. Climate Change Agreements give an 80% reduction in the cost of the levy in return for industry meeting targets; currently most CCA targets in the glass sector are relative (SEC – specific energy consumption). Within the Agreements “relative” targets may not discourage production increases per se due to possible economies of scale. However shifts to the manufacture of products requiring more energy per unit, such as the low emissivity glass, may be discouraged, or producers must find ways of producing them that minimises the additional energy required; risk management through the use of product mix algorithms may be used to mitigate such effects until 2006. However, other energy efficiency policies, for example higher energy efficiency requirements in building regulations substantially increase demand for these products. A tension is felt by the glass industry between these policy tools in that they are perceived as being in direct conflict.

In all 50 items were identified and commented upon from the research.

4.2 Key Issues Identified in the Findings

Similarly using the headings of Political, Economic, Social and technological, the Key issues were identified and listed. It was stated whether there existed a "barrier" or an "enabler" and their impacts were discussed. For an example see table 5

Table 5: Example of key Issues as recorded in the Changing Patterns - Glass sector Pilot - Pioneering Sustainable Consumption and Production Chains report

Table 5 - Key Issues Political section
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Enabler	Impact
Differentiated PRN (Packaging Recovery Note) value based on environmental credentials.	<p>The current PRN system does not differentiate between environmentally high benefit uses of glass and very low benefit uses. The use of a differentiated system would help to increase recycling to the remanufacture with added CO₂ savings.</p> <p>It may be useful to consider a differentiated PRN value based on environmental credentials notwithstanding the practical difficulties of implementing such a system. Whilst Government agrees that closed loop recycling of packaging glass would usually be the BPEO, it would be necessary to take into account transport distances or for that matter determine the cut off point for high vs. low values e.g. should the use of recycled glass in fibreglass manufacture or as a fluxing agent on brick manufacture be considered high value, in that both provide very significant reductions in energy and emissions together with raw material savings.</p>

4.3 Project Opportunities

Following the methodology and the outcome of the information seeking process and using the principles established at the beginning of the project a set of five project opportunities were established (table 6).

Table 6: List of Project Opportunities identified in the Changing Patterns - Glass sector Pilot - Pioneering Sustainable Consumption and Production Chains report

Table 6 - Project Opportunities	
1	<p>Area: Container Glass Sector and Recycling Sector Source: Retail Supermarket Sector Overview: The project would look at the possibility of supermarket own-label products being packaged in glass containers manufactured using a high proportion of recycled glass cullet, and to a specification allowing for a higher variability in clarity and colour than the current specification allows.</p>
2	<p>Area: Container Glass Sector and Packer Filler Sector Source: Retail Supermarket Sector Overview: The project would explore the concept of using ultra-violet (u/v) resistant foils and/or alternative technologies on clear glass bottles for the storage and marketing of red wine, as an alternative to utilising green glass bottles as at present.</p>
3	<p>Area: Container Glass Sector and Recycling Sector Source: Licensed Retail Sector Overview: The project would look at the feasibility of increasing glass container recovery rates from licensed premises in a small geographical area with a view to developing a model, and case study that could be applied nationally in the UK. This would include the examination and development of existing “pilot” projects.</p>
4	<p>Area: Flat Glass Sector and Recycling Sector Source: Replacement Window Sector Overview: Much good work has been done, albeit geographically restricted areas, on the recycling of glass from windows removed during the replacement of single with double glazing. This experience presents the opportunity for an excellent “Good Practice Guide” or case study. This project would investigate the work conducted, examine the possibility of developing the case study materials, and produce those materials.</p>
5	<p>Area: Flat Glass Sector/Recycling Source: Replacement Window Sector Overview: This project is related to (Project No: 004) in that there is considerable scope for developing this approach further, to present a sound model to allow the recycling of the majority of materials removed with replacement glazing (glass, PVCu, aluminium, steel, wood etc.) with a view to reprocessing and possibly secondary manufacture at the</p>

	point of recovery. This project would be a feasibility study to investigate further the opportunities for an integrated recycling, manufacturing and waste management centre.
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4.4 Commentary on the proposed projects

The completion of the report and a subsequent launch at an Environment Agency event in October 2004 which included presentations by Future Perfect, British Glass, DTI and WRAP effectively completed the DTI/Glass Sector SCP Pilot Study work as carried out by the consultant Future Perfect Ltd and British Glass. However it was recognised that the aim now would be for government and its agents to explore and encourage further collaborative action and adoption of the proposals, so as to take forward the practical implementation of the Key Issues.

It should be noted that these five project opportunities in Table 6 reflected what was considered politically and economically practicable, given the constraints of the existing legislative and market environment. They did not necessarily reflect the major areas of concern of individual stakeholders. Indeed it was recognised that some suggestions required really substantial and innovative changes in legislation, national infrastructure and people's perception and behaviour. Because these elements were not considered practicable by all parties they were not subsequently included in the proposed initiatives.

Government were understandably keen to identify simple and cheap solutions which might give the greatest advances towards greater sustainability at the least cost or disruption. However it became apparent that within the glass supply chain such "low hanging fruit", however much to be desired, simple did not exist for "cherry picking".

Of interest, and with no surprise, was the fact that several of the areas were already under consideration for work if not actually already receiving government funding through existing environmental schemes. This should not be taken as a failure of the pilot study to identify totally new areas but of the timeliness and practicality of carrying out such projects. When many organisations are working on sustainability issues it is highly likely that there will be convergence within those projects that are ultimately practicable and not least where there are economic benefits to be obtained. The pilot study's job was to identify where stakeholders felt progress could be made and it was inevitable that some of the issues would already be being addressed, perhaps without their knowledge, or were likely to be so in the near future.

During and since the exercise, stakeholders have continued to address the sustainability problem and much work has been driven by the Carbon Trust and WRAP programmes and their associated funding mechanisms. The consultancy GTS Ltd, with its close links to the trade association, British Glass, has been heavily involved in this work.

5 Projects that have taken place since the writing of the Changing Patterns report.

Unfortunately it has not been possible, partially due to changes in staffing in DTi, to ascertain how much the Changing Patterns Glass Initiative actually influenced the choice and support of projects that were subsequently agreed and performed, for instance with The Carbon Trust and WRAP. It is clear however that those projects were very much in line with the principles and categories identified in the initiative and no doubt the momentum gathered by such an exercise has kept the ball rolling.

Some industrial sectors which were involved in the Changing Patterns Project have, it is understood, since become involved with the government's Sustainability Challenge programme. The danger of course is that without a continuing central structure and comprehensive handover of responsibility, work is likely to be duplicated, forgotten or ignored. It would be useful to be able to evaluate the effect that the Changing Patterns Programme has had on those sectors that were involved.

Below is a summary of recent projects which fall into the categories identified in the glass initiative. The Project Opportunity numbers refer back to those in Table 6.

5.1 Project Opportunity 1:

Several projects fall under this opportunity category and are to do with increasing cullet usage and production efficiency through one or more methodologies.

5.1.1 Container Glass Reformulation to deliver lower melting temperatures: The Carbon Trust,

The aim of this project was to reformulate the chemical composition of container glass to deliver properties matching those of current container glass, whilst requiring significantly lower melting temperatures, thus saving energy. Preliminary results indicate that a 40°C temperature reduction can be achieved with associated savings in energy use and pollutant emissions. Further information: Final report due early 2007.

5.1.2 Maximising Cullet Addition in Container Glass - "Colourite"- Waste Resource Action Program (WRAP)

In the UK, there is proportionally more green glass cullet collected than is manufactured. The work set out to review methods for reducing the colour of glass in the furnace resulting from lower quality cullet containing a relatively high proportion of green glass. The literature survey and practical work indicated several practices worthy of further investigation but with manipulation of the dilution, decolourising & colour balance likely to be most practicable. A colour prediction model was developed that allowed the glass colour to be predicted based on cullet and raw material quality. A consumer perception study was also undertaken to investigate whether glass colour influenced consumer buying decisions.

Further information at: <http://www.wrap.org.uk/> or for the report <http://www.wrap.org.uk/downloads/RandDIntRepGLA39Report1.3d590003.pdf>

5.1.3 Container Lite and ContainerRite - WRAP

A suite of projects investigated the possibilities for reducing the tonnage of glass packaging waste from food, wine, beer, cider and spirits being disposed of to landfill. Phase I Container Lite of the project resulted in significant weight reductions of over 30,000 tonnes p.a. across a variety of products. Phase II ContainerRite aims to 1) continue to reduce the weight of glass packaging waste by investigating further light weighting, 2) examine the opportunities for bulk imports of food and drink to the UK to increase manufacturing consumption of green cullet in the UK and 3) increase the use of clear bottles for products that are traditionally packaged in green glass.

Further information: Phase I report to be available shortly on the WRAP Website, Project code INN003-6

5.1.4 A Study of the Balance between Furnace Operating Parameters and Recycled Glass in Glass Melting Furnaces, Carbon Trust

This project developed an algorithm to permit operators to predict the melting energy requirements of varying levels of cullet concentration in the batch at different operating parameters. The project demonstrated a potential furnace energy saving of 2.1% which translates to a saving of some CO₂ emissions of 13,650 tonnes per furnace p.a.

Further information:

<http://www.britglass.org.uk/Files/CarbonTrust-Cullet-Energy.pdf>

5.2 Project Opportunity 2 - Alternative technologies for ultra violet (UV) resistance

5.2.1 Wine in Flint Bottles, WRAP

As part of a larger study called "A study into the interaction of imported wine bottles and the UK's cullet supply" the work investigated technical solutions to UV protection of wine in flint bottles. It found that commercially available solutions in the form of organic coatings and plastic sleeves already existed. It was also technically possible, by small additions of rare earths to the batch, to provide UV protection in clear glass but that the cost of such additions was significant.

Further information:

http://www.wrap.org.uk/downloads/GTS_GLA0059_WineInFlint_Jan06.5d5b840d.pdf

5.3 Project Opportunity 3 - Increasing glass recovery from Licensed Retail Establishments, WRAP

WRAP have carried out several studies and trials to identify best practise for the collection of glass from licensed premises (pubs, hotels etc). Several commercial collection schemes have operated on both national and more successfully on local scales. The largest scheme in the UK has stopped and this is most likely due to the quantities of glass collectable in any given area at a given cost, bearing in mind that it takes some 3-4,000 bottles to make a tonne of such cullet and the current cullet value may be as low as €20/t.

Further information: Contact Berryman Ltd via <http://www.berryman-uk.co.uk/index.htm> and see

http://www.wrap.org.uk/manufacturing/info_by_material/old_materials_sections/glass/pubglass/index.html

5.4 Project Opportunity 4 - Recovery and Reuse of Glazing units, WRAP

WRAP and the Building Research Establishment have carried out extensive work on the practicalities for collecting post consumer flat glass from demolition and building sites. To-date it has been found impractical to use this glass for remelt in float glass furnaces due to the potential for contamination. However some small schemes successfully recycle such glass to alternative uses.

Further information:

http://www.wrap.org.uk/manufacturing/info_by_material/old_materials_sections/glass/flatglass/index.html

Some flat glass manufacturers do individually operate successful schemes for the return of off-cuts to their float glass furnace from the manufacturers of new glazing units.

Good practice guides have been produced for the processing of glazing waste on construction sites in an effort to increase the availability of flat glass available for recycling.

Further information: See

http://www.wrap.org.uk/manufacturing/info_by_material/glass/types_of_glass.html for work on Flat Glass recycling and in particular "Recycling in Construction: How to Segregate and Recycle Glass" and Recycling Your Window Waste - Good practice Guide

5.5 Project Opportunity 5 - Other projects looking at alternative uses for post consumer glass

A wide range of projects and trials have taken place investigating alternative higher value markets for glass that is unsuitable for closed loop recycling, these uses include.

- Water filtration

- Brick flux
- Shot blasting
- Foam glass
- Glasscrete

Further information: Reports are available on the WRAP website

6 Discussion and Overall conclusions

Using government guidelines work was carried out in the UK container and flat glass sectors to identify the barriers and enablers to sustainability as discussed with all parties in the glass stakeholder chains. It was intended to use the experience gained to inform work across other industrial sectors.

The initial objectives established in the Container sector were to identify the major environmental impacts of the container manufacture and supply chain and the barriers and enablers to improvement. The initial objectives in the flat glass sector were to identify the key elements of governmental, industry and consumer strategy that impacts on the thermal glazing supply chain and to encourage take-up of more efficient glazing and thus decrease the UK carbon emissions from buildings.

50 barriers and/or enablers were identified and commented upon by the stakeholders and these were categorised as political, economic, social or technological. Such was the pressure to recommend in the report only those areas that were reasonably straightforward, low cost and practicable under the current national infrastructure that only 5 recommendations for further work were eventually listed.

The final recommendations relating to the container sector were generally in line with the original objectives. The final flat glass recommendations did not address the original objectives but dealt with a less contentious area, the recycling of post consumer flat glass. It was possible that this apparent change of direction was due to the considerable political and legislative barriers which would need to be overcome to encourage the take-up of glazing in existing buildings perhaps by reducing the cost to consumers, for instance by further reducing taxation on energy saving measures at the consumer level or directly or indirectly reducing costs at manufacturing and distribution level for instance through the use of Climate Change/carbon credits rather than taxes. Regulations were also in place to deal with some aspects of thermal glazing.

The 50 enablers and barriers identified in the report remain as invaluable source material for all stakeholders, providing sincere commentary from various viewpoints on how they felt progress might be made in sustainability.

The 5 Project Opportunities have been successfully taken forward. However it is not possible to evaluate what role the study might have

eventually played in encouraging those projects. It is not clear whether or not they were done in parallel, independently or as a result of the study. It is recommended that as a matter of course when such initiatives are planned and executed their impacts should also be evaluated in order to advise future work.

References

Changing Patterns - Glass sector Pilot. Pioneering Sustainable Consumption and Production Chains. Project funded by British glass Manufacturers' Confederation and the Department of Trade and Industry, March 2005. Peter Barden, Future Perfect Ltd. A full and executive summary is available at <http://www.britglass.org.uk/Industry/Publications.html>

See the WRAP (Waste Resource Action Programme) website for relevant WRAP documents <http://www.wrap.org.uk>

See the Carbon Trust website for relevant Carbon Trust documents. <http://www.carbontrust.co.uk>

John Stockdale is the Environmental Manager for the British Glass Manufacturers' Confederation in the UK. The opinions and ideas discussed here are in no way to be taken as the opinion or position of British Glass or its members but are solely used to explore and add to the debate on current issues.

CSR Responsible Purchasing: a practical business guide

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Abstract

As more sectors and companies are affected by globalisation and other societal challenges, supply chain and purchasing strategies will increase in importance. In addition to the ‘usual suspects’, such as the textile and furniture sectors, other sectors are being scrutinised concerning their sourcing practices. In this paper, we review how companies can develop and implement responsible supply chain strategies. Interviews with companies, together with desk research are used to develop a practical framework, for what we will refer here to as responsible purchasing. We then use this framework combined with case studies and best practices to suggest how companies could change their current purchasing practices to successfully integrate environmental and social issues into their supply chain strategy.

Introduction

Nowadays, many purchasers are operating in an increasingly challenging and competitive environment. Companies are focusing on their core-activities, resulting in outsourcing of non-core functions. Supply chains are becoming more complex and sensitive due to increasing globalisation. At the same time, there is growing concern in both government and society at large about the environmental and social consequences of globalisation. Non-governmental organisations and the general public expect companies to deliver responsible products that should be clean, manufactured without child labour and come from countries with free trade. Multilateral organisations and national governments are developing policies and legislation that stimulate adoption of responsible purchasing practices. In response, we notice that several companies have developed methods for responsible purchasing practices.

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But what is responsible purchasing? And why should companies pay attention to it? And, if relevant, how can it be put to practice? We will try to address these questions in this article.

Responsible purchasing: what is in the name?

Responsible purchasing is becoming an essential aspect of modern-day risk management for many companies. As public concern mounts about environmental and supply chain labour standards, companies need to demonstrate they are taking the issues seriously. Child labour has become an issue of particular concern, implying that buyers should ensure that the products they buy come from sources of high integrity. If they do not, they face the prospect of damaging public criticism that can impact brands, customers' trust, corporate reputations and shareholder value. These issues pose new and important challenges to purchasing departments. Without doubt, these challenges will change the scope and role of purchasing within companies. We will refer hereafter to these new challenges by using the term Responsible Purchasing.

Responsible purchasing is the process in which organisations buy supplies and services and take in addition to traditional factors as price, quality and availability also into account:

- environmental aspects: the effect on the environment that the product and/or service has over its whole lifecycle (also known as green procurement)
- social aspects: effects on issues such as poverty eradication, international equity in the distribution of resources, labour conditions and human rights.

(AccountAbility, 2004, Buying Matters, 2006, IBM Business Consulting Services, 2005 and Van Weele, 2005)

Companies are challenged to put responsible purchasing into practice. What does it mean for companies to shift their purchasing process towards a more responsible one, taking environmental and social aspects into account? But to begin with, why should a company pay attention to responsible purchasing in the first place?

Why bother?

To date, only a limited number of multinational companies, mainly in the business to consumer-sectors, have made serious efforts in the area of responsible purchasing. Most people are familiar with the apparel sector and its sweatshop problems. But, increasingly, other sectors and companies are put in the limelight and have become more active. What are the most significant considerations for initiating more responsible approaches to purchasing? In summary, five reasons can be identified.

1. Corporate Reputation

Trust comes by foot and goes on horseback. While it costs companies many years to build their brand and reputation, they can be damaged very quickly. Rebuilding damaged company and product brand reputations can be time-consuming and costly. In today's markets, intangible assets such as brand value are very important for companies. Particularly in this period of "mass/CNN" communication, companies can be quite sensitive to reputation damage. Of course, what is stated above can also be put the other way around. Companies can maintain and enhance their reputation with responsible purchasing initiatives¹. (AccountAbility, 2004 and Buter *et al.*, 2004)

2. Legislation and quasi-regulation

Supra-national (particularly the European Union) and national governments are introducing legislation which forces companies to take action in their supply chain. Examples are the End of Life Directive (ELV) in the automotive sector, the new European chemical policy (REACH) and several directives in the electronics sector (WEEE, RoHS, EuP). Companies depend on their supply base for their compliance and impose strict requirements on their supply bases. In addition, there are many multilateral (OECD, Global Compact, ILO-convention) and sector codes of conduct, which stress the importance of responsible purchasing strategies and stimulate companies to take action. Although these codes don't have a formal legal status, in practice they often are regarded as a quasi-regulation and become common practice.

3. Anticipation of future societal signals

Responsible Purchasing helps companies to become more receptive to (early) societal signals. It enables them to respond to environmental and social concerns, such as growing scarcity of raw materials, obesity or food safety. (Buter *et al.*, 2004)

¹ Reinforcement of reputation leads to (micro-) economic value creation. For example, 60% improvement of reputation explains a 7% increase in market value; an estimated 40% of the market value of a company is related to its reputation. A crisis in reputation coincides statistically with a decrease in value of 8 %. (Cramer, 2003)

4. Stimulant for innovation

Responsible purchasing can force and/or stimulate a company to search for alternative products or services that are in line with environmental or social requirements. In this way, innovation can be encouraged. (KPMG, 2005)

5. Peer pressure

And last but not least, we see in many cases a more straightforward reason to become active, being competitive. As competitors undertake activities concerning their suppliers and profile themselves more explicitly, peer pressure increases.

Summarised, progressive companies are beginning to realise that their performance can be significantly affected in environmental and social dimensions. Responsible purchasing initiatives can lead to benefits; however, the most important drivers currently seem to be risk prevention.

Toolbox 1: assessing and mapping risks

Because risks are not always as obvious as one may think, it is recommended to conduct a risk assessment from time to time. The “New Zealand Business Council for Sustainable Development” has developed risk tools that assist a company in identifying and mapping its risks in the area of corporate responsibility (Appendix 1) and responsible purchasing (Appendix 2).

Putting responsible purchasing into practice

If companies have come to the conclusion that they need to start taking environmental and social aspects into account, the question then is how. Below we present a practical framework that helps companies to develop and implement responsible purchasing. In order to do so, it is important to understand the purchasing process of the organisation. We present a schematic overview of a typical purchasing process, which can be analysed at three different levels: strategic, tactical and operational. (Van Bergen, 2004). Hereafter we discuss how responsible purchasing can be developed and implemented at these three levels.

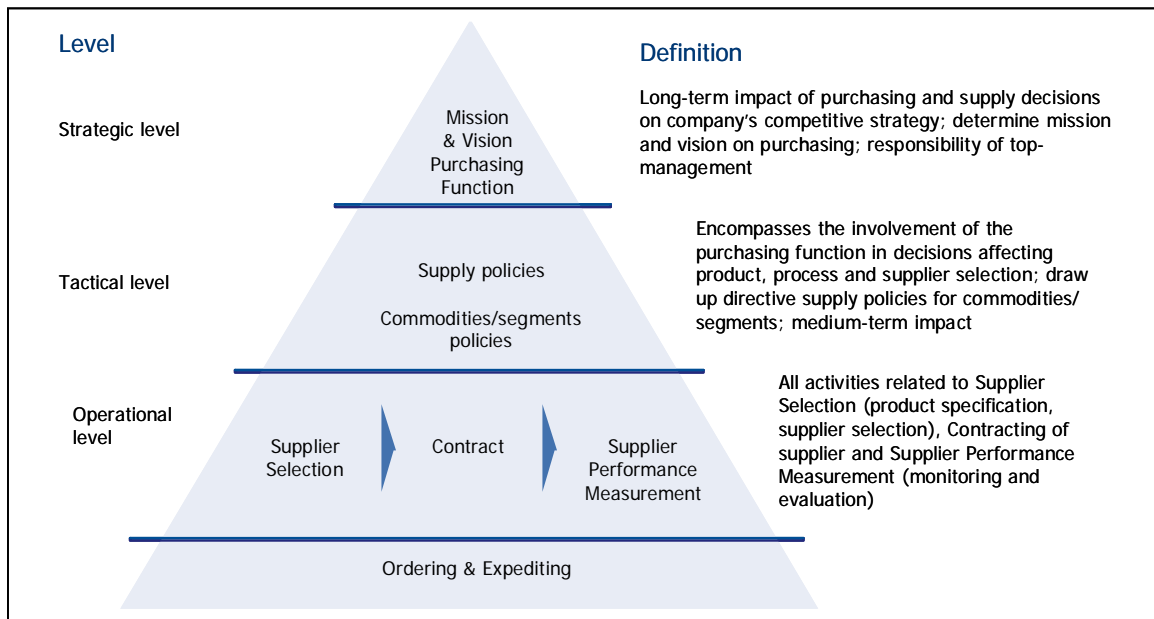


Figure 1: Schematic overview of the Purchasing Process

1 Responsible purchasing at Strategic Level

At strategic level, the mission and vision of the purchasing function is defined. This policy is, or at least should be, derived from the company's corporate strategy. The corporate strategy addresses the long-term mission and philosophy of an organisation, including long-term survival. What end-user markets is the company targeting and what are the major developments going on in those markets? What competition is the company suffering from and what leeway does the company have in setting its own policies? Understanding these type of questions is important since it will determine how purchasing strategies will assist the company in meeting its goals and objectives.

An effective purchasing strategy is one that fits the needs of the business as defined in the corporate strategy. Purchasing strategies need the flexibility to adapt as the business strategies change. (Monczka *et al.*, 2005 and Van Bergen *et al.*, 2002).

The strategy development process takes place implicitly or explicitly at different levels (Handfield *et al.*, 2005, Monczka *et al.*, 2005 and Van Bergen *et al.*, 2002):

1. **Corporate strategies:** The strategies are concerned with 1) the definition of businesses in which the corporation wishes to participate and 2) the acquisition and allocation of resources to these businesses.
2. **Business Unit strategies:** These strategies are concerned with 1) the scope or boundaries of each business and the links with corporate strategy and 2) the basis on which the business unit will achieve and maintain a competitive advantage within an industry.
3. **Purchasing strategies:** These strategies, which are part of a level of strategy development called functional strategies, specify how

purchasing will 1) support the desired competitive business-unit and corporate strategies and 2) complement other functional strategies (such as marketing, operations, quality, environmental and social strategies). Moreover, functional strategies influence each other. Environmental and social functional strategies have an influence on the strategic purchasing policy, as a result of which responsible purchasing is adopted and anchored. A responsible purchasing strategy formally integrates environmental and social issues with supply base management and purchasing process activities.

4. **Commodity strategies:** These strategies specify how a group tasked with developing the strategy for the specific commodity being purchased will achieve goals that in turn will support the purchasing-, business unit- and finally the corporate level strategies.

Based upon the company's overall objectives, responsible purchasing objectives must be seen in conjunction with other objectives, such as cost-reduction, reduction of the supplier base, improving product quality and/or lead time reduction.

To develop and implement responsible purchasing successfully, it is important that top-management commits itself to the responsible purchasing policy and that they encourage it. Because purchasing managers play a crucial role in achieving a successful implementation and are often confronted with several, sometimes competing, priorities, it is important to involve them at an early stage. Responsible purchasing means adding a new dimension to existing purchasing processes. The rationale for doing so needs to be explained and understood, in order to minimise resistance and scepticism from the procurement department.

Case studies

DAF Trucks: in order to get responsible purchasing onto the management agenda, DAF Trucks developed 3 Key Performance Indicators (KPIs) which are "Organisation & Performance", "Risk Management", and "EcoDesign". These KPIs were made part of the Management Accounting System, in line with the rating models used by DAF for Vendor Rating, Quality and Logistics (A, B, C-rating). Furthermore an internal training course was developed for the purchasing department.

Heineken: conducted an in-depth benchmark in cooperation with some of its competitors and front-runners to support the development of its responsible purchasing strategy.

2 Responsible purchasing at tactical level

Once purchasing has identified (at strategic level) a set of company-wide goals that it must achieve, another set of more detailed strategies should emerge. At the next level of detail, the tactical level, the strategic purchasing policy should be broken down into more detailed guidelines and sub-strategies.

In practice we see that most companies start formulating (environmental and social) supplier guidelines, referred to as the supplier code. Only a few front-runners add environmental and social guidelines to their sub-strategies at commodity level (Van Bergen et al., 2002). Below we elaborate on the supplier code and the commodity strategies.

Supplier Code

The supplier code is a document that presents a number of social and environmental principles and guidelines that a company itself and its suppliers or contractors are expected to observe. It sets out what the company believes are acceptable minimum standards. A company can decide to devise its own codes or to implement a code that has been developed by a sector, trade association or other organisations (e.g. Ethical trading Initiative).

Formulating a supplier code must not be underestimated. In practice it often takes quite some time and effort to develop appropriate guidelines that are acceptable and approved by the organisation. Typically, the purchasing and legal department are involved in the formulation of the supplier code.

Most company codes combine environmental, social and ethical / general requirements into one supplier code. Based on a review of several supplier codes, we see the following topics being addressed.

- **Environmental requirements:** often companies require adherence to the environmental management standard ISO 14001, but equivalent performance is usually accepted. Some codes set very specific requirements (detailed lists and questionnaires) to phase out hazardous substances or require energy, waste and/or packaging reduction and application of ecodesign.
- **Social requirements:** are often based on the set of internationally recognised labour standards enshrined in the core International Labour organisation (ILO) and include topics such as:
 - Child Labour/Forced Labour: all suppliers should strictly comply with laws, regulations and social standards (including the protection of employee rights and the prohibition of child and forced labour).
 - Health and Safety: requiring health and safety measures and/or management system (e.g. OSHA standards)
 - Other social topics, such as diversity and inclusiveness, discrimination, work hours, compensation, right of association, disciplinary practices, collective bargaining, wages and benefits (for more information, see Appendix 3).
- **Ethical / general requirements:** prohibiting personal relationships between suppliers and procurement agents, favouring suppliers with good practices, requiring posting code of conduct in all major workspaces, translating and training local staff, demonstrating compliance, agreeing to submit to inspections.

Due to regional differences and legal considerations, the formulation of the social and ethical requirements requires most attention.

Hereafter, the agreed upon supplier is implemented in a stepped-approach, often starting with the key and risky commodities and suppliers followed by the rest of the supply base. Supplier codes have little effect unless companies are monitored and compliance is enforced. The level of enforcement can vary from only informing and sending the supplier code, asking to sign, asking for guarantees and/or underlying documents, requiring self-assessments to conducting (formal 3rd party) supplier audits.

Case studies

Medium-sized clothing company (anonymous)

The (long term) ambition of the company is to only work with SA8000 certified suppliers. From experience the company learnt that the best approach is to have close contact with supplier and persuade them of the benefits and economic spinn-offs of SA8000 certification. A good example is that when the supplier and company tried to deal with employee overtime, they managed to organise the workflow in a more efficient way. This resulted in a: a higher productivity, lower over-time, increased wages and a more committed workforce. Based on this succes the company chose to focus its efforts on getting their top 15 suppliers at SA8000 level.

In addition to the cooperative approach the company adopts general rules in order to keep control on the supply -chain. For example the company only works with suppliers that mainly produce in-house and ask companies to adopt the BSCI standards. In order to fascilitate the screening of suppliers by the purchasing department the company currently develops a scorecard which also includes sustainability criteria.

Commodity strategies

In addition to issuing a general supplier code, some companies also integrate environmental and social issues in their commodity strategies. The term “commodity” refers to a general class of purchased items, a product family or segment. The goods procured are divided into a number of segments, each of which has its own strategy. A commodity strategy is the specific set of decisions that a company makes for the corresponding segment concerning the commercial aspects, targeted number of suppliers, the role played by the suppliers, the degree of co-operation with the supplier, and the kinds of objectives in the purchase contracts. (Handfield et al., 2005, and Van Bergen et al., 2005)

Case studies

Unilever: Unilever is working through its Business Partner Code with all its first-tier suppliers on human rights, labour standards, working conditions and care for the environment. All suppliers must sign this code. Not signing means no relationship.

In addition to the general code, a more focused and more dialogue oriented approach is developed on the 5 biggest commodities where it can make a difference to sustainability because of significant amounts of purchasing.

For its fish commodity, for example, Unilever encourages suppliers to seek certification to the Marine Stewardship Council Standard, and assesses each fishery against five indicators: fisheries research; quota system; regulatory tools; control systems; long-term management plan.

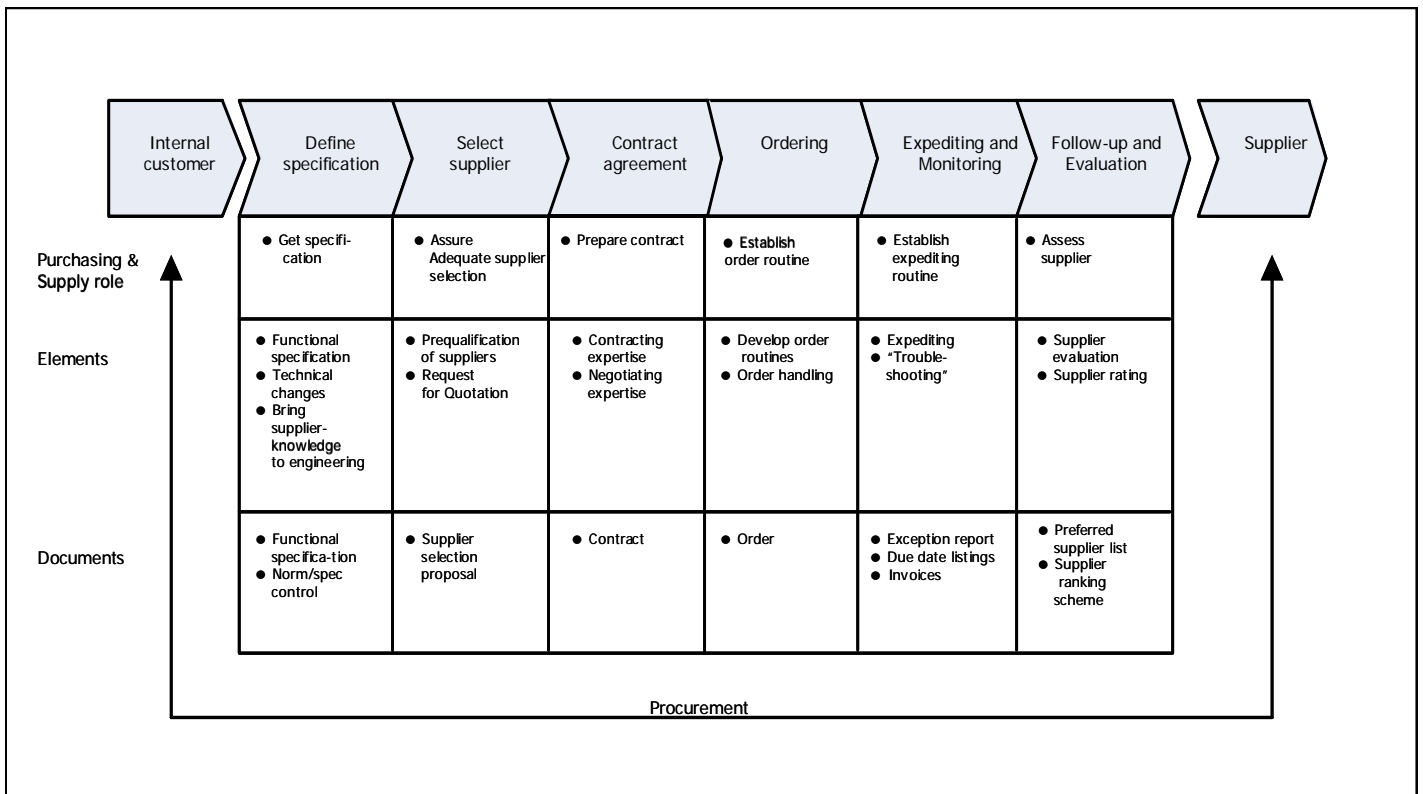
DAF Trucks: DAF Trucks distinguishes between 4 categories of purchased goods. Parts specifically designed for DAF (either with DAF design or with supplier design) and standardised products (either technically complex or simple). Each of these categories is approached differently. In case a supplier designs a part, they are responsible for taking into account environmental considerations, so for this category the KPI “EcoDesign” is most important. For suppliers that produce a part designed by DAF (already EcoDesigned) the KPI EcoDesign has no added value, but the supplier is responsible for “Organisation & Performance” and “Risk Management” (e.g. green manufacturing issues, ISO 14000).

3 Responsible Purchasing at operational level

At operational level, the procurement process aims at:

- determining specifications;
- selecting the most suitable supplier;
- negotiating with the supplier in order to establish an agreement;
- placing the order with the selected supplier;
- monitoring and control of the order to secure supply (expediting);
- follow-up and evaluation (including claims, supplier rating and supplier ranking).

Figure 2 schematically illustrates the main activities within the procurement function. We hereafter refer to this process as the procurement process. Depending on the business context, responsible purchasing may affect all phases of the procurement process. Below we discuss the implementation of responsible purchasing in the most relevant phases of the procurement process.



Specification

During the specification phase, the purchasing requirements are determined. It is generally possible to differentiate between:

- Functional specifications, which describe the functionality which the product must have for the user.
- Technical specification, which describes the technical properties and characteristics of the product, as well as the activities to be performed by the supplier.

In both cases, specific environmental or social requirements can be added to the specifications to stress legal compliance or ask for attention to specific (sector or company) environmental and social issues.

Case study

Construction sector: Traditionally the building sector is confronted with detailed technical specifications from their clients with a strong drive for lowest cost, leaving the little room to propose alternatives. Although governments puts increasing emphasis on the use of FSC-wood.

Nevertheless, more and more construction companies get involved in an earlier stage of construction design (such as public private partnerships) and are faced with functional specifications. In these cases, the construction company can provide clients with choices and distinguish themselves with innovative design and sustainable solutions.

Selection

After the purchasing requirements have been defined, the market exploration and supplier selection starts.

Depending on the type of goods and services this may include:

- Defining prequalification requirements (“target profile”), which is used to select and evaluate potential suppliers. In the Target Profile specific environmental and social topics can be included (please refer to Appendix 4).
- Developing a list of prospective suppliers (‘long list’). This can be done with Supply Market Analysis or without market research.
- Sending out the Request for Information (RFI). In some cases supplier visits or audits are conducted to assess and/or verify capabilities. This can also be on environmental and social items.
- Create shortlist. Based on the previous phases, the most promising suppliers are selected and receive a Request for Quotation (RFQ), which contains all relevant information necessary to make a bid.

These activities are commonly referred to as the tendering process. After receipt of the quotations, an evaluation is made in which all relevant aspects are weighed, leading to a ranking scheme. Based on the ranking scheme and additional discussions, the best (group of) supplier can be selected.

Case study

DAF Trucks: Input for the measurement of Environmental performance at DAF Trucks is the self- assessment that suppliers have to provide. The results of these assessments are made part of the supplier profile (which has 5 parameters, with environment included in the Quality parameter). This supplier profile is used in short-listing for specific contracts, the Supplier Market Analysis. DAF Trucks has started using the results from the environmental self-assessment in preparations for auditing.

Contracting

In the next phase, negotiating and contracting takes place. Various kinds of contracts can be used, such as Long Term Agreements, running orders and one-off orders. The technical contents of the purchase agreement naturally depend on the product or project that is to be purchased.

It is important to ensure that, as a minimum, the supplier code is enclosed in the purchasing agreement. By signing the contract, the supplier agrees to comply with the terms and conditions in the contract as well as the Supplier Code. (Van Bergen *et al.*, 2002, and Van Weele, 2005).

Monitoring

After delivery of the product(s), the company will monitor the supplier relationship and try – if necessary - to achieve improvements. A measurement tool could be used to measure the quality and delivery performance, but can also include measurements of environmental and social performance.

Monitoring can be done off-site (for example via self-assessments) or on-site with the most important suppliers (based on expenditure, dependency of supplier and the nature of environmental and social risks). This could involve visiting suppliers' production facilities, interviewing management and employees and assessing their compliance with the Supplier Code. Audits can either be done by internal staff (typically product technologists or quality representatives, occasionally buyers) or by external specialists. A checklist of questions which could be used during supplier audits is given in Appendix 5.

Case studies

Philips Electronics: Special internal training sessions are organised to qualify managers from various functional areas including Purchasing, Human Resources, Quality and Internal Audit, to conduct supplier audits. Training focuses on how to prepare for and execute an audit. During actual audits, auditors focused on how factory management deploys and approaches business functions like leadership, quality and sustainability. In order to detect non-compliance with the sustainability requirements, the auditors conduct worker interviews at the production facility, payroll reviews, confirmation of health and safety measures, compliance with relevant national laws and checks for banned substances. (Philips, 2005)

DAF Trucks: The previously-mentioned A,B,C rating is monitored on a monthly basis. The rating is integrated into the Management Accounting system (in line with other parameters like Quality & Reliability of Delivery) and is monitored by Purchasing Department. C-status suppliers will have to come up with improvement plans and results within a fixed time schedule.

Follow-up and Evaluation

Depending on the supplier performance and supplier audit results, an improvement process could be started. If suppliers do not meet the requirements of the supplier code or other environmental or social requirements, a time-limited improvement plan is agreed to achieve the desired level of performance.

Case study

Philips Electronics: Audit results and any areas of non-compliance are discussed after each audit in a feedback meeting which finalizes each audit. According to the severity of the non-compliance, an appropriate timeline and improvement plan is agreed upon with the supplier. All non-compliances are registered in a special database, the General Business Principles database. Philips' overall approach is to ensure suppliers meet their standards through open and honest discussions. Suppliers are expected to implement corrective actions if an audit shows that they are not meeting Philips' sustainability requirements and Philips will monitor their progress. If a supplier appears to be unwilling to commit to the sustainability requirements or does not follow up on the agreed corrective actions, as a last resort, the relationship with the appropriate supplier can be terminated. (Philips, 2005)

4 Conclusions and Recommendations:

General conclusions:

- 1 Currently, concepts such as green, environmental and ethical purchasing are being expanded with the inclusion of social considerations and evolve into what we have called responsible purchasing.
- 2 Responsible Purchasing is becoming more important due to trends such as globalisation, deregulation and pressure from society. These developments force companies to act more responsibly, especially when these companies purchase overseas.
- 3 Companies start responsible purchasing initiatives for varying reasons. The most important driver currently seems to be preventing reputation damage.
- 4 When developing and implementing responsible purchasing, three different levels must be distinguished: the strategic, tactical and operational level.

4.1 Strategic level

Purchasing in general is becoming more important due to changing business models. As a result the procurement function is getting more attention from senior management. Together with the trends of globalisation and outsourcing, we expect that responsible purchasing will equally gain importance. It is our impression that, apart from the “usual suspects”, not all sectors and companies fully appreciate this changing business environment.

4.2 Tactical level

Most companies active in responsible purchasing issue one generic supplier code to their supply base. For sake of simplicity and clarity this makes perfect sense. However in order to be more effective we recommend companies to take specific countries and/or specific products risks into account when implementing the Supplier Code. Only a few frontrunners differentiate their suppliers’ requirements per segment in addition to the generic supplier code.

4.3 Operational level

Without addressing the strategic and tactical level, it is not possible to effectively implement responsible purchasing at operational level. In terms of the procurement process, the phases of product specification, supplier selection and monitoring are the most important phases.

Outlook

We expect that the importance of Responsible Purchasing will grow substantially, due to the fact that purchasing is receiving more attention from senior management and, as results of globalisation, concern about environmental and social issues in the supply chains is mounting.

Recently in the Netherlands the VBDO (Organisation of Sustainable Shareholders) announced its “Responsible Supply Chain” benchmark initiative. This benchmark is conducted among approximately 30 stock-

exchange listed manufacturing companies and will assess how responsible these companies perform in their supply chain. VBDO will critically monitor this group of companies over the next 5 years and address the issue at shareholders' meetings. Furthermore VBDO announced that it is to grant an Award for the "best company in class". In the UK, the British purchasing training and consulting organisation CIPS annually presents an Award for Supply Management, which recognises excellence in Purchasing and Supply Management with a category for Corporate Responsibility.

All together, we expect that more and more companies will develop Responsible Purchasing initiatives.

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Appendix 1: Assessing Corporate Responsibility risks

Environmental	Social	Economic
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5 is highest risk

	Issues	Risk	Examples	Rating 1-5
Procurement	Sustainable source of raw materials including all components	Chain of custody is uncertain. May result in consumer concern/NGO activity; Ineligibility for public/private tenders	Retailers request GM-free – foods and non-foods; NGO activity relating to deforestation; UK Govt procuring doors and desks for Whitehall from endangered species	
	Use of chemicals/hazardous substances	Product safety scare. Precautionary Principle might be applied in certain countries. Product Recall	Pesticides in produce. Marks & Spencer ban PVC.	
	Animal husbandry: Breeding; Feeding; Food supply	Loss of business because chain of custody cannot be proved		
	Long-term supply	Source drying up will threaten economic viability	Fears for long term-fish supply prompted development of MSC; Maui gas supply; Toyota developed hybrid vehicle recognizing diversifying energy supply.	
	Short-term supply	Insufficient product to fulfill demand	NZ police not able to source enough LPG vehicles	
	Waste & packaging	Inefficient use of resources. Cost to business	Cost of landfill – levies and charges	
	Labour standards & practices. Conditions do not conform to ILO standards	Media scrutiny; boycotts; Loss of business, eg. ineligible for public/private tenders	Overseas labour conditions, eg. Nike; Gap.	
	Supplier dependence and viability	Eliminating a supplier from supply base might close their business and cause public outcry	Marks & Spencer's decision to move some of its supply base from UK to overseas.	
	Fair pay for suppliers	Sustainability of supply base and potential adverse publicity	Coffee supply; Fair Trade products	
	Inventory levels	Negative impact on cash flow	Companies left with seasonal stock due to inefficient procurement	
Local supply or overseas	Buying local may be more expensive and problems with continuous supply.	Sainsbury have preference for local produce supply – selling \$6bn worth per year.		
	Escalating cost of supply	Economic viability of product or services	Increase in fuel costs; Energy costs which cannot be passed on to end consumer	
Internal operations	Water; Air or soil pollution/ Contamination	Effect on reputation in local and wider community. Cost of remediation and risk of lawsuits	Prestige oil spill; Potential effect of any phosphate/nitrates land pollution to 'clean,	
	Perceived health impacts from local emissions	Effect on reputation in local and wider community. Cost of remediation and lawsuits	PCBs; Mobile phone masts; Incinerators	
	Waste management	Increased costs of disposal to landfill	Potential taxation	
	Work/Life balance of employees; Unsocial hours	Retention of staff. Additional costs of recruitment. Potentially	Impact of OSHAS 18001	

		punitive costs for stress in the workplace or lawsuits		
	Labour standards and practices; Pay & conditions	Staff retention; Strikes; Absenteeism; Claims	Wal-Mart challenged about trade unions; Strikes	
	Increased cost of fuel; Energy; Delivery method	Economic viability of product or services	Plant closures on temporary basis because of high power costs	
	Increased delivery times due to congestion	Increased resource costs; Service delays to customer; Impact on drivers; Road accidents		
	Inefficient operations/Poor productivity/Cost of overheads	Economic viability of product or services; Higher direct and indirect costs; Effect on competitiveness	Companies outsourcing or setting up lower cost operations overseas.	
Product Development & Stewardship	Impact and efficiency of product in use	Adverse publicity; Product boycott; Reduction in market share	Major recall of Firestone tyres because of product fault	
	Cost or suitability of raw materials increases. Need to find substitutes	Financial impact	Search for alternatives to materials such as PVC	

(Continued)	Issues	Risk	Examples	Rating 1-5
	End-of-life collection and disposal	Loss of market share; Non-compliance with potential legislation in home or overseas market	Mobile phones; Car parts; White goods.	
	Product traceability; bar codes and labels	Costly recall if unable to pinpoint batches of product	Pan Health products recall	
	Packaging and materials: need to match packaging to product requirements	Increased costs from overpackaging; Legislation in some markets relating to takeback systems, eg. bottles, cans	Returnable levies on bottles in some countries	
	Customer demand	Loss of market share	First mover gains: Shell, Nike	
	Increased cost of product/service because of increases in raw materials; Energy; Advertising	Market viability; Loss of market share	Pulp prices effect on the paper industry – can increase the price differential between sustainable and non-sustainable pulp supplies	
	Investor Appeal	Exclusion from ethical indices	DJSI, FTSE4Good	
	Sustainable source of raw materials including all components	Chain of custody is uncertain. May result in consumer concern/NGO activity; Ineligibility for public/private tenders	Retailers request GM-free – foods and non-foods; NGO activity relating to deforestation; UK Govt procuring doors and desks for Whitehall from endangered species	

Source: NZBCSD, 2003

Appendix 2: Assessing supply chain risks

	Supplier (1st tier/2nd tier/3rd tier etc)			Retailer			Consumer/user	
Issues to Consider (Relating to CR issues)	Material Acquisition from primary source	Manufacture / Process	Despatch / Transport	Operations including Warehousing	Product design & development	Sales & Market development	Product/Service in use	End of Life
General								
Changing customer expectations								
Adverse media coverage								
Threat to brand or corporate reputation								
Government procurement requirement								
Losing alignment with corporate/employee								
No appeal to ethical investors								
Specific Issues								
Long-term supply or raw materials:								
Use of chemicals/ hazardous substances								
Animal husbandry								
Short term access to supply								
Waste and packaging used								
Labour standards and practices including unsocial hours								
Local supply or overseas								
Water, air or soil pollution/ emissions								
Transport; fuel; congestion								
Increase in transport costs								
Energy utilisation								
Increased operating costs; eg. Energy, fuel, waste disposal								
Regulatory requirements								

Source: NZBCSD, 2003

Appendix 3: Social requirements in Supplier Codes

Issues typically included in generic Supplier Guidelines

Employment is freely chosen: Employers should not use prison labour or any other form of bonded labour. Workers should be free to leave when they please (after appropriate notice) and should not be 'tied in' by having to lodge their passports or ID cards.

Freedom of association: Workers should have the right to form and join trade unions and to bargain collectively.

Safe and healthy working conditions: Working environments and materials meet appropriate health and safety standards.

No child labour: Children should not be employed below the legal minimum age and appropriate steps should be put in place to remove children from employment and guide them towards education.

Payment of a living wage: Workers should be paid at least the national minimum wage in their country, but preferably a wage that is enough for them to live on. Workers should also receive a pay slip and breakdown of their payment.

Non-excessive working hours: Working hours should comply with national laws and in any case not be more than 48 hours per week plus a maximum of 12 hours overtime. Overtime should be voluntary and agreed in advance.

No discrimination: Employers should not discriminate against workers on any grounds including race, ethnicity, gender, caste, union membership, with regard to recruitment, promotion, training or any other matter.

Regular employment: As far as possible, workers should be given proper employment contracts and full-time employment. Employers should not try to avoid payment of social security, sick leave and maternity and other benefits through subcontracting or labour-only contracting arrangements.

No harsh or inhumane treatment of workers: There should be no physical, verbal or sexual abuse of workers.

Source: Insight Investment, 2004

Appendix 4: Principles and criteria for Supplier Codes

Principle	Criteria	Examples	Performance Indicators	Regulatory Framework
1. Employer Practices	Comply with Local and International Labour Standards	<ul style="list-style-type: none"> • 48 hours max. normal work week • Wage is above legal minimum • Freedom of Association • Security of Contracts • Equal Opportunities: Race & Culture, Age, Gender & Sexuality; Disability • Training & Development Programme 	Staff Retention; Reputation as 'good employer'; Pays in the median/upper quartile; Diversity of employees % against the industry/ local norm; HR Policy/ Company Benefits reflect work/life balance, eg. childcare, teleworking, leave of absence policy.	
2. Health & Safety	Commitment to Health and Safety which meets minimum legal requirements	<ul style="list-style-type: none"> • Health & Safety Policy • Active participation of employees • Employee health monitoring • Training • Contractor Management Policy 	Number of Lost Time Incidents or Medically Reportable Incidents; Records demonstrate safe workplace.	H&S Management (OSHAS 18001)
3. Working Conditions for factories in developing countries	Comply with International Labour Standards and where local standards are higher to local standards	<ul style="list-style-type: none"> • No children under 15 in full time labour • No use of forced or compulsory labour • Does not engage in discriminatory practices • Freedom of Association and right to collective bargaining • Health care & Safety at work • Normal work week is 48 hours or less • No wage is lower than the applicable legal minimum 	Employees are provided with drinking water; clean toilets in adequate numbers; adequate ventilation and emergency exits. Employees receive pay slip; Accreditation to SA8000; Supplier has been audited by external body or customer.	Human Rights Act Local Legislation
4. Governance	Demonstrates commitment at Board level	<ul style="list-style-type: none"> • Corporate Policy • Inclusion of CR targets in CEO's performance review and remuneration • Whistle Blower Policy 	Corporate Policy; Transparent KPIs; CR Report; No public record of fraudulent activity	
5. Environmental Responsibility: Energy Efficiency	Company complies with existing and pending national and international legislation on the energy efficiency of products and the energy use of buildings it operates	<ul style="list-style-type: none"> • Emissions & Energy reporting • Reduce energy by x% p.a. • Reduce vehicle emissions by x% p.a. • Energy efficient design of products and buildings • Consider viability of renewable energies 	Carbon Footprint reported as tonnes of CO2 net emissions; ISO 14001	

<p>6. Environmental responsibility: Eco-efficiency</p>	<p>Products and production procedures which maximise eco-efficiency</p>	<ul style="list-style-type: none"> • Recyclable content of product is reviewed and audited • No over-packaging, Use of Reusable trays / shippers • Recover x% waste for recycling • Increase timber products sourced from sustainable certified forests by x% p.a. • Consider sustainable sourcing of raw materials • Reduce water consumption by x% 	<p>Reduction in waste to landfill year on year; Packaging Policy; Product Life Cycle Analysis; Profit from waste to energy system; Set target for waste management; FSC or other external accreditation, eg. MSC, or other accreditation; Water usage by person.</p>	<p>WEEE, EuP Proposal</p>
<p>7. Hazardous Substances / chemicals/ GMOs</p>	<p>Comply with existing and pending chemicals-related legislation. This might include legislation on product ingredients, product labelling and product disposal</p>	<ul style="list-style-type: none"> • Measures environmental impact of materials and processes • Identifies and acts on potential areas of concern 	<p>Hazardous Chemical register; Validate any adverse public concern by NGOs or other stakeholders; Transparent labelling; Environmental Choice</p>	<p>RoHS, REACH</p>

(Continued) Principle	Criteria	Examples	Performance Indicators	Regulatory Framework
8. Supplier Management	Commitment to local economies and reduced transport costs; Supplier relationships.	<ul style="list-style-type: none"> • Conduct review of supply base taking into account product source • Support economic sustainability of suppliers 	Programme to monitor local sourcing; Reduced transport costs; Work with key suppliers to ensure procurement policy does not unreasonably threaten supplier viability	

Source: NZBCSD, 2003

Appendix 5: List of common questions for CR issues at suppliers

This checklist can be used in the different phases of the procurement process (e.g. request for quotations, contracting, supplier audits).

1. General Questions
Does your company have a company representative for Corporate Social and Environmental Responsibility for addressing the Supplier Code of Conduct?
Does your company have procedures in place designed to ensure that the requirements set out in our contract and Supplier Code of Conduct are met in your company?
Does your company have procedures for internal reporting of any non-compliance with our requirements that may occur within your company?
Does your company have a Code of Conduct or standards of engagement to which you expect your suppliers to adhere?
Is your company currently subject to any enforcement action by any governmental authority for non-compliance with environmental, safety or labour requirements at any facility at which products supplied to our company are manufactured?
2. Labour and Employment
Does your company have a written labour/employment policy statement? If yes, does the policy statement include a commitment to continual improvement of labour and employment policy performance for its employees?
Does your company have a policy stating that there will be no child labour?
Does your company have a policy stating that all suppliers in your business must not use child labour?
Does your company have a procedure to ensure that no children will be hired?
Are documents supporting age information for all employees kept on record?
Does your company have a policy stating that no forced labour is used for worker employment?
Does your company have a policy stating that all suppliers in your business must not use forced labour?
3. Remuneration
What is the local minimum legal wage level? How does your company compare your employees' salary payment to your legal local wage level in the area?
Are wages paid to employees documented, and is this information stored for future reference?
How do you ensure fair compensation among different ethnic and gender groups?
Does your company have policies to encourage employees to receive training and education and award them for their skill and capability improvement?
4. Equal opportunity
Does the company treats its employment equally in employment and occupation regardless of religion, race and gender?
Is there a grievance system in place, which enables employees to come forward with cases of discrimination?
5. Association
What is your company's policy of respecting employee's freedom of association?

6. Community improvement

What does your company do to improve the quality of life in your communities, e.g. to help the community to improve welfare educationally, culturally, economically, medically and socially?

What does your company do to help employees from disadvantaged backgrounds?

(continued)
7. Health and Safety
Does your company have a written occupational health and safety policy?
Does your company implement working practices to prevent personal injury and damage to property?
Does your company provide its employees with training on healthy and safe working conditions?
Does your company provide annual physical exams for employees?
8. Environment
Does your company hold an ISO 14001 or EMAS certificate?
Does your company hold all necessary environmental licenses?
Does your company have a policy on hazardous substances?
Does your company consider the environmental performance of your suppliers?
Does your company have packaging guidelines?
9. Supplier Management
Does your company have a code of conduct or standards of engagement for suppliers?
Does your company set targets for suppliers?
Does your company assess existing suppliers against defined CR criteria?
Does your company assess new suppliers against defined CR criteria?
Does your company require your suppliers to have external certification?
Does your company work with your suppliers to develop greener solutions/reduce packaging waste/conduct Life Cycle Analysis?
Does your company audit your suppliers?
Does your company select suppliers because of their CR standards?
Has your company de-selected suppliers because of their environmental or ethical behaviour?
Does your company observe, use external validation and test documentation to validate your suppliers' response, e.g. regarding forestry, third-world practices, chemical management?
Does your company collate and record measurements and data?
Has your company increased/decreased your procurement team because of initiating RP procedures?
10. Fair competition
How does your company ensure fair competition during the process of your supplier selection?
How does your company prevent the offering, payment or acceptance of bribes during the process of your supplier selection?

Source: various supplier codes

CSR Sustainable production and consumption of textiles

– Interaction between fashion, outsourcing and cleaner production

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1 Introduction

The paper builds upon a number of studies of the dynamics in management of environmental impact connected to production and consumption of textiles and summaries these into important policy issues in relation to production and consumption of consumer products. The environmental impact connected to textiles is shaped by a) the use of chemicals, equipment and routines along the product chains from agriculture, chemical industry, textile industry, transportation and use; b) the globalisation of the textile sector implying increasing transportation and very complex product chains; c) the ongoing specialisation and changing fashion within textiles which imply increasing consumption of textiles among Western consumers.

Cleaner production programmes during the 1990's in a number of European countries focused on the national textile industry and obtained improvements in relation to chemical use and emissions to waste water. However, the impact of these programmes has been limited by the, almost parallel, substantial outsourcing of textile production to Eastern European and South East Asian countries. Some European countries have established environmental capacity development programmes in some of those countries, where to a substantial part of the European textile production has been outsourced. The impact of these programmes seems to be limited. The

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weak environmental regulation in many Eastern European and South East Asian countries imply that mainly companies that receive environmental demands from their European (or American) customers focus on reduction of environmental impact. However, a substantial part of the European textile industry and retail sector is not focusing on environmental impact related to the production and consumption of their products, but mostly on reducing costs and increasing the number of changes in fashion. The combination of the low cost and the fashion strategies has implied an increased consumption of textiles among Western consumers.

2 Theoretical background

A more sustainable development demands substantial changes in the production and consumption patterns in the Western world. It is not enough that a company here and there is developing a more green strategy. There is a need for sustainable transition within product and service areas towards reduced resource consumption and reduced use of hazardous chemicals. Transition is not happening from one day to the other. Analyses of experience with sustainable transition like the development of the Danish wind energy sector and the increase in the Danish use of wind power show that such changes might be very long-term processes with a complex and ongoing interaction between production, consumption, knowledge development and governmental regulation (see for example Karnøe and Garud, 1998). The analysis is based on Karnøe's and Garud's approach for analyses of the creation of new technological paths, which sees such creation as a combination of path creation and path dependency. The focus is on the shaping of new institutions, structures, new knowledge fields and on the re-use and re-shaping of existing institutions, structures etc.

The point of Karnøe and Garud is that the concept of "path dependence" implies that paths are created and that new paths therefore also can be created. What we need to understand is on the one hand what stabilises development paths or trajectories and on the other hand how new paths are created and stabilised. Path dependence is created through the building of institutions in terms of standards and rules, investments in facilities and technology in general and by the competence developing in the governmental institutions, companies etc.

The interaction between the systems of production, consumption/use, knowledge and regulation is in some literature described as a co-shaping or a co-evolution of production and consumption. Karnøe and Garud emphasise that the creation of new paths involves a complex process where each of the systems sometimes set frames for the further development of one or more of the other systems and sometimes adapts to conditions set by one or more of the other systems.

The focus on the four systems of production, consumption, knowledge and regulation does not imply that these systems are seen as homogenous units. It is important to be aware of the mechanisms of change within each of the systems. Local initiatives might disrupt existing structures and contribute to the emergence of a new system or they might become incorporated into

the existing system and thereby contribute to the continuity of the existing system. There might be a shift in relations over time in the relations from competitive to symbiotic relations and maybe back again (Schot et al, 2001).

All in all, technological changes must be understood as a constant process of interaction between actors with different frames of reference. This leads to a constant process of path dependence and path creation as actors reproduce, enact and negotiate with each other.

3 Material flows and environmental aspects related to textiles

The main focus in this paper is on the production and consumption of textiles and clothing, which includes garments and household textiles, like carpets. (When referring to the sector and its products in general, 'textiles' will be used as the overall notion) The aim is to present the overall challenges to sustainable production and consumption. The case demonstrates one example from the varied area of growing resource consumption and environmental impact from production and consumption, where the resource consumption and the environmental impacts are distributed along the production chain and prevention policies must focus not only on design and reuse but also on the patterns of consumption.

The textile and clothing industry is a very distributed and heterogeneous industrial sector. The textile and clothing chain is composed of a wide number of sub-sectors covering the entire production cycle from the production of raw materials (fibres) to semi-processed (yarn, woven and knitted fabrics with their finishing processes) and final/consumer products (carpets, home textiles, clothing and industrial use (technical textiles)). In 1999 the world production of fibres was 55% synthetics, 37% cotton, 5% celluloses and 3% wool.

Until 2005 textile and clothing was, as the only major manufacturing sector, subject to intensive use of quotas, which limited the export from certain countries, including China, to the US and EU. The cancellation in 2005 was part of the ATC-agreement (Agreement on Textile and Clothing) negotiated via WTO. The cancellation implied a huge increase in the import from China to the US (200%) and the EU (90%) and a decrease in the manufacturing in the US and the EU and in a number of developing countries. These changes were followed by a special transition agreement between the EU and China, which limits the increase in Chinese exports. The US imposed new quotas, also limiting the Chinese export (Promoting..., 2005) (ILO, 2005).

Like for other products the resource consumption and environmental aspects are important in all parts of the life cycle. For a piece of textile: from fibre production in agriculture (including natural fibres like cotton, wool and hemp) and chemical industry (including synthetic fibres from plants e.g. viscose or from oil and gas like polyester, polyamide etc.) to the discarding

after use in households, professional use etc. The resource consumption and environmental impacts can be related to:

- the impact of cleaner production in the life cycle based on substitution of chemicals, reduction of the amounts of hazardous chemicals etc.
- the impact of the changing fashion on the amount of textiles which the consumer has (the stock of textiles) and on the speed of discarding of textiles (the flow of textiles through the household).

The role and impact of cleaner production is related to the global structure of the sector. The outsourcing of a substantial part of the manufacturing of textiles from textile industry in Northern and Western Europe to especially Southern and Eastern Europe and Asia has in general implied a reduction in the level of environmental protection in textile manufacturing and implied, among others, an increase in the amount and hazardousness of waste. There seems to be differences in the level of environmental concern and management in different segments of the textile sector. Some Western companies set demands to their suppliers in other countries, while other companies do not set such demands. The demands of the domestic, national environmental authorities are limited in a number of the countries whereto the manufacturing has been outsourced, which implies that environmental demands often seem to be customer-driven. This implies that the level of environmental management in the textile industry in the countries with textile manufacturing differs quite a lot. It looks like the industry in the countries whereto the manufacturing has been outsourced can be divided into three parts: A) A part with the highest level of environmental protection due to environmental demands from Western customers, B) A part with medium level of protection which is not met with environmental demands from their Western customers, and C) The part of the industry, which primarily is serving the domestic markets and practices the lowest level of environmental protection (see for example (Robins & Roberts (eds.) 1997).

The consumption of textiles in the Western countries has been increasing since the 1960'ies. Behrendt et al (2003) reports an increasing amount of new clothing sales in Germany (figures are from the mid 1990'ies): 6 kg per inhabitant per year and 30 items per inhabitant per year. Røpke (2000) reports, based on data from John Hille from Idébanken in Norway, an increasing amount of new sales of garments and footwear in Norway. The number of new shoes from 2 pairs in 1960 to 4 pairs in 1996. Hille (1995) mentions a consumption of textiles and footwear (new sales) in Norway of around 50,000 tonnes, equalising 10-12 kg per inhabitant per year. The Norwegian consumption of clothes and footwear is estimated to have grown with 21% from 1997-1999 with a stable part of the costs for consumption (Hille, 2000), which points to a relative decrease in prices, probably due to increased outsourcing and stronger global competition

The geographical distribution and dynamics of the material flows are very complex due to the global structure of the sector. In order to illustrate this, the following paragraphs describe the international role of the textile sectors in Denmark and Thailand. An increasing part of the products sold in an industrialised country like Denmark is manufactured in developing or

newly industrialised countries. Furthermore an increasing part of the products exported from Denmark has in different extent been manufactured in developing or newly industrialised countries, while design and distribution still take place in Denmark (Stranddorf et al, 2002). This development is also seen from the fact that the employment in the Danish textile and garment sector decreased with around 40% during the 1990'ies (About the textile and garment branch 2001) and a similar decrease was seen for the total European industry (Walters et al, 2005). Around 2/3 of the Danish export is clothes (not necessarily manufactured in Denmark) and the remaining 1/3 textiles, which covers a number of different products like medical textiles, interior textiles (including carpets) and fabrics (manufactured in Denmark to a higher degree).

A country like Thailand has another role in the international structure of the sector. Around 2/3 of the Thai textile export is garments manufactured in Thailand and around 1/3 semi-manufactured materials like yarn and fabric for further manufacturing in other countries (Thai Textile Export 2003).

3.1 Environmental aspects and their constitution

Table 1 gives an overview of types of processes, environmental aspects and impacts in general and wastes in the life cycles of textiles. The table is not focusing on a specific type of textiles. The order of some of the processes differs, for example depending on the sequence of dyeing and sewing.

Some important actors in the environmental management and in innovation related to textiles are:

- Chemical industry (pesticides, chemicals for dyeing etc.)
- Fibre manufacturers
- Textile and clothes manufacturers
- Designers
- Textile and clothing retail chains
- Supermarket chains with sale of textiles and clothes
- National and local authorities (innovation, competitiveness, environment)
- EU (innovation, competitiveness, environment)
- Branch organisations at different levels
- International organisations like WTO, FAO and UNEP

Life cycle assessments of textiles show that the fibre production and manufacturing stages of textiles contribute significantly to the environmental impacts of textiles. The use stage may contribute to the biggest energy consumption if a textile is tumble dried. The biggest amount of product related waste is post-consumer textiles, which is either incinerated or land filled. Furthermore there is hazardous waste from the different steps of the production, especially due to the use of chemicals for fibre production and wet treatment in textile manufacturing. Waste water polluted with chemicals produce polluted sludge from wastewater treatment. In countries without wastewater treatment there is (of course) no polluted sludge from wastewater treatment, but in stead polluted wastewater. Besides wastes from the

Table 1: Overview of processes, resources and waste types in the life cycles of textiles. Source: based on Laursen et al (2006), Lewis & Gertsakis (2001) and Stranddorf et al (2002)

Processes	Characteristics of processes, environmental aspects and impacts and resource consumption	Types of waste generated
Fibre production, natural fibres	Toxic impacts from application of pesticides in the growing and processing of natural fibres. Water consumption for cotton growing Energy consumption for production and application of pesticides and fertilisers	Packaging from pesticides and excess of pesticides (e.g. expired stocks) Organic waste polluted with pesticides from growing and handling of cotton and harvesting and handling of wool
Fibre production, synthetic fibres	Consumption of oil and natural gas in the production of synthetic fibres and of chemicals in the processing of natural fibres for synthetic fibres	Hazardous waste from use of chemicals
Spinning, knitting, weaving	Consumption of chemicals for increased speed of processes High level of polluted dust and of noise at workplaces	Dust polluted with chemicals from fibre production and from spinning etc. Polluted sludge from waste water treatment
Wet treatment	Consumption of water and chemicals for bleaching, dyeing, waterproofing, surface treatment for dirt repelling, fire retarding, printing etc. Wastewater pollution	Hazardous waste from handling of chemicals Polluted sludge from waste water treatment
Cutting, sewing and packing	Manual and mechanised work Monotonous work High level of dust at workplaces	Cuttings and trimmings, polluted with chemicals from previous parts of the production
Distribution and sale	Consumption of fuels for transportation with ships, air planes and/or lorries	Transportation packaging (cardboard boxes, plastic bags)
Use stage	Consumption of water, detergent and energy for washing and drying Waste water pollution from washing Chemical consumption for dry cleaning Energy consumption for ironing	Packaging (plastic, cardboard, paper) Waste water sludge polluted with detergents and excess chemicals from the clothes, including softener from PVC prints on clothes
Post-consumer handling	Second hand sales for reuse of textiles Recycling of fibres	Discarded clothes
Waste handling	Incineration Land filling	Small contribution to slag from incineration of metal bottoms etc. Waste from incineration of PVC

production of textiles, there is a substantial amount of indirect waste from energy production from fossil fuels (ashes and dusts) for production, washing and drying. The energy-related waste contributes most to the generation of solid waste, ashes and radioactive wastes (Laursen et al 2006).

A minimisation of the resource consumption and the environmental impacts can take place through consumption of fewer textiles, and through cleaner production strategies aiming at reducing the amount and toxicity of chemicals during the production of fibres and textiles. Due to the big environmental impact from the production stages of textiles prevention through extended life time, reduced consumption, and reuse of textiles and minimisation through recycling of textiles are potentially very important strategies from an environmental point of view. The big environmental impact from the production stages imply that cleaner production during the production of textiles can reduce the environmental impact substantially, including the hazardousness of waste, for example through the use of organic cotton or substitution of chemicals for wet treatment processes (Laursen et al 2006).

The consumption of pesticides for cotton growing is very intense. Hille (1995) mentions that while 2.3% of the cultivated land was grown with cotton 18 % of the pesticide consumption was used on this land. Lewis and Gertsakis (2003) mention that around 10% of the world's pesticide consumption and 25% of the insecticides produced are used in cotton growing.

A Danish study of the washing out of chemicals from textile and clothing showed a big variety in the percentage of the wash out (from 0.1% to more than 100% (because some chemicals also are created during washing)). 12 chemicals are assessed as causing problems in the aquatic environment (and thereby also in waste water sludge). 6 chemicals might have effects and 7 chemicals could not be assessed due to lack of information. 20 chemicals pose risks to some extent to consumers and employees in the retail sector (Laursen et al, 2002). These chemicals will potentially also end up in the waste streams from discarded textiles in the post-consumer phase.

The amount of textile waste in household waste seems to be around 2-3 % w/w (Eunomia Research & Consulting, 2006). Behrendt et al (2003) mentions an amount of clothing waste at the consumer stage in Germany of around 960,000 tonnes in 1995, equalising around 12 kg per inhabitant.

4 Policies influencing environmental aspects and innovation

In the following an overview of the type of regulation influencing environmental impacts and innovation in the textile sector globally is provided and the interaction between environmental policies and innovation analysed. The paragraph discusses the international regulation of chemicals including pesticides and textile chemicals, the EU IPPC Directive, the EU Eco-label and the *lack* of focus on the size of the consumption of textiles.

The textile sector has been part of the primary concerns of cleaner technology programs and local environmental regulation schemes in Denmark (Søndergård et al, 2004) and in other Western European countries. Several studies have analysed the dynamics of this development and interaction. The preventive activities in the textile sector have had the following path:

1. Mid 1980s: environmental surveys
2. Beginning of 1990s: demonstration and technical development,
3. Mid 1990s: general projects and attempts to create a product-oriented approach
4. End 1990s and onwards: product orientation with focus on eco-label scheme and sector-based policy network

4.1 Policies regulating chemicals in fibre manufacturing

Since the environmental impacts throughout the textile sector are influenced by the use of chemicals in the life cycle, it is important to look at the regulation of chemicals used in the sector. New chemicals are increasingly being approved under the European system; for agricultural pesticides this process is conducted under the Authorisation Directive 91/414. Under the EU system the active ingredients in pesticides are assessed by a committee of Member States, and if they are shown to be acceptable they are entered on a list of substances known as 'Annex I listing'. Once an active ingredient has been listed, formulated products containing the active ingredient can be approved in Member State countries for specified uses. The review of pesticides registrations by the European Union (EU) resulted in the withdrawal of 320 pesticides in July 2003 and more were withdrawn later at the end of 2003. At present, there are two parallel systems for the approval of pesticides in EU member states. Under the first system, the scientific evaluation of pesticides is carried out at the national level. However, this is gradually being replaced by a system in which a major part of the scientific evaluation is carried out by the European Commission. The review is due to be completed by 2008 (EU pesticide review leads...).

Since the major part of the cotton used in European textiles are harvested outside of Europe the international regulation of chemicals is important. The Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade came into force in 2004 and had been implemented on a voluntary basis since September 1998 in the form of the interim PIC procedure. The Convention started with 27 chemicals (including 22 pesticides). PIC is a procedure that helps participating countries learn more about the characteristics of potentially hazardous chemicals that may be shipped to them, initiates a decision making process on the future import of these chemicals by the countries themselves and facilitates the dissemination of this decision to other countries. The aim is to promote a shared responsibility between exporting and importing countries in protecting human health and the environment from the harmful effects of certain hazardous chemicals being traded internationally. The PIC procedure is implemented jointly by FAO and UNEP through the FAO/UNEP Joint Programme for the Operation of

PIC (Rotterdam Convention..., 2004) Rotterdam Convention Secretariat, 2006) (Sustainable Agri-Food Production and Consumption Forum, 2006).

Organic growing of organic cotton should also be seen as a cleaner production strategy, since it prevents (among others) the use and emission of pesticides. Today a certification of the farm is needed in order to secure customers that the practice actually is following the organic rules. This is expensive to the farmers in developing countries. There has been and are currently projects aiming at building certification capacity in countries in transition (like the Balkan countries and Ukraine) and developing countries (like Vietnam and India), so that advice and certification can be conducted by local organisations and companies. A number of the current projects are managed by Helvetas, a Swiss development aid organisation (Helvetas, 2006).

4.2 Policies regulating textile industry

Some activities in the textile industry are regulated via the EU IPPC Directive (IPPC Directive, Council Directive 96/61/EC). According to the IPPC Reference Document on BAT (BREF note) for the textile industry 'the main environmental concern in the textile industry is about the amount of water discharged and the chemical load it carries. Other important issues are energy consumption, air emissions, solid wastes and odours, which can be a significant nuisance in certain treatments' (IPPC, 2003). The document recommends technologies and proposes acceptable emission levels. Walters et al (2005) questions the level of environmental protection secured by the BREF note. For example, they find it strange that the BREF note recommends the use of a process for wool scouring, where trichloroethylene is used, in order to wash out pesticide residues of the lanolin from the wool, since the solvent is classified as carcinogen and the BREF note accounts for the fate of half the solvent used as 'un-captured loss'.

Partly prior and partly parallel to the implementation of the IPPC Directive and the shaping of the BREF notes, cleaner production programmes have been set up in several European countries. There is no overview of how many of these programmes that had or have focus on the textile industry, but at least in Denmark and the Netherlands there has been focus on the textile industry. The Netherlands and Denmark have also transferred experiences to the Central and Eastern European countries (Wenzel et al, 1999; BECO Group Project Profile, 2006). The Netherlands is also involved in financing cleaner production programmes to the textile industry in Pakistan, one of the countries with export of fabrics and textiles to Europe (see for example (NEC Projects..., 2006)). Similar programmes have also been organised in India and Vietnam, other important Asian textile manufacturing countries. These programmes have the potential to limit the hazardousness of the chemicals used for textile manufacturing and thereby the local environmental impacts, but also the hazardousness of post-consumer textile wastes in Europe. There is no joint overview of the impact of these programmes.

4.3 Product-related policies and actions

During the 1990ies, some European governments developed restrictions to the residues of chemicals in textiles and clothing due to the long-term skin contact, which means that this regulation is based on a health concern. Especially the German government's ban of azo-dyes has had big impact throughout the sector and was later the background for an EU ban of 22 azo-dyes that can release aromatic amines (some of which are carcinogenic) at concentrations higher than 30 ppm. Other chemicals, where the residues in the final product are regulated by a number of countries, are pentachlorophenol and its compounds, PCB and PCT (can be used as textile softener), harmful heavy metals (including nickel) and formaldehyde (Policy Research Center for Environment and Economy, 1999). Ökotex 100 is a related privately organised product labelling scheme, which restricts the content of formaldehyde, heavy metals and other chemicals from the textile and clothing manufacturing and also on pesticides from fibre growing, harvesting etc. Some textile companies use the ability of suppliers to be approved according to Ökotex 100 as a kind of quality check for the capacity of the supplier (Stranddorf et al, 2002).

Similar to other industries different corporate strategies towards governmental regulation is seen: front-runner strategies and more reacting and adapting strategies. Danish front-runner companies translated for example themselves the societal discourses on pesticides and on PVC into preventive action (Forman et al, 2003).

Another type of product-related regulation is eco-labelling. The EU Eco-label is based on Regulation 880/92 from 1992 and revised in 2000 (Regulation 1980/2000). It is a market-based instrument that is meant to stimulate both the supply and the demand of products, which have reduced environmental impact in different parts of the life cycles of a product group. The European Union Eco-labelling Board (EUEB) develops environmental criteria for product groups in collaboration with the Commission. The actual development of a proposal for the criteria is done by an ad hoc working group with national representatives from EUEB and coordinated by one of the countries, often a country with an economic interest in the product area (Tanasescu, 2005). A company applies for a license to its national so-called Competent Body, which awards the label, after the approval has been announced in an official EU newsletter. The criteria document is revised every 5 years. Earlier this period was shorter, but in order to give the innovation activities in industry the best conditions the period of validity was extended. When a new set of criteria is approved, are also those aspects, which will be considered for inclusion in the next revision, announced in order to give industry better opportunities for making innovations, which may be eligible for a longer period.

The eco-label criteria for textiles and clothing contain demands to limits to toxic residues in the fibres and air water and pollution during fibre processes. Furthermore the criteria have limitations to the use of substances harmful for the environment in the production, use and end of life of the textiles. There are for example limitations to the level of impurities, the level of formaldehyde, heavy metals, PAH and COD in wet processes. Finally the

criteria also have demands for the quality of product like colour fastness and shrinkage (EU Flower Criteria..., 2002).

The EU-labelling scheme is not a success at EU level in relation to textiles, since a small country like Denmark has around 40% of the licenses (27 out of around 64 licenses in 2006) (Ecolabel Companies by Country and Product Group, 2006). Some of the barriers seem to be lack of knowledge about the eco-labelling scheme and the costs for obtaining and having a license (0.15% of the product's annual sale in the EU up to a maximum level). There is awareness about the indirect uses of the eco-label criteria (in general, not necessarily specifically for textile products). The criteria might be used by other eco-labelling schemes, in public and private procurement calls for tenders, by companies as a benchmark for their own products, and to generate environmental product declarations (Tanasescu, 2005). A Global Eco-labelling Network (GEN) has been organised in order to allow for mutual recognition of eco-labelling scheme and thereby avoid that these schemes act as trade barriers. Many of the members are Asian countries, but also a few European ones, including Denmark.

Eco-labelling schemes have been a topic for discussion and disagreement in WTO. The background is that the governments of some countries claim that the criteria concern processes and production methods (PPM) in the manufacturing country, which is not eligible in WTO, unless the criteria also improve the impact on the consumer or the environment in the country where the product is sold. The EU has changed its eco-labelling scheme in order to make it more eligible in a WTO context by allowing companies outside EU to apply for a license.

4.4 Extended product life time and utilisation of textile products

The ever-changing fashion of textile and clothing combined with the relative reduction of prices on textiles and clothing sold in some parts of the retail sector has implied an increase in the amount of clothing items many citizens have, as mentioned earlier, but it is not an issue addressed by the governments in the Western countries. Røpke (2000) mentions besides ever-changing fashion also the product diversification as a driver behind the increased sale/purchase of products. The citizens are for example not (just) having a big amount of the same type of shoes, but also different shoes for different purposes and occasions.

This increasing purchase and stock of products imply, together with the outsourcing of the industry, bigger resource consumption and bigger environmental impacts from production and consumption (laundry etc.). The increased impacts are due to the relatively lower level of environmental protection, which characterises most industries in developing and newly industrialised countries. The toxicity of the chemicals is addressed by the eco-labelling criteria, but the increasing amount of clothing items is not addressed by governmental regulation. Four types of private initiatives have been identified:

- extension of product life through the design of the product

- extension of material life time by closed material loops organised by a product service carpet manufacturing company
- extension of product life time through second-hand shops
- increased use of a reduced number of products through schemes for sharing or renting of textiles and clothes.

A carpet manufacturing company has organised itself as a product service company, which owns the carpets files, while the customers buy the service of having a floor covered with carpet. The business model reduces the amount of waste and has in a combination with several initiatives focusing on use of natural fibres and substitution of hazardous chemicals implied a reduction of the amount and the hazardousness of the waste (Lewis & Gertsakis, 2001).

In the European Union, consumers discard every year 5.8 million tons of textiles. Around 2001 only about 1.5 million tons (25%) of these post consumer textiles were recycled by charity and industrial enterprises. About 1 million tons of these were exported directly to Third World countries and about 0.5 million tons was converted to various products and sold inside the European Union. The remaining 4.3 million tons (75%) of these post consumer textiles are land filled or burnt in municipal waste incinerators, representing an unused source of raw materials. Of the 0.5 million tons that is recycled, the main applications are wiping rags, fibre production and application in the paper industry (Innovative technologies for ... 2001) (Woolridge et al, 2006).

The German textile company Hess Natur has taken two initiatives to reduce the resource consumption by reducing the number of clothes, which a consumer needs. They have designed a so-called 'long life collection' of classical clothing that is said to be unlikely to go out of style and which can be combined with other items over a much longer time-span than normally. Furthermore they have established a lending service for wedding outfits, because these otherwise very often would be used once (Paulitsch, 2001). An analysis of the practice and future visions for so-called eco-services based on renting, leasing, sharing and pooling, reports within the area of textiles and clothes only about renting of tents and about nappy laundry services (Behrendt et al, 2003).

5 Effectiveness of policies and future challenges

Cleaner production programmes during the 1990'es in a number of Western European countries have focused on the national textile industry and obtained improvements in relation to chemical use and emissions to waste water and have thereby obtained a reduction in the environmental impacts from Western textile manufacturing. However, the impact of these programmes has been limited by the, almost parallel, substantial outsourcing of textile manufacturing to especially Eastern European and South East Asian countries. Furthermore, have the global structure of the cotton production, the diverse structure of cotton growers and the substantial purchase of cotton via cotton exchange limited the possibilities for prevention of chemical wastes at the source. Some European countries have

established environmental capacity development programmes in some of the countries, where textile manufacturing has been outsourced. The impact of these programmes seems to be limited, because of the weak environmental regulation and public environmental discourses in many Eastern European and South East Asian countries. This seems to imply that mainly companies, which receive environmental demands from their European (or American) customers, focus on reduction of environmental impacts. However, a substantial part of the European textile industry and retail sector is not focusing on environmental impact related to the production and consumption of their products, but mostly on reducing costs and increasing the number of changes in fashion, which all in all points to a limited impact from these programmes. The efforts to promote eco-labelling schemes could potentially influence the upstream manufacturing in other countries. However, the eco-labelling strategy has only demonstrated little quantitative impact on the textile manufacturing and consumption patterns even though the industry, in some countries, have been advised how they can obtain eco-label licenses, which are not limiting the possibilities for innovation and fashion changes. If the industries apply for licenses that cover material types and processes, and not a specific product, fashion changes may not demand a new application.

The low cost strategy and the strategy of product differentiation and changing fashion have implied an increased consumption of textiles among Western consumers and thereby an increase in the amount of post-consumer solid waste **and** in the environmental impact along the product chains of textile production. A preventive policy should emphasise the role of the Western textile importers and retailers and encourage them to use their capacity in demanding and supporting upstream improvements in their textile product chains. This is even more important since a part of the competition in the textile sector is pushing for lower prices and even more short lived, fashion based consumption, which leads to pressure for lower qualities with shorter product life time, and probably less environmental consciousness in the upstream product chain.

There is a need for the future REACH scheme to address this upstream use of chemicals and the impacts from manufacturing in developing countries and from the use and laundry phase in the European countries. The emissions or discharges during the use phase should not be seen as unintended (or incidental) discharges, which – according to the present outline of REACH - could allow the textile importing companies not to care about the chemicals being used upstream. Such a translation of the REACH scheme in the ongoing RIPs (REACH Implementation Projects) would limit the role of REACH in the regulation of the big amount of chemicals in the textile sector to nearly nothing. Given the fact that there are substantial releases of some chemicals during especially the laundry part of the use stage, such a translation in the shaping of the future REACH scheme will fail to address this issue.

Another future challenge to the textile waste management comes from the increased innovation of so-called technical textiles utilising new materials and chemicals in treating textiles for specific properties of use or fashion, including electronic textiles, where electronic components are

integrated into the single piece of textile or clothes. This implies that a part of the future textile waste need to be handled as potential hazardous or electronics waste. If these products also are manufactured in countries with a low level of environmental protection – which at least might be the case for chemically treated textiles for water and smell resistance – the content of chemicals, heavy metals, and the types of plastic used might imply not only environmental problems from the manufacturing, but also in the laundry and in the post-consumer waste handling.

A future strategy for a more sustainable production and consumption of textiles (and other similar consumer products) needs to build on a global life cycle and supply chain approach. It should combine elements like stronger enforcement of measures for transnational regulation of upstream manufacturing of products. This could be mandatory eco-labelling or environmental product declarations in order to get a higher degree of management and/or transparency of the upstream processes. Furthermore support to environmental and consumer organisations in Western countries and Eastern European and South East Asian countries for capacity building around environmental impact from production and consumption and increased ability to create national and transnational focus on the environmental impacts from production and consumption, including the closer links between the two ‘types’ of impact. Finally, there is need for stronger enforcement of international regulation of chemicals for agriculture and industry, and increased taxes on fuel in order to limit the transportation mileage for transportation of parts for consumer products and of finished consumer products.

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CSR Managing Sustainable Product Development

With a Case for Passenger Vehicles

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1 Introduction

1.1 Sustainable Product Design and Development

Sustainable product design aims in merging good design and sustainability.

Design has in particular the dimensions of function and aesthetics (ratio and emotions). Good design is the prerequisite for market success as often only an emotional design attracts customers – in particular looking at luxurious products. Good functionality of a design is important for the use intensity of the product. Aesthetics should follow function or vice versa – depending on the perspective.

Sustainable development is defined by meeting ‘the needs of the present without compromising the ability of future generations to meet their needs’ (United Nations, 1987). Normally, this approach refers to three dimensions – environmental, social/societal and economic. Other definitions mention 8 or more dimensions of sustainability - physical, properties, environmental, economic, social, equity, cultural, psychological, ethical (Bossel, 1998). However, also the organisational aspects are of importance.

Sustainable Product Design is a subset of a broader approach towards a Sustainable Product Development that looks beyond product design aspects also at other strategies to improve the sustainability of meeting needs – by products, services and/or organisational aspects. Available strategies can base for example on the following concepts:

- Classical Design-for-X (with X = Disassembly, Recovery, Environment) or Cradle-to-cradle design or sustainable product design.
- Product Service Systems.
- Sustainable Life Cycle Management.

1.2 Sustainable Mobility

Depending on the type of need the focus is on one or the other solutions. For the area of sustainable mobility solutions may be found in three areas:

- Technology
- Systems & Infrastructure
- Behaviour.

Technology aspects relate for example to further improved high tech gasoline and diesel engines, flexible fuel vehicles (FFV) or other alternative fuelled vehicles, hybrid solutions or long-term fuel cell vehicles. All these technologies aim at further reducing CO₂ emissions from vehicles. Also other Design-for-X solutions are mainly technology-related.

System and infrastructure aspects include for example the density of filling stations for modern fuels. Also social and environmental supply chain aspects have a striking role. Service approaches as mentioned earlier are system related solutions.

Behaviour related aspects can be best explained looking at the huge potential of a driving pattern that is safe and fuel efficient.

The three mentioned sustainability mobility solutions can be applied to all life cycle phases of mobility. Each life cycle stakeholder group has specific roles and responsibilities in order to achieve more sustainable performance. The paper provides examples of these roles and responsibilities of life cycle stakeholder as part of a Life Cycle Management (LCM) concept. One aspect for automotive manufacturers besides innovations is also the day-to-day management of product development. The paper is detailing in particular the latest approach of sustainability management within product development based on the Product Sustainability Index (PSI).

2 Sustainable Life Cycle Management

2.1 Fundamentals

The fundamental idea of sustainable life cycle management is the concept of a shared responsibility of all life cycle stakeholders. Along the product life cycle different stakeholders have opportunities to improve social, economic and environmental aspects. All stakeholders have up-stream and down-stream partners. The resulting interfaces can be utilised to provide incentives for life cycle partners to improve their performance. Part of this concept is to look for most efficient solutions along the life cycle. This can be done based on tools addressing the dimensions of sustainability (Life Cycle Assessment, Life Cycle Costing and Social Life Cycle Assessment; see <http://www.life-cycle-management.eu>).

Table 1 lists the roles of the direct life cycle stakeholders to improve the environmental, social and economic performance of products and services. This sustainable life cycle management can be initiated by each of the life cycle stakeholders. While big corporations may have advantages in organising life cycle management (purchasing power, available resources, lower dependency on few consumer) in reality also small companies have their opportunities (lower number of products, processes and departments, faster and better internal communication, easier decision structure).

Table 1: Role of life cycle stakeholder to improve the environmental, social and economic performance of products and services – based on (Schmidt, 2001)

	Role of industry (manufacturers and suppliers)	Role of consumer (users / end-users)	Role of companies in the disposal / recovery business
Up-stream in the life cycle	Sustainable Supply Chain Management (social & environmental minimum standards)	Purchasing sustainable products (fair trade, green products) accepting premium.	Information to end-user
Own life cycle stage	DfE / cradle-to-cradle design, Sustainable design, environmental management, social standards, corporate citizenship	Sustainable use / consumption, following use instructions, minimise consumption of energy & materials	Establishing sustainable recovery routes generating competitive products
Down-stream in the life cycle	Product information & training, sustainable dealer standards	Directing products and materials to the appropriate collection / disposal / recovery facilities	Information to producers, sustainable supply of recovery products.

DfX = Design for Environment

Note: simplified table – other, indirect stakeholders (for example investors, banks, research institutes) have also roles to provide incentives for the listed direct stakeholders (for example by providing capital for sustainable investments).

2.2 Examples of passenger vehicles

There exist numerous examples for each of the entries in Table 1 – some of them detailed in (Schmidt, 2001). For example, the development and mass production of sustainable propulsion technologies, offering the necessary fuel infrastructure (fuel development & filling stations), safe eco-driving (Hennig 2001) and the generation of recyclates. However, the efficiency of these measures is quite different (Table 2).

Table 2: Efficiency of exemplary actions of different life cycle stakeholder for passenger vehicles

	Propulsion technique 1	Eco-driving	40 kg recyclates*
Life Cycle Global Warming Potential	- 15%	- 25%	- 0,03%
Summer Smog Potential	- 20%	- 30%	Close to zero
Life Cycle Cost	- 1 %	- 5%	Close to zero
Other Impacts	Image	Safety, drive-by-exterior noise	Use of sustainable materials

* It is not suggested that it is reasonable to introduce 40 kg recyclates in passenger vehicles.

Obviously, the main stakeholder impacting important environmental, social and economic parameters is the consumer. But also the team work of different stakeholders is crucial. This can be best demonstrated looking at alternative fuelled vehicles that need the support by the vehicle producer

(offering these vehicles), fuel supplier (work on alternative low carbon fuels and ensure widespread availability of these fuels to the consumer) and consumer (accepting premiums and a maybe lower density of filling stations, applying eco-driving). Such an integrated approach is the best way to efficiently and effectively improve key impacts of vehicles.

The example of passenger vehicles can illustrate also the important role of governments shaping in particular consumer purchasing and driving behaviour in a more sustainable way. For example, tax incentives for vehicles with improved environmental performance (for example CO₂ based taxation schemes) are often necessary to generate a sufficient market demand for these vehicles. However, to avoid market distortion these incentives should not be technology prescriptive – for example preferring vehicles using a certain alternative propulsion system (for example full hybrid vehicles) while conventional propulsion technologies (gasoline, diesel) can achieve the same objective. It is also crucial that policy makers create a reliable, non-contradictory framework where different regulation is do not cancel the effects of each other.

3 Sustainable Vehicle Design

3.1 Context of Sustainable Vehicle Design

The concept of a shared life cycle stakeholder responsibility is not meant as a proposal that stakeholders have no unique roles for their own life cycle phase. However, the description of the concept of sustainable life cycle management serves as a description of the broader context of sustainable vehicle design.

Besides the general positioning of sustainable vehicle design within a sustainable life cycle management also the organisational context has to be clarified. It is of utmost importance in complex, big corporations to make the individual departments / organisations directly responsible for that specific aspect of sustainability that can be impacted by their area of responsibility.

Main affected departments include Product Development, Manufacturing but also Human Resources and External Affairs. Each main functional group translates the meaning of sustainability to their own area. This is the best way to allocate understanding, ownership and responsibilities in a complex organization. In the case of automotive products Product Development needs very long lead times, longer than any other of the above mentioned functions – changes in methods take several years to trickle through buy-in, cycle planning, kick-off, development and launch. PD also has a greater impact on automotive products compared to other organisations of automotive manufacturers.

Sustainable vehicle design is a challenge looking at the complexity of the passenger vehicles where engineering management as well as design engineers need to cope with a global supply chain, a as well as thousands of technically challenging components linked with sever quality, technical, process and infrastructure constraints. This requires a company-specific solution rather than a one-size-fits-all approach. One of Ford of Europe's solutions for managing a sustainable product development is the Product Sustainability Index (PSI).

3.2 Ford of Europe's Product Sustainability Index (PSI)

While there is so far no international standard for measuring the product sustainability there is a common understanding that life cycle thinking should be the basis of such an approach (VDI, 2006). Therefore, the chosen PSI indicators are partly based on ISO14040 (Life Cycle Assessment) and the current work of SETAC Europe on Life Cycle Costing (SETAC, 2006). Part of the additional guiding principles for the inclusion of indicators in the PSI had been the following management directions (Schmidt and Taylor, 2006):

- Key environmental, social, and economic vehicle attributes only
- Controllable (mainly influenced by the Product Development department, not by other functions).
- No additional data need (regular status tracking possible based on readily available product development data).
- Bottom-line issues only (no technologies as alternative fuels but the overall life cycle impact).
- Reduce to a manageable amount of indicators.

PSI is not reduced to a single score as sustainability is by definition not one-dimensional but always measured by different indicators. Further reasons have been shared in a previous paper (Schmidt and Sullivan, 2002).

Other sustainable mobility aspects - in particular service aspects - are not covered as not appropriate on the engineering level. Also legal compliance issues as recyclability are not covered within PSI as these are base line requirements. Some recycling requirements may not even add environmental benefits as outlined in a previous paper (Schmidt et al 2004).

The resulting PSI indicators are (Schmidt and Taylor, 2006):

- Life Cycle Global Warming Potential (Greenhouse emissions along the life cycle – part of an LCA according to ISO14040)
- Life Cycle Air Quality Potential (Summer Smog Creation Potential (POCP) along the life cycle (VOCs, NO_x) – part of an LCA according to ISO14040)
- Sustainable Materials (Recycled & natural materials. Note. All materials are linked to environmentally, social and economic impacts and cannot be inherent sustainable. However, recycled materials and renewably grown, natural fibres represent a kind of role model how limited resources can be used in a sustainable way. Overruling is the question whether these materials have – in their specific application – a lower environmental impact along the product life cycle compared to potential alternative materials)
- Restricted Substances (Vehicle Interior Air Quality / allergy-tested interior, management of substances along the supply chain; 15 point rating).
- Drive-by-exterior Noise
- Safety (pedestrian and occupant)
- Mobility Capability (Mobility capacity (luggage compartment volume plus weighted number of seats) related to vehicle size. This is an indicator in transition towards an indicator covering also aspects of providing mobility services to disabled)
- Life Cycle Ownership Costs (Vehicle Price + 3 years fuel costs, maintenance costs, taxation, insurance minus residual value).

The implementation of PSI has been done in a process driven, top-down approach. Process-driven, as PSI has been linked in the existing Ford Product Development System from the very beginning. For example, Ford's PSI is included in particular in the companies' "Multi-Panel Chart" where all vehicle attributes (craftsmanship, safety, environment, costs, etc.) are tracked, through all the development milestones, against the approved vehicle program targets. Vehicle Integration engineers have been made responsible by the specific vehicle program management to track the performance of the vehicle against the targets. The PSI targets are determined from already existing targets as listed in other sections of the "Multi-Panel Chart" (e.g. fuel economy) as well as PSI specific targets not covered otherwise (e.g. related to the maximal impacts from the selected materials). PSI reflects the overall impact of the different vehicle attributes and makes the trade-offs visible (e.g. between life cycle global warming potential and the life cycle cost of ownership).

In a top-down approach, senior management demanded and finally authorized PSI in autumn 2002. The roles & responsibilities have been agreed in a way that mainly all actions and responsibilities are conducted by Product Development itself without using a central staff organization (exemption: development of methodology). This way, an optimal integration of PSI is ensured – i.e. sustainability is not the responsibility of specialists (within or outside Product Development) but is executed by the same people running other aspects of the vehicle development.

A comprehensive but very simple spreadsheet file has been developed by a Ford LCA specialist to enable non-specialists to track PSI. This tool has been verified against detailed ISO 14040 external reviewed LCAs (Schmidt and Butt 2006). Based on the central input of few and select data, the PSI – including the simplified Life Cycle calculations – are tracked from the very beginning of the vehicle development throughout its end. Almost all data used had been anyway readily available in the above mentioned "Multi Panel Chart". Few additional data have been needed (for example any material changes and data about air-conditioning systems). With around 1 hour training, the responsible engineers have been in the position to understand the concept, use the above mentioned file and conducting simplified Life Cycle avoid unnecessary bureaucratic burdens or the need for additional resources while ensuring that sustainability is an integral part of the complex product development process.

The described approach is designed to fit perfectly to the Ford design processes and culture. It is not suggested that this approach necessarily fits to other company cultures or markets as the methodologies and approaches cannot be generalized. Any mandatory approaches would be counterproductive. Sustainability can only work based on internal understanding, drivers, motivations and commitment rather than law and order. PSI is a voluntary approach aiming at integrating environmental, social and economic aspects in the product development as part of Ford's commitment towards sustainability and creating dialogue around these issues.

3.3 PSI application for Ford Galaxy and Ford S-MAX

The first design team that used PSI from the beginning developed the new Ford Galaxy and Ford S-MAX. Four vehicles have been assessed:

- New Ford Galaxy 2.0 l TDCi with DPF Trend edition,
- New Ford Galaxy 2.0 l, Trend edition,
- New Ford S-MAX 2.0 l TDCi with DPF Trend edition,
- New Ford S-MAX 2.0 l, Trend edition.

Note: DPF = Diesel Particulate Filter

The environmental, economic and social performance has been compared to the prior Ford Galaxy (1.9l TDI, 96 kW, manual 6 speed version). Within Vehicle Integration engineers have been made responsible for tracking the status based on the input collected in the “Multi-Panel Chart” and few additional key data specific for PSI. The additional PSI data related to the material breakdown of the different vehicles have been derived from complete teardown data of the predecessor models, weight assumptions as well as weight actions and finally International Material Data System (IMDS) data. Towards the end of the development, an additional verification study has been performed by a corporate LCA specialist. The PSI, as well as the internal verification study, has been successfully reviewed by two external reviewers – Professor Dr David Hunkeler (former Universities Vanderbilt in Nashville/USA and Lausanne/Switzerland) and Prof Dr Walter Klöpffer (University of Mainz/Germany) - according to ISO 14040. One of the important findings has been that the life cycle calculations done by the non-experts based on a simple spreadsheet file are fully in line with the results of a more detailed study performed by the LCA expert based on an expert tool (IKP and PE, 2005) (calculated absolute figures are less than 2% below; the relative results are the same).

The PSI application itself (without expert verification study and external review that are not necessary for the internal usage of PSI as a sustainability management tool) is done efficiently. Due to the focus on available data as well as a simple spreadsheet file the incremental resources needed for the management tool itself has been rather low (approx. 10 –15 hours for the whole product development process). However, the efforts for the verification study and the external review are much more significant. This has been only done in this specific case because Ford Galaxy and S-MAX have piloted the PSI application. The verification study allowed to get a better confidence about the accuracy of the PSI calculations while the external ISO 14040 review allowed the publication of the taken efforts.

The PSI status has been tracked for different Gateways (Kick-off (KO), Program Approval (PA), Program Readiness (PR) and Change Cut-off (CC)). Table 3 summarizes the results for the studied diesel powered Ford vehicles.

4 Summary

Managing a sustainable product development is a challenge including and beyond managing the design in a sustainable way. Ford of Europe’s Product Sustainability Index (PSI) can be seen as an example for a sustainability management tool that efficiently guides the development of passenger vehicles. However, this is only one tool in a set of tools covering the different functional areas of an automotive manufacturer.

In addition, an integrated approach is necessary to gain additional improvement potentials. This sustainable life cycle management is a central approach to efficiently improve the environmental and socio-economic performance of products as passenger vehicles.

Table 3: PSI results of diesel powered Ford Galaxy and Ford S-MAX

Indicator	Previous Ford Galaxy 1.9 L TDI	Ford Galaxy 2.0L TDCi with DPF	Ford S-MAX 2.0L TDCi with DPF
GWP [t CO ₂ -eq] ⁽¹⁾	41	40	39
POCP [kg Ethene-eq] ⁽¹⁾	39	37	37
Sustainable Materials (note: figures may change)	Approx 1 kg	Approx 18 kg	Approx 18 kg
Restricted Substances	Substance management, pollen filter	Substance management, TÜV tested pollen filter efficiency and allergy-tested label ⁽²⁾	
Drive-by-exterior Noise dB(A)	73	71	71
Safety	Reference ⁽³⁾	Significant improvement targeted ⁽⁴⁾	Significant improvement targeted ⁽⁴⁾
Mobility Capability	9,9 m ² , 7 seats, 330l	10,4 m ² , 7 seats, 435l	10,25 m ² , 5 seats, 1171l
Theoretical Life Cycle Ownership Costs ⁽⁵⁾	Reference	5 % lower costs	10% lower costs
<p>⁽¹⁾ based on PSI calculation that have been verified by an independently reviewed LCA according to ISO14040. LCA done based on the methodology and data described previously (Schmidt et al 2004), (Schmidt and Butt, 2006).</p> <p>⁽²⁾ based on an independent TÜV certification, certification number AZ 137 12, TÜVdotCOMID 0000007407.</p> <p>⁽³⁾ including Euro NCAP safety rating: 3 stars for adult occupant protection, 2 stars for pedestrian protection.</p> <p>⁽⁴⁾ including Euro NCAP safety rating: 5 stars for adult occupant protection, 4 stars for child protection and 2 stars for pedestrian protection.</p> <p>⁽⁵⁾ 3 years Cost of Ownership including residual value, no guarantee.</p>			

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TOU; Greening the Screen T-EDU

A model for sector engagement in sustainable development

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1 Introduction

Screen production is a high impact industry and faces similar business challenges to the general business community. Some leading overseas studios, film production companies and their sector bodies have been developing environmentally preferable screen production practices since the late 1980s (EMA, 2002). Overseas engagement in sustainability is more advanced than in the New Zealand screen production industry with companies in the European Union being the most advanced. In partnership with the screen production sector, an environmental toolkit has been developed for the New Zealand film and television industry. This is believed to be the first of its kind in the world and the process for its development may provide a useful model for engaging with other sectors.

The business case for the adoption of corporate social and environmental responsibility is well documented. For New Zealand, the business case is possibly more compelling because of the economic value of the “clean green” New Zealand brand and the rapid growth of the sector. Good environmental management practices will ensure that growth is sustainable for the environment and for the wider community.

There has always been a niche market for film, television and documentary based on the natural environment or environmental issues. It is not surprising to learn that such productions are made in an environmentally responsible manner. This is well illustrated with the recent release of Al Gore’s documentary – ‘An Inconvenient Truth’. In keeping with the climate change theme the makers advertised that the production was carbon neutral within the credits and the publicity material. However, environmental responsibility for mainstream screen productions is still a relatively new concept.

Proceedings: Sustainable Consumption and Production: Opportunities and Threats, 23-25 November 2006, Wuppertal, Germany. Launch conference of the Sustainable Consumption Research Exchange (SCORE!) Network, supported by the EU’s 6th Framework Programme.

SustainAbility and WWF-UK (2004) assessed the non-financial reports of a selection of media and entertainment companies and found that they focused on the direct environmental impacts, the environmental footprint, of their immediate operations rather than on the far greater, though indirect, influence that they have on audiences through their communications. Through film and television, all sorts of information is synthesised to educate, inspire, challenge and effect behaviour change. The film industry is unique in its ability to influence audiences drawn from a wide cross-section of society. Some claim that film and television companies have an unwritten responsibility to use their influence for a greater good such as sustainable development.

The New Zealand screen production industry is a major vehicle for showcasing the nation as *Clean Green New Zealand*. It is the vision of New Zealand captured on film that attracts more and more international production companies and tourists to visit New Zealand every year. The screen production industry was identified in the *New Zealand Growth and Innovation Framework* as one of four sectors with significant future economic implications for New Zealand. In its report for the New Zealand Film Commission on the *Lord of the Rings* trilogy, the New Zealand Institute of Economic Research (NZIER, 2002) found seven significant lasting effects, including:

- raising the international profile of the New Zealand screen production industry
- strong growth of foreign production financing
- enhanced New Zealand brand
- a strong foundation of screen production entrepreneurship
- broadening and deepening film related infrastructure
- potential spin off industries such as merchandise
- upskilling the industry at both technical and management levels.

The film industry relies to some extent on the beautiful environment of New Zealand. Economically it is in the industry's best interest to ensure continued access to this environment and ensure that it is not damaged. New Zealand screen production companies would claim that they comply with all applicable environmental legislation and requirements but they were apparently unaware of the extent of engagement of the large overseas screen production companies operating with environmentally and socially responsible practices.

The BBC, The Walt Disney Company, Time Warner and Vivendi Universal have all recently made high profile productions using New Zealand film locations. These overseas screen production companies are not being challenged to demonstrate that they are applying their own environmental performance standards to their operations in New Zealand.

2 Greening the Screen

In February 2005, *Greening the Screen* began as a partnership project between the New Zealand Ministry for the Environment, Landcare Research,

Waitakere City Council and New Zealand production company South Pacific Pictures Ltd. The main purpose of the project was to develop environmental guidelines for the New Zealand screen production industry with the intention to:

- Encourage screen production companies to strive to improve their environmental performance;
- help protect New Zealand's natural, historical and cultural heritage and the value of the 'clean green New Zealand' brand;
- contribute to sustainable economic growth in the screen production industry;
- enhance the reputation and competitiveness of the screen production industry;
- support the adoption of environmentally responsible practices;
- demonstrate sector-wide leadership in corporate environmental responsibility.

2.1 Research and development

The project team set out to gain an in-depth understanding of the screen production industry and its environmental impacts. At the time, this was relatively new research for New Zealand, as the environmental impacts of screen production had not previously been studied in any detail.

2.1.1 *Environmental performance survey*

Over 100 screen production companies were surveyed to gauge the current level of uptake of measures to improve environmental performance. Although 66% of the companies surveyed rated their environmental performance as good or very good, environmental management practices were relatively unsophisticated. The three most common environmental practices were: environmental policy (21%), staff environmental awareness training and education programmes (17%), and measures and procedures to ensure compliance with environmental regulations (17%). None were certified to a recognized environmental management system standard.

The three most common environmental initiatives were: waste reduction, (35%), energy efficiency (1%), and "green" travel plans (15%). Only 5% of the companies surveyed had specific initiatives to address greenhouse gas emissions. Seven companies reported that stakeholders required them to have environmental credentials; however, only two companies had joined a sustainable business group, and one company was listed on a sustainability performance index. Most companies listed customer/client, employees and regulators as the most likely groups that would influence them to improve environmental performance.

There was a poor understanding of the links between business activities and environmental impacts with 94 % of respondents reporting that their business activities had little or no impact on the environment. Companies identified their main environmental impacts as electricity, paper and fuel consumption. The most important issue faced by the companies was health and safety, followed by energy conservation and waste disposal.

2.1.2 *In-depth environmental review*

A full time researcher was placed with South Pacific Pictures for a period of five months. The researcher undertook a full environmental review of South Pacific Pictures' corporate office (McConachy & Smith, 2005b) and two of their key productions, *Shortland Street* and the feature film *Sione's Wedding* (McConachy & Smith, 2005c). The project set clear confidentiality agreements for the pilot company which afforded the researcher unrestricted access to all parts of the company and its records ensuring that the review was both comprehensive and accurate.

2.2 Process for screen production industry engagement

The process followed for the development of the *Greening the Screen* environmental toolkit proved to be extremely successful. The following account details the steps followed during the project.

2.2.1 *Desk study*

A desk study (McConachy & Smith, 2005a) provided tangible examples of initiatives already being undertaken by screen production companies and productions elsewhere in the world, i.e. the environmental management measures offered during the consultation stage were not only those expected of industry in general but could be justified with examples of their implementation by the screen production industry elsewhere in the world. It was important to be able to refer to examples from similar sized organisations from the same sector. The desk study informed both the development of opportunities for South Pacific Pictures and the content of the toolkit. It also enabled the project to evaluate sustainable development in the screen production industry worldwide and benchmark the New Zealand industry against worldwide standards.

2.2.2 *Pilot company and environmental champion*

The involvement of South Pacific Pictures as the pilot company was a key factor in the success of the project as their commitment to the project encouraged other companies and screen production professionals to provide input to the development of the environmental toolkit. South Pacific Pictures' general manager (at the time) is held in very high regard by the New Zealand screen production industry and sits on a number of influential committees where he promoted the concept of *Greening the Screen* and the work. This facilitated access to many other screen production organisations during the consultation stages of the project.

The studio manager was identified as the company environmental champion. It was important that the company champion developed ownership for the project within the company. The company champion was responsible for informing the wider company about the project and facilitating employee participation.

2.2.3 Embedding a researcher in the pilot company

An important sensitivity in the screen production industry is the perception of those outside the industry of the glamour associated with screen production – this is often referred to as “star-gazing”. Embedding an industry-experienced researcher in the company and restricting the access of other external project personnel was an important factor in gaining the confidence of the pilot company and this almost certainly facilitated access to production staff. For other industry sectors, this step would be important in establishing credibility of the researcher, acknowledging the contribution of that sector to the economy and society, demonstrating respect for the professional skills required, and expressing excitement for achievements of that industry sector.

2.2.4 Establishing a baseline

An environmental review (McConachy & Smith, 2005b) was undertaken after mapping company activities, scoping the data to be collected and the methodology for collecting it. The review was dependent on the support of the company champion and cooperation of employees from all areas of the company. The review produced a large amount of data relevant to the environmental impacts of the company. These findings were publicised internally to generate solutions and as a stimulus for action. By undertaking a comprehensive environmental review with the pilot company, a model for future environmental reviews within the sector was developed. This was translated into a planning tool for the environmental toolkit and website that assists production companies to map environmental impacts for individual productions, identify opportunities for improving environmental performance and potential mitigations.

A key factor in the success of the environmental review was ensuring confidentiality of the information gathered for the review and subsequent investigations. Although the research was for the benefit of the wider screen production industry, confidentiality was crucial so that the pilot company could manage any negative outcomes arising from the review.

2.2.5 Investigating and implementing opportunities

The main environmental impacts of the company’s screen production activities became opportunities that were investigated (McConachy & Smith, 2005d) further to collect information about the nature of the impact and possible solutions. A template for reporting each investigation was established to include:

- baseline information summarising the environmental impacts and related costs
- potential environmental improvements explaining why the environmental issue is of concern and the benefits expected to result from improving environmental performance
- comparison of options describing the various options for improving environmental performance and evaluating each in terms of environmental benefits and costs

- summary of options and the findings of the investigation in terms of costs, savings and pay-back periods likely to arise from the opportunity
- further information providing the internet addresses for key organisations and sources of further information.

Five of the thirteen opportunities were implemented and monitored (McConachy & Smith, 2005e, 2005f) to capture both environmental benefits and cost savings. These included:

- Achievement of carbon neutral status for the television series *Shortland Street*.
- The installation of a worm farm to divert organic waste from landfill.
- Double-sided printing of scripts and associated material to reduce paper consumption.
- Publication of an environmental policy.
- Establishment of a health, safety and environment committee.

As a result of improved recycling facilities onsite and better staff awareness glass, plastic and aluminium sent to landfill was reduced by 76%, organic waste was reduced by 37% and disposable paper cups by 51%. Paper consumption was significantly reduced.

2.2.6 *Industry organisations*

Key screen industry bodies such as the NZ Screen Council, the NZ Film Commission, Film NZ, the Screen Directors Guild of NZ and the NZ Film and Video Technicians Guild were consulted (Smith & McConachy, 2005g) to explore appropriate ways that those organisations could contribute to *Greening the Screen* in the future. Opportunities for integrating environmental criteria into the mainstream business of the sector included:

- Sector training standards
- Film school curricula
- Regional film office workshops
- Sector code of practice for health and safety
- Funding programmes
- Film and television awards.

In effect, this step provided the project team with a “licence to operate” within the sector. These organisations were also given the opportunity to review the toolkit and provide feedback before its launch.

2.2.7 *Consulting across the sector*

A workshop was organised with industry professionals representing the various crafts within the screen production sector; for example: lighting, camera, makeup, wardrobe, art etc. The workshop was facilitated by a highly respected industry leader. The key findings from the review of international practice were presented and discussed. The potential structure, functionality and content for the proposed guidelines were explored. Those individuals unable to attend the workshop were visited or contacted to ensure that their

feedback was captured. Significant contributions came from the workshop and subsequent follow-up that helped to shape the toolkit.

2.2.8 *The Environmental Toolkit*

The guidelines and website were launched as the *Greening the Screen Environmental Toolkit* (Smith & McConachy, 2005h) by New Zealand's Minister for Broadcasting at the New Zealand Screen Production and Development Association's (SPADA) annual conference in November 2005. Ten industry organisations endorsed the toolkit published information about *Greening the Screen* on their websites. The toolkit is designed in stand-alone sections for different audiences:

- **The Business Case** – explains the importance of corporate environmental responsibility for senior managers and business leaders.
- **Management** – provides instructions for identifying and managing environmental impacts.
- **Tools** – provide simple explanations, suggestions for improving environmental practices and a menu of common sense tips for different screen production activities:
 - Office
 - Behind the screen
 - Location
 - On screen
 - Off screen

Throughout the toolkit, screen production examples illustrate environmental opportunities and benefits in practice. The appendices provide a range of environmental management tools and resources tailored for the screen production industry.

2.2.9 *Embedding good environmental practice in the sector*

One of the serious concerns that emerged from consultation with screen production professionals was that publication of the toolkit and website would not be sufficient to ensure that good environmental practices became embedded in the screen production industry. They felt that further support would be required to enable other companies and productions to implement the toolkit and thereby create sufficient traction for *Greening the Screen* to become expected best practice across the sector.

With support from the Ministry for the Environment the project received a further eighteen months of funding to support industry associations, production companies and professionals to implement the toolkit, while at the same time further documenting New Zealand case studies to add to the website.

In the longer term, it is recognized that the project needs to be owned and managed by the sector although access to environmental management expertise will still be required. To ensure that *Greening the Screen* is fully integrated in the screen production sector, work has begun to hold workshops with Regional Film Offices, to include relevant material in film school curricula, to integrate environmental considerations into the screen industry Code of Practice for Health and Safety, to develop environmental

screen production awards, and to develop sector specific environmental performance indicators and reporting.

2.3 Outcomes

The key outcomes from the project were:

- Identification of the environmental impacts associated with screen production in New Zealand.
- Overall improvement of South Pacific Pictures environmental performance, including reduction and offsetting of carbon dioxide emissions from the company's key production *Shortland Street*.
- Industry acknowledgement of its environmental impacts and the need for change.
- High level of industry support and buy-in.
- Linking the screen production industry and the relevant environmental agencies/organisations that are able to provide support.
- Developing a sector-specific toolkit the only one of its kind for screen production in the world.
- Recruiting screen production companies who wish to become involved in the project and implement the toolkit.
- Building capacity within the screen production industry to take responsibility for managing its environmental impacts and in turn creating another reason why New Zealand is one of the best film locations in the world.
- Working with the screen production industry to protect the environment for the benefit of every New Zealander and future generations to come.

3 Overall conclusion

When the *Greening the Screen* project was initiated New Zealand had few resources for the environmental sustainability of its screen production industry, and was clearly lagging behind overseas standards in this area. *Greening the Screen* is a successful model that has provided New Zealand screen production with tools to improve its environmental performance, and it may be the first of its kind in the world.

The project worked with a major screen production company and successfully reduced the environmental impact of its activities while obtaining cost savings. The main aim of the project was for the industry to accept sustainability as an important consideration in its future activities.

“We all recognise the importance of preserving and protecting our environment. South Pacific Pictures exposure to Greening the Screen has brought home to us how we can actually make a difference. With very little effort we can make significant improvements to the way we use resources while we reduce our waste. And to our surprise we have realised that whilst we make these improvements and reductions we are going to save money. We're very excited to have lead the Greening the Screen project and

Greening the Screen

we're absolutely committed to achieving results that will help us and the environment."

John Barnett, South Pacific Pictures

Other New Zealand screen production companies are recognising the advantages of sustainable practices and are beginning to implement the *Greening the Screen* toolkit.

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The Role for Hands-On Programs

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1 Introduction

The ambitious objectives established in the Lisbon Strategy can only be achieved through sustainable behaviours aiming the industry. But, its success will depend upon continuous innovation in products and processes and a qualified workforce.

The Manufacture agenda for 2015 points out five pillars with the associated enabling technologies for supporting the competitive and sustainable reaction: (1) new added-value products and services; (2) new business models; (3) new advanced industrial engineering; (4) new emerging manufacturing science and technologies; and (5) transforming of existing R&D and education infrastructure to support world-class manufacturing.

As we know, there is a vocation crises and lack of qualified technicians in Europe. To ensure the availability of a sustainable and qualified workforce, it's essential to increase public awareness of: (1) the value of industry and science; (2) the importance of knowledge-based careers related to the industry field; and (3) the meaning of sustainable production/consumption patterns. These context lead to the need and desire for designing programs for children and young adults to make the best of time-out-of-school for contributing positively towards a productive and conscientious adulthood.

This work rests on the belief that hands-on programs are important tools for education in consideration of the global citizen and of the sustained society development. The empirical part of this paper will be grounded on the “Think Industry Project” (TIP), one hands-on program focused on experiencing, and on entrepreneurial spirit. The authors will focus on the Technological Centre for the Metal Working Industry’ (CATIM) experience as a member of Association of the Technological Centres of Portugal (RECET). CATIM has this project running since 1995 and it has encompassed more than 7600 youngsters with ages between 13 and 17 years old. The main objective for the TIP is to develop a positive vision of the industry and of employment opportunities and technical careers in the industrial sector, towards a sustainable and active citizenship. The TIP activities are clustered in three main categories: (1) awareness; (2)

experiencing; and (3) complementary support actions. The authors will focus on two experiencing activities, developed in two different parts of the process: (1) industrial technology lab; and (2) “This is an idea!” a game intended to foster an entrepreneurial spirit focused on innovation and sustainability, and the importance brands and Industrial Property’ (IP) rights. Experiencing activities, e.g. “Fuel Cells” and “Solar Energy”, are designed to explore and promote concepts related with sustainable consumption and production, aiming the energy and electronics use in everyday life. The importance of hands-on projects mixing technology, innovation, sustainability and entrepreneurship as means for promoting the education for sustainable consumption and production is explored in this paper and grounded on CATIMs’ practical experience.

2 Pillars for the sustainable consumption and production’ education

Educational programs’ design (in or out-of-school) must be according to the needs shown by the industry and global trends. Only by aligning offer and demand we can achieve competitiveness and Excellency. The Manufuture agenda focus on the trends for the new industry and consequently on training and development needs.

2.1 The Manufuture agenda for 2015

The Manufuture agenda (Manufuture, 2006) focuses on the transformation of industry and R&D activities and approaches to learning and industry. The main drivers for change are:

1. Competition, especially for emerging economies;
2. The shortening life cycle of enabling technologies;
3. Environmental and sustainable issues;
4. Regulatory climate;
5. Values and public acceptance.

This transformation is seen through five strategic pillars (Manufuture, 2006) and their associated enabling technologies:

1. New added value products and services;
2. New business models;
3. Advanced industrial engineering;
4. Emerging manufacturing sciences and technologies;
5. Infrastructures and education.

Our approach is based on the objectives related with transformation of R&D and with pillar five “Infrastructures and education” (see figure 1 and 2). The strategic goal number 3 for the Manufuture agenda can be transcript as it follows: “A *Europe-wide co-operative Research and Technological Development (RTD) infrastructures with systems and education that favor collaborative research efforts for manufacturing excellence promotes technology transfer and market take-up of R&D results, provides competitive technical assistance, and improves lifelong learning and re-training of a workforce including growing numbers of aging and displaced workers.*” (Manufuture, 2006, p. 54).

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Figure 1: Industrial transformation reference model guided by drivers, and based on five pillars to achieve environment for European enterprises (Adapted from Manufuture, 2006)

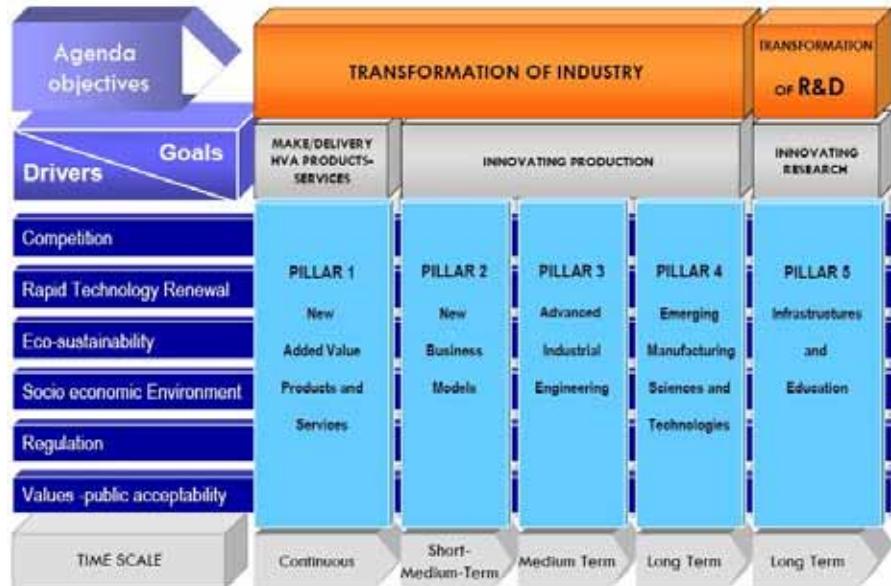
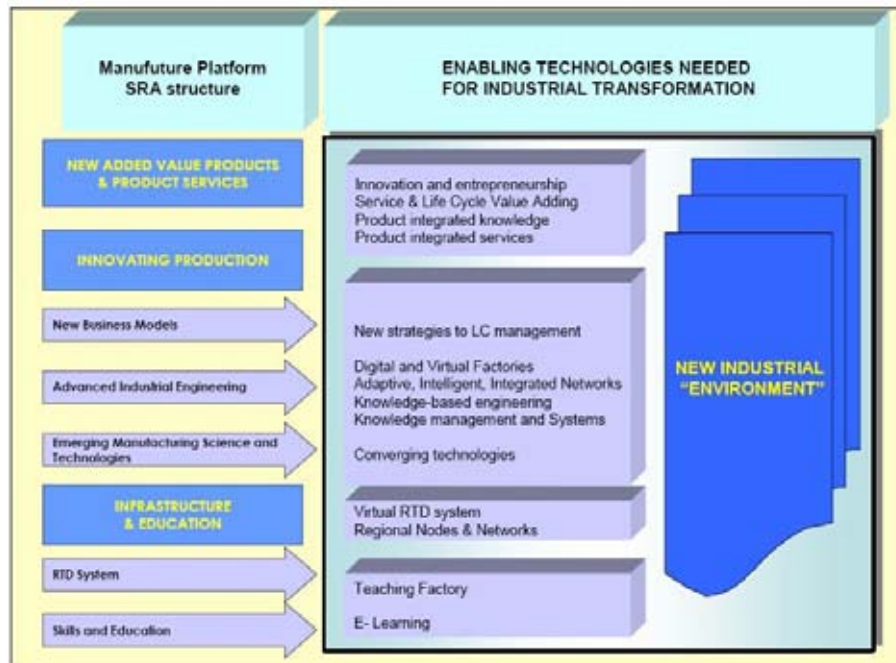


Figure 2: Enabling manufacturing technologies for industrial transformation – global pillars and examples (Adapted from Manufuture, 2006)



According to the Manufuture (2006) the model below (see figure 2) shows that appropriate knowledge-base solutions can be used to transform

industry. The industry must shift along with the training and the formal education systems towards the development of “skills”.

As we know, not only in Europe but also worldwide, there is a vocation crisis for the technical careers related to industry. And, in our particular case, the metal working industry is associated with “dirty, hard and difficult” tasks. So youngsters tend to choose “easier” paths and careers with another public image. Various researchers have studied students’ attitudes towards “industry”, “science”, “technology” and “SCP”. Researches show that youngsters often have stereotypical images and that those images affect their attitude toward science, industry, technology and SCP (Berdslee and O’Dowd, 1961; Brush, 1979; Chambers, 1983; Finson et al., 1995; Flick, 1990; Mason et al., 1991; Mead and Metraux, 1957; Palmer, 1997). It appears that if a youngster can see himself/herself in a career, then, the likelihood of that person pursuing an educational program to prepare him/her to that career increases (Smith and Erb, 1986).

3 SCP education: hands-on programs

3.1 General outline

Over the past 20 years “scientific literacy” is one of the goals for science education worldwide (in and out of school). The proofs of it are the several educational reports, networks and projects on the subject, e.g. “EO-HOU – Hands-on Universe Europe” (EO-HOU, 2006), “Hands-on science” (HSCI, 2006) as European Projects; “Beyond 2000: Science Education for the Future” (Millar and Osborne, 1998), “Sector Workforce Development Plan for Engineering Manufacture” (Engineering and Marine Training Authority, 2006), activities under “Imagineering Foundation” (Imagineering Foundation, 2006) in the United Kingdom; “Cité des metier” (Cité des Metier, 2006), “Youngs in Industry” (Ministere de l’Economie des Finances et de l’Industrie, 2006), “Bravo Industry” (Union des Industries et Métiers de la Metalurgie, 2006) in France; “Science for all American – Project 2061” (American Association for the Advancement of Science, 1990, 1993) and “Benchmarks for Science Literacy” (National Research Council, 1996) in the United States.

The idea to make the best of time-out of school along with school time gained adepts, and hands-on programs arose with those purposes. A retrospective of the promotion of hands-on programs shows us that we are in the midst of a time of debate over its use due to the razing interest in promoting general literacy over the formal teaching system and complementary systems. The idea for hands-on programs is not new, on the contrary, it’s used on the formal curricula for teaching several concepts, mainly scientific concepts. But there are also hands-on programs for making the best of out-of-school time, such as TIP.

We approach hands-on programs in a wider meaning than the one posed on classical literature (Brederman, 1985; Carpenter, 1963; Hake, 1992; Kyle et al, 1988ab 1989; Shymansky, 1989; Shymansky et al, 1982, 1983, 1990; Wise, 1996). It broadens the meaning of “lab” to encompass a wider range of settings, like the classroom, real manufacturing industries and planet Earth; and the meaning of “experiment” to include a wider variety of activities that

may not be actual experiments, such as measuring and observing. Our approach to hands-on programs also includes the general view of SCP issues and the relation of every action/learning with everyday life and industrial settings related with the productive industry and possible impacts on society.

3.2 Theoretical rationales for hands-on programs

Hands-on programs have been originally proposed as means to increase student achievement (in science education), and in our approach, hands-on projects such a TIP, also intent to promote general conscience on SCP issues, and be the basis for a differentiation for career interests. A set of theories has been proposed to explain how hands-on programs benefit students learning (Shulam and Tamir, 1973). Science educators mainly identify two broad domains of scientific knowledge: (1) content knowledge, and (2) process skills knowledge (Glynn and Duit, 1995; Lawson, 1995) we extend it to a third one, (3) SCP awareness. Content knowledge, also known as declarative knowledge includes the real “contents” that students are supposed to know, remember and understand, such as theories, principles, facts, theorems, laws, etc.. Process skills or procedural knowledge are the techniques and approaches to solving a problem, such as observation, measurement, hypothesis formulation and testing, among many others. SCP awareness it’s the link of both of the former to real life contexts, namely industry. It allows youngsters to give a meaning to their knowledge, promoting the learning and development of a global awareness for the impact of different knowledges and it’s real application. In our point of view, the conjunction of these three complementary issues is necessary so that students can fully understand scientific knowledge and develop capabilities to apply it in real everyday life settings, namely the industry, never forgetting the global impact of each and every action.

Scientific knowledge alone is most of the times abstract and complex, what makes it difficult to understand and to give it a meaning. Hands-on approaches, namely TIP, allow students to manipulate and conceptualise objects, what truly helps to transform this abstract knowledge into concrete knowledge, with one “real” meaning and application.

These ideas, that hands-on programs support content knowledge understanding, are consistent with human development theories, which advocate that mental development is done in successive phases (e.g. Gage and Berliner, 1994; Lawson, 1995; Piaget, 1973). The higher stages encompass the capability to work with abstractions (such as ideas), while in previous development stages there is only the ability to work with concrete matters. Research shows that the interaction with the physical surrounding environment (along with other factors) is a key to sustain these developmental leaps (e.g. Gage and Berliner, 1994; Lawson, 1995; Piaget, 1973).

This argument for supporting hands-on programs is also according to the cognitive theory’s information processing model of the mind. Which encloses a long-term memory (to store data, information and/or knowledge) and a short-term memory (to hold data, information and/or knowledge for immediate use). With TIP, we intent to help students to retrieve information from long-term memory, so that it can be used in everyday life activities. TIP’s activities are designed to create additional associations between pieces

of knowledge so that information can be referred by its abstract meaning, its physical illustration, and its application to real settings. According to Gage and Berliner (1984) these kinds of programs allow the rates of recalled information to increase.

The cognitive theory approach defends that the separated pieces of data/information/knowledge stored in the long-term memory are organized in schemas. These schemas are organizing principles that guide one individual understanding of the separated pieces of data/information and are used as the base to organize new pieces of data/information and eventually knowledge. For several reasons, individuals can create schemas that are not according to the real world functioning, leading to misconceptions of reality. Sometimes these misconceptions became barriers to learning. We may ask ourselves why... (a) Learning may occur in such a way that it confirms the misconception; (b) Learning may not occur, because information that does not confirm the misconception is ignored (Champagne et al, 1982; Driver, 1992; Driver and Bell, 1986; Eylon and Linn, 1988; Friedler and Tamir, 1990). TIP's approach is to guide students in the discovery of misconceptions and to make them rationalize why several misconceptions don't explain the phenomenon accurately and provide alternative and realistic conceptions for that particular subject.

The theoretical rationales given for the impact of hands-on programs have not been unquestioned. Critics argue that these programs may improve as well as reduce students' achievement. Whereas there are no doubts that hands-on programs help student to visualize abstract ideas, opponents argue that these programs confuse as well as clarify thoughts. Additionally some studies point that students may not link hands-on activities to other activities related with the topic (Atkinson, 1990; Resnick and Klopfer, 1989; Wellington, 1998). And that's why in TIP activities is always provided and explored the rationale for each activity alone.

However we must have in mind that through an adequate formal interaction with adults', students (with different ages) may develop important scientific skills (Martins and Veiga, 2001) and attain a vocational identity development (Taveira and Moreno, 2003). According to Johnston and Gray (1999) that interaction may:

1. Promote experiences with a specific focus or learning objectives;
2. Function as a role model by observing and expressing ideas themselves;
3. Create an opportunity for asking questions to challenge thinking or develop the experience further;
4. Act as motivation for students to express their ideas and look for other extended, similar or new experiences.

We might add, that it also allows youngsters to:

1. Give new meanings to reality;
2. Rationalize the impact of their learning in real settings;
3. Promote SCP awareness;
4. Promote awareness for technical careers related to industry;
5. Promote and discuss the vocational identity development.

3.3 Experimental activities for science education and SCP' awareness

Experimental activities are viewed to be fundamental for learning science and to promote global awareness of SCP, by researchers, teachers (Martins and Veiga, 2001, Neves et al., 2006), members from the industry, parents and stakeholders in general (Neves et al., 2006). Although, it does not imply that those who defend it have the same understanding of it (Wellington, 1998). For example, there are two approaches related to the delivering of these kinds of programs: (1) there are those who defend, that the physical environment itself, (e.g. objects and materials' manipulation) represents a mean and/or type of learning with educational value; (2) others intent to go further and give a meaning to the context, defending that learning methods and techniques are important because help to give answers. Although nowadays the general view is that no method should be given a pride of place, they might complement each other according to the aims of what is being done. In fact, choosing contexts that allow students to think, to practice, to question, to take control and to make decisions is a relevant way to provide opportunities that enable students to use their own intellectual skills and to extend them to meet new challenges in science learning (Blenkin and Kelly, 1996) and in personal development, such as in vocational identity development (Taveira and Moreno, 2003).

3.4 Using familiar contexts for science education and SCP's awareness

It's usual and it makes sense to use and explore concepts that allow the development of a global awareness and a better understanding of the worlds' functioning. This might be the base for an informed and responsible citizenship towards SCP behaviours and the choice of careers aiming SCP trends.

In this paper, we will explore two activities, one related with water and the other with sun, along with its application for producing energy with the help of technology and engineering. Water and sun are the bases for life in Planet Earth, and they have several uses, e.g. everyday life, industry, agriculture, leisure, means of transport. Things that youngsters know and take contact everyday of their lives, but most of the time, don't rationalized possible applications for it in everyday life and don't do the corresponding link to contents delivered at school and its application, e.g. renewable energies and alternative sources of energy.

3.5 Implications for career guidance, counselling and SCP's awareness

What influences students' attitudes is a subject of ongoing discussion and research (e.g. Scherz and Oren, 2006; Siegel and Ranney, 2003). Researchers defend that the way people behave in various situations is determined by their attitudes towards that subject (e.g. Fishbein and Ajzen, 1975; Scherz and Oren, 2006), for example, if people can imagine themselves on those careers they tent to follow educational paths according to it (Smith and Erb, 1986).

Vocational development theories should be taken on account when developing hands-on programs that intent to promote global awareness for technical careers and SCP. During the last two decades, several intervention strategies and programs have been developed worldwide, with the intent to foster career exploration by youngsters, encompassing a diverse range of ages (e.g. Atkinson and Murrel, 1988; Betz, 1992; Blustein, 1992; Blustein and Flum, 1999; Engineering and Marine Training Authority, 2006; Gottfredson, 1996; Luzzo et al, 1996; Morrow, 1995; Neves, 2006; Prediger, 1995, 1999; Prediger and Schmertz, 1998; Rodriguez-Moreno, 1999; Union des Industries et Métiers de la Metalurgie, 2006).

Table 1: Analyses of the careers exploration process (adapted from Taveira and Moreno, 2003)

Why do people explore?	Goals of exploration (e.g. to gather information, to construct meaning, to solve dilemmas and problems, to reduce confusion, uncertainty, anxiety, and stress, to test self and environment hypothesis)
How much value do they attribute to exploratory activity?	Instrumental value of career exploration
How confident are people in their ability to successfully explore for career purposes?	Self-efficacy to the domain of career exploration
Where do they explore?	Extent of self and environmental exploration
How do they explore?	In a systematic and intentional mode or in a fortuitous and unconscious manner
How much and what do they explore?	Frequency of exploratory behaviour, nature and amount of information obtained
Directness of exploration?	Number of options explored Focus of exploration
What type of conditions are facilitating or inhibiting career exploration?	Personal Developmental Relational Academic Socio-economic Political
What occurs after exploration takes place?	Improvement of self-concept Vocational maturity Self-esteem Vocational identity development Differentiation of career interests Progress in career decision-making Career satisfaction

Conceptualisation of career exploration portrays the construct as a status of the career decision-making process or as a vital process of career learning and development (Taveira and Moreno, 2003). The simplistic notion of career information as information-seeking behaviour has been progressively abandoned in the literature, although much effort is needed to replace this in practice. TIP's project is the materialization of this approach with another pool of additional objectives to be reached.

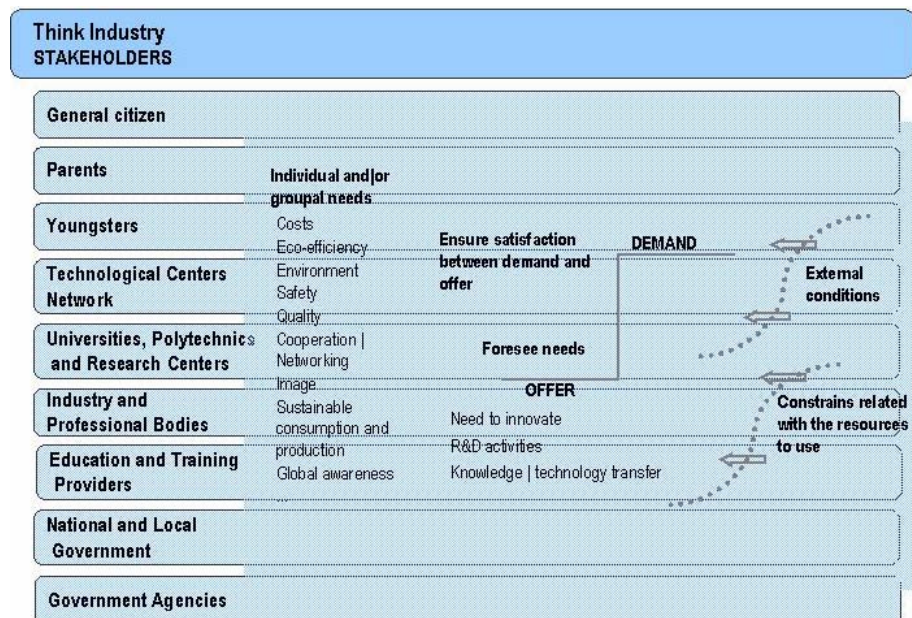
4 Think Industry Project (TIP)

4.1 TIP's outline

TIP is a hands-on program designed for the Portuguese reality that encompasses youngsters with ages from 13 to 17 years old. It was based on previously developed and validated models. CATIM has the project running since 1995 (Rocha, 1998) and more than 7600 youngsters were evolved in it just in this Technological Centre.

TIP is a wide project, so as a consequence it encompasses several different stakeholders (see figure 3), such as: general citizen, parents, youngsters, Technological Centres Network, Universities, Polytechnics and Research Institutes, Industry and Professional bodies, Education and Training Providers, National and local Government, Government Agencies.

Figure 3: TIP's stakeholders and environmental issues



The main objectives for TIP are to develop a positive vision of the industry and of employment opportunities and technical careers in the industrial sector towards a sustainable and active citizenship. In table 2 we

present the main problem dimensions, specific targets and general objectives.

TIP’s activities can be clustered into: (1) Technology laboratories; (2) Simulation games; (3) Field trips to industrial enterprises; (4) Visits and trips to events; (5) Thematic seminars; (6) Sessions held up at schools; and (7) TIP in the mass media. The activities developed under the TIP scope, generally tent to promote the understanding of different settings of the industrial value-chain, e.g. “simulation games” that represent management actions and functions, and “technology laboratories” that correspond to the manipulation of equipments related to the industrial activity and the underneath technologies applied in several industrial processes such as robotics, hydraulics, energy consumption, environment, mechanics, milling, lathering, etc..

Table 2: Problem dimensions and TIP’s specific objectives

Main Problem Dimensions	Specific Targets	
Traditional image for the industry	<ul style="list-style-type: none"> • Develop a positive vision of the industry • To link industry with positive values and attractive careers 	<p>To develop a positive vision of the industry and of employment opportunities and technical careers in the industrial sector towards an active citizenship</p>
Withdraw between youngsters in school ages and industrial activities and careers	<ul style="list-style-type: none"> • To make youngsters and industry closer (and <i>vice-versa</i>) • Evolve youngsters and industry in mutual approximation processes 	
Training choices and market integration heavily influenced by commerce and services	<ul style="list-style-type: none"> • Make youngsters aware of industrial careers in short term • Motivate youngsters to carry on their studies on technological areas 	

TIP is also designed to show youngsters new ways of learning and working, e.g. using e-learning and Communities of Practise (Fernandes and Rocha 2006 a, b; Rocha and Fernandes, 2006).

5 Experiencing Activities

We will explore two experiences: (1) Solar energy, and (2) Fuel cell energy. The rational for everyday life context is the same for both, and the technology laboratory context is unique for each one.

5.1 Rational for everyday life context

The purposes of these experiences are: (1) to give students a broad knowledge of two alternative and green sources of energy, and (2) to show them that solar energy and fuel cell energy can be an energetic option and potentials substitutes of oil, for a better and “greener” future.

Before beginning the activity, its conducted an exercise for recognizing the problems of pollution around the planet and our oil dependence. This will help to reinforce the idea that others sources of energy, specially the

ones that are not oil derived and environment friendly, are a good choice for a sustainable future and bases for the choice of a technical careers.

Several questions for thinking are posed, each factor allowed the formulation of a specific question (by the tutor) and a hypothesis to explain it (by the youngsters), which basically come from the everyday life context previously explored. Some examples of these questions are:

1. What kind of human activity produces pollution?
2. In these activities, which is the most aggressive to environment?
3. How can we have a better and sustainable future with the preservation of the environment?

5.2 Fuel cells energy: hands-on

This experience was designed to be performed by youngsters with the help from one tutor.

5.2.1 Technology laboratory context

Bill of materials:

- 4 fuel cell's;
- 1 wrench n° 8 (or 1 small adjustable wrench);
- 1 clamp;
- 2 electric wires;
- 1 small electric engine (1 V);
- 1 helix;
- 1 pipe;
- 1 multimeter;
- 1 cup with distilled water;
- 1 card support;
- 1 electrolyser (production of hydrogen unit).

5.2.2 Part 1: To see the constitution of a fuel cell

Step 1: Using a wrench, size 8, loose the screws of the fuel cell.



Step 2: Separate, carefully, the acrylic protections and the negative polar region (black screw) of the positive polar region (red screw).

Step 3: Using a clamp, take off the membrane (transparent film) and place it in a cup with distilled water during 5 minutes (warning: do not touch in the membrane with the hands).

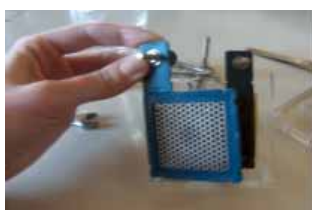


Step 4: Use the clamp again, this time, to take the membrane off the cup and put in one of the polar regions.



Step 5: Set up the polar regions, the place the screws.

fuel cell, joining the acrylic protection and



5.2.3 Part 2: See the functioning of a fuel cell

Step 1: Use electric wires to bind the engine with helix to the energy cell.

Step 2: Supply hydrogen to the fuel cell through the negative polar region.



5.2.4 Part 3: Voltage measurement (difference of electrical potential) of the fuel cell using one digital Multimeter



Step 1: Register the value.

5.2.5 Part 4: Finishing the project

Step 1: Bind in series some fuel cells to light one led of 3,5 V

Step 2: Do the electric linking.

Step 3: Do the canalisation for the hydrogen supply.

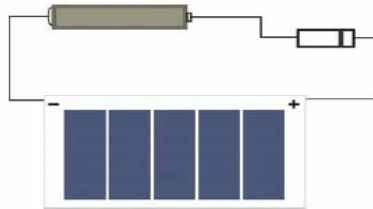


5.3 Solar energy: hands-on

This experience was designed to be performed by youngsters with the help from one tutor.

5.3.1 Technology laboratories context

5.3.2 Experience 1: Loading batteries using solar energy



Bill of Material:

- 1 solar cell (3,5V)
- 1 diode
- 1 support of stacks
- 1 rechargeable battery
- 3 wires

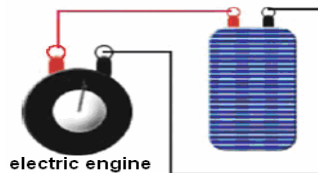
Step 1: Load a rechargeable battery, using a solar panel of 3,5V.

Step 2: Register the values of voltage observed throughout the time.

Time (minutes)	Voltage (V)
Beginning	
After 5 min	
After 15 min	

5.3.3 Experience 2: Start an electric engine form one sollar cell

Step 1: Set up the following project.

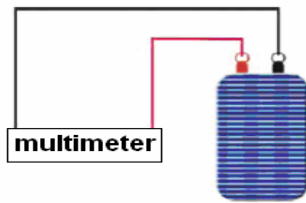


Bill of Materials:

- 1 solar cell
- 1 engine
- 2 wires

5.3.4 Experience 3: Voltage and current of a solar cell

Step 1: Set up the following project.



Bill of Materials:

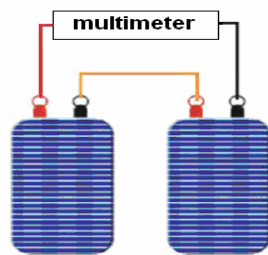
- 1 solar cell
- 1 multimeter
- 2 wires

Step 2: Complete the table with the observed values.

	Tension (V)	Current (mA)
Default by maker	0.50	380
In the sun		
In the shadow		

5.3.5 *Experience 4: Voltage and current of two mounted solar cells in series circuit*

Step 1: Set up the following project.



Bill of Materials:

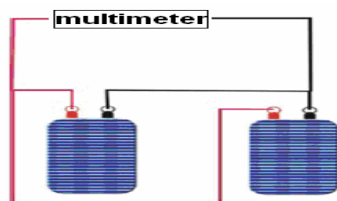
- 2 solar cell
- 1 multimeter
- 2 wires

Step 2: Complete the table with the observed values.

	Voltage (V)	Current(mA)
Factory values	1	380
In the sun		
In the shadow		

5.3.6 *Experience 5: Voltage and Current of two solar cells mounted in parallel circuit*

Step 1: Set up the following project.



Bill of material:

- 2 photovoltaic cell
- 1 multimeter
- 3 wires

Step 2: Complete the table with the observed values.

	Voltage (V)	Current(mA)
Factory values	1	380
In the sun		
In the shadow		

6 Analyses and Discussion

All these experiences and approaches have well defined objectives related with the development of a positive vision throughout the industry, employment opportunities and technical careers in the industrial sector towards an active citizenship. The conjunction of content knowledge, process skills knowledge and SCP awareness is made in all of the TIP's activities helping youngsters to give meaning to curricula contents and everyday life activities.

Concerning the "technology lab" context, there are two main moments for the exploration of the concepts underneath: prior to the experiment and post the experiment. At first, it's promoted reflection and discussion about "pollution", "human actions that lead to pollution", "green energies". Questions such as "What is pollution?", "What are some of the causes for pollution?", "What's Men role in all these?", "What can we do to prevent pollution?", "What kind of green energies do you know?", "What are the applications of these energies?" arise along the discussion. From these questioning several conclusions appear, e.g. Men are the cause of most pollution on planet Earth, technology can help us to have a better life, there are alternative energies. These conclusions are then explored with the experiences in more practical and hands-on settings.

After performing the experiences, an all set of new questions are explored: "Why do we have those values (tables) along the different experiences?"; "Which scientific areas are involved?"; "What kind of jobs are there in these scientific areas?"; "Which green energy sources did they know before and now?".

The "technology lab" approach is complemented with field trips to industries. These plants were selected according to Excellency standards and the image of the new industry defended in the Manufature agenda and exposed above. Industries that compete by adding value to their products and services, and not by reducing costs.

We can firmly notice that prior to the experience and field trips, youngsters gave generic and imprecise answers to the questions, but post-experiences/field trips answers were more precise, youngsters shown awareness for SCP issues and made the link of their actions with technology applications, industry and future careers.

TIP allows its participants to get in touch with new technologies applied in real settings, to give meaning to several everyday life activities and to curricula contents, along with the rationalization and their application to industry. TIP also helps youngsters to create mindsets for the industry and technical careers related to engineering and technology. The images that youngsters have of relevant workplaces in the industry, also changed prior

and post experiences/field trips, at first they were superficial, unreal and even incorrect. These images might be formed due to several factors e.g. school, TV, movies, news, parents, teachers. Has we have exposed above, when people can see themselves in a career, the likelihood of that person to pursuit an educational program to prepare him/her to that career increases. Following that belief, TIP tries to give them new tools so that they can rationalize and make an informed career choice based on correct facts and not on misconceptions. Moreover, these approaches to learning and development processes also provide opportunities for the develop of social skills, e.g. communicating ideas, taking turns, sharing, helping, working as a group, “selling” ideas to others. These set of skills are transversal to all fields of knowledge and important to an active work life.

7 Overall conclusion

Industry, namely manufacturing has huge potential for generating wealth, jobs and better life-quality. The new industry must compete by adding value to the processes and products, and not by reducing costs. Industry must attract and hold on to capable and qualified people going beyond demographic trends of aging and the unattractiveness of industry as a career. Solutions must encompass an all lot of areas, such as formal and informal education and life-long learning, among many others. We must overlap the career context crises and motivate youngsters to follow technical careers.

Hands-on programs, such as TIP, have great responsibility along with the formal teaching system for the sustainable image and mentality shifts. Educational and support infrastructures (e.g. technological centres, research institutes) must be brought into line with new industrial needs, e.g. support the development of new business models for the industry; carry and sensitise to a new culture of advanced industrial engineering and to support emerging fields such as manufacturing sciences and technologies. With projects like TIP we can make time-out-of-school really matter, and make youngsters follow paths towards an informed career choice having in mind SCP issues and it’s global impact.

Tell me and I forget.

Show me and I might remember.

Involve me and I learn.

(Confucius, 2003)

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TOU; Leisure activities in an environmental T-EDU perspective

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1 Introduction

In spite of the growing literature on consumption and environment, few studies have focused on leisure activities in an environmental perspective – the main exception being the relatively numerous studies on tourism. The neglect of leisure activities in environmental studies is surprising, as leisure-related consumption is increasing rapidly, and some of the environmental impacts are obvious. Of course, some of these impacts are indirectly analysed in research on consumption areas such as mobility, food and household electricity use, but new insights might emerge if the focus is turned directly towards the leisure activities. Our intention with this paper is to explore this idea.

2 The concept of leisure

The concept of leisure belongs to the group of broad concepts which everybody understands and nobody can define. Introductory books on leisure thus include detailed discussions on the meaning and definition of the concept. One approach is based on time where leisure appears as a kind of residual category of ‘free time’ after the subtraction of time used for different necessary tasks and commitments – encouraging discussion on what should then be considered necessary tasks and commitments. It can seem obvious to subtract time for paid work, for household work and for life-supporting activities like sleep and eating, but the more precise limitations are difficult: is it work to read special magazines at home, is it household work to take care of the kids, is it life-support to sleep late on Sunday morning? And how should activities like transport be considered? Another approach is activity-based, defining leisure as activities carried out at one’s own choice. However, definitional problems emerge again as many

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activities, which are usually conceived as leisure, are sometimes experienced as obligations such as physical exercise or paying visits to relatives. This complexity has led some to develop different systems of categorization to distinguish between different forms of leisure, according to the degree of freedom to choose and the kind of motivation behind the activity ((Russell 2005), p. 82-88 about Kelly and Neulinger). In general, a definition based on the idea of free choice is complicated by the importance of social structures and discourses. Freedom is at the core of the leisure concept – not the least in the Scandinavian languages where the concept translates into ‘fritid’, free time – but the results of the ‘free choice’ are socially constructed.

In this paper we apply a very broad conception of leisure as, in principle, we include all activities that some people would count as leisure. From an environmental perspective it is not so important whether people consider their activities to be pleasant or boring duties and whether they feel to have chosen them freely or feel obliged. Indirectly, these feelings can be important for political strategies concerning leisure and environment, but they are not decisive for the delimitation of the activities.

3 Time and environment

In the field of consumption and environment it is usual to consider the environmental impacts of consumer spending on different consumption categories such as food, housing and transport (survey in (Røpke 2001)). This approach seems obvious as the environmental impacts are directly related to the materials, energy and land appropriation associated with the provision (and waste handling) of goods and services and with the use practices. Furthermore, this approach can apply the categories in production statistics and the statistics on energy and materials coupled to national income account statistics. The approach can also be used in relation to leisure goods as the statistics include categories related to leisure and tourism; for instance, it is possible to calculate energy intensities per monetary unit used for sports- and camping equipment, for restaurant visits, for radio- and television sets etc. (Munksgaard, Pedersen, and Wier 1998; Biesiot and Moll (Eds.) 1995). Combined with statistics on the increasing spending on leisure goods and services, such data can give some indication of the environmental implications of leisure consumption.

However, the focus on leisure calls for a different approach with a focus on time use and activities instead of categories of consumer spending. As described above, leisure is usually conceived from a time perspective or an activity perspective which calls for considering the relationship between time use and leisure activities on the one hand and environmental impacts on the other. As Mikko Jalas (Jalas 2002; Jalas 2004) has demonstrated, the combination of time use studies, consumption statistics and environmental statistics can provide illustrative information about the environmental impact of time use, although the approach is still in the infant stage. In this paper we are not aiming at providing quantitative results but we apply the same idea as the basis for organizing the discussion on the environmental impacts of leisure activities.

From a time and activity perspective, the environmental impacts of leisure can increase in three ways:

- More time for leisure.
- More resource-intensive activities.
- More activities per unit of time.

With T for time, A for activities and R for resource, we have the environmental impacts expressed as resource use depending on time, activity-intensity per time unit and resource-intensity per activity:

$$R = T \times A/T \times R/A$$

Increases in the average resource-intensity per activity R/A can result from both a general trend of increase and from changes in the composition of activities, that is, a shift towards relatively resource-intensive activities at the expense of less resource-intensive activities. Below we deal with the general trend and the changing composition separately, so we refer to four factors or dimensions.

A few caveats should be noted immediately. Firstly, the factors are interdependent. For instance, more time for leisure can open up for less resource-intensive activities. Secondly, for more leisure time to have increased environmental impacts it must be accompanied by either more money for acquiring leisure goods or a shift towards activities that are more resource-intensive per money unit.

Thirdly, leisure activities are intertwined with each other and with non-leisure activities, so it is not obvious which environmental impacts should be attributed to a separate activity. Take do-it-yourself activities as an example: should the resources used for DIY be attributed to housing or to the DIY activity (whether this is considered a leisure activity or a part of household work)? Is gardening a peaceful activity with few environmental impacts (except for the eventual use of pesticides and electric equipment), or does it relate to the appropriation of land area involved in suburban housing? All the leisure activities taking place at home are somehow integrated with housing as a consumption category, and some activities encourage a high standard of housing – as for instance, the interest in socializing with guests at home. Similarly, in statistics the use of the car is considered a specific consumption category, but much car driving can be attributed to various leisure activities. Of course, the statistics offer a delimitation of leisure as a consumption category, that is, the purchase of equipment for leisure purposes and of leisure related services. However, this does not seem satisfactory as the basis for discussing the environmental impacts of the way we spend our leisure time.

A particularly interesting example of intertwining is shopping as all the purchases, and thus indirectly the whole system involved, could be attributed to a large number of various other activities or consumption areas so shopping could be seen as a completely environmentally neutral activity. Simultaneously, this is counter-intuitive as shopping for many people

encourages the purchase of things that make other activities far more resource-intensive than they would be without this stimulating experience.

Because of these definitional problems it can be difficult to assess the resource-intensities of various activities. In a qualitative perspective we can point out some features which contribute to a relatively low resource-intensity of an activity per unit of time. This holds when the activity

- is time-consuming
- requires few material devices
- uses shared facilities
- takes place close to home, involves little transport
- requires concentration on one thing at a time.

Good examples of leisure activities with low resource-intensity are reading books from the local library, sleeping an extra hour in the morning, having a long talk with family or neighbours, taking a local walk. However, when many other activities are considered the definitional problems complicate the discussion.

The paper is structured according to the four dimensions of the environmental impact of leisure: leisure time available, general resource-intensity of activities, the number of activities per unit of time, and the composition of activities. However, before we embark on the exposition of the different dimensions separately, we will briefly introduce a general economic theory on time allocation as well as some general socio-psychological considerations concerning motivations for engaging in leisure activities.

4 Economic theory on time allocation

In literature on leisure in a time perspective a reference to Staffan Burenstam Linder's famous little book *The Harried Leisure Class* (Linder 1970) is close to obligatory. Although Linder's theory on time allocation is very general and abstract, it provides an interesting perspective which we will refer to several times in the following sections, and this outline serves to make the references understandable. The theory is based on the fundamental principles of neoclassical economics, and Linder extends these to incorporate time as a resource. His approach is thus the same as that introduced by Gary Becker almost at the same time, but Linder's reflections are more directly applicable for the purpose of this paper. Linder's book is very thoroughly prepared so this brief summary cannot do justice to all the subtleties of the arguments and the illustrative examples.

Linder takes his point of departure in the statement that time can be considered to be a resource comparable to other resources (he notes that this idea does not make sense in cultures with low productivity and time surplus; such cultures do not share our concept of time). Whereas the importance of labour time is generally acknowledged by economic theory in relation to production, economists do not take into account that also consumption takes time. Consumption is usually considered to be an instantaneous act, and individuals only experience two forms of time: labour time and "free time". When it is acknowledged that consumption takes time, individuals face a

more complicated task of allocating their time between different activities. Linder distinguishes between five different categories of time (p. 13f):

- Working time, also called time spent in specialized production.
- Time for personal work, subdivided into two types: the maintenance of one's body (sleep, personal hygiene etc.) and the maintenance of consumption goods.
- Consumption time, that is, the time spent enjoying consumer goods.
- Culture time which is time devoted to the cultivation of mind and spirit.
- Economic free time which is time that is not utilized. It can be time in passivity and "slacks" in the use of time.

When an individual spends time in one these categories, he or she gets a yield of "utility" (or well-being, pleasure), and in accordance with basic neoclassical ideas, individuals are supposed to maximize the yield per time unit. This implies that the marginal yield will always tend to be the same for all categories and subtypes.

In the course of economic development the yield on working time increases because of productivity and income increases, and as incomes rise, the demands for yield on the use of time increases. Linder argues that the first "victim" of this process is economic free time: fewer "slacks" will be tolerated, the degree to which time is actively utilized will increase, and the pace of life will quicken (p. 16). This fits well with the observation of the attitude towards time in different cultures ((Russell 2005), Chs. 5 and 12). When time in passivity is reduced, the marginal yield of time in passivity increases, and the equilibrium is re-established.

The rising income also calls for increasing yield of consumption time, and Linder argues that this can be achieved by the acquisition of more consumption goods. The idea is that consumption is a process where the individual produces "utility" by combining the two inputs, time and consumption goods, and when the quantity of one or both inputs increases, so does the output. Furthermore, the inputs are substitutable so a decrease in consumption time can be offset by an increase in the quantity of consumption goods. When the yield on working time increases, time as a resource becomes more expensive (the so-called "shadow price" increases), and therefore, it becomes more "profitable" to use less time and more goods in the consumption process. The result will be an increasing goods intensity per unit of consumption time.

The argument is highly abstract, but Linder illustrates this acceleration of consumption with some examples (p. 79): a more expensive version of a commodity can be used for the same activity; a consumer can enjoy more than one consumption product at the same time; or the consumer can enjoy one commodity at a time, but each one for a shorter period.

Consumption activities differ with regard to the possibilities for increasing the yield by the addition of consumption goods. For some activities the pleasure can hardly be increased at all by trying to increase the goods-intensity, whereas in other activities the yield can be increased markedly (p. 80). When goods become cheaper in the course of economic development, the goods-intensive activities become more attractive and

more time will be devoted to these at the expense of other activities, the pleasure of which cannot be increased by more goods. This development hits cultural activities particularly hard, as the pleasure derived from time spent in developing the mind and spirit is very little dependent on goods (p. 95). Of course, it is possible that a change of tastes will appear so some cultural pursuits expand in spite of the impacts of cheaper goods, but Linder finds few examples (p. 106).

When the goods-intensity of our activities increases, we become ever more busy because the goods have to be maintained and we have to make ever more spending decisions. People with higher than average incomes can afford to pay others for doing some of the maintenance and spending work, but the well-paid, simultaneously, tend to work more in the specialized production so, in general, busyness will increase. Also in the personal work we try to increase productivity by adding more equipment (e.g. washing machines) which adds further to the need for maintenance and thus to the busyness.

Linder is critical towards the development he identifies and argues that the acceleration entails risks. Relaxed enjoyment becomes more difficult; ancient and venerable pleasures like enjoying a meal and making love will be subject to tough competition for time; and the hectic life can be fatal for activities that require excellence, discipline, and patience (Ch. VII). Linder also briefly mentions the environmental impacts of the growth mania (e.g. p. 140). These risks are exacerbated because many people underestimate the maintenance requirements of goods and acquire articles without reflecting on the time it takes to use them – and thus make suboptimal decisions. In the end of the book Linder expresses the hope that perhaps “being constantly chased by a scarcity of time will some day be recognized as an .. undignified way of life” (p. 145).

The neoclassical language of optimization, including the idea that individuals allocate their time so as to achieve the same marginal yield on all activities, is highly questionable. However, in a less abstract form Linder’s reasoning makes good sense, and it can be supplemented with psychological, sociological, and historical perspectives which explain some of the conditions that Linder takes as given.

5 Motivation and leisure

Linder’s economic theory of time allocation tends to take it as a given fact that the yield on activities increases when the input of goods is increased. This makes good sense when standards improve for a given activity – it is nicer to watch a bigger television screen and to drive a more comfortable car. However, many activities change over time in combination with the changes of equipment and services. Here more social and psychological aspects of motivation must be included to account for the idea that people are interested in such changes.

In general, leisure researchers observe that concurrently with income increases consumers have become interested in spending more on leisure-

related goods and services and also in responding to the availability of new opportunities. As Klepp observes, a person who in the 1970s enjoyed nature by hiking and canoe paddling, can engage in hang-gliding and rafting today ((Klepp 1993) p. 19). Klepp explains this trend by referring to a universally human feature: in leisure activities as in so much else humans have a tendency to stretch themselves as far as possible (p. 19). To illustrate this he also uses a story by Mark Twain, where Tom Sayer gets the tedious task of liming 30 yards of hoarding on a hot summer day. By pretending that liming is both amusing and so difficult that few can manage it, Tom makes some other boys do the job for him and even to pay him to get the chance. Mark Twain's comment to this is that Tom has discovered an important law for human behaviour: for something to be experienced as attractive, it must be difficult to obtain (pp. 7, 19). This issue is elaborated in the leisure literature on intrinsic and extrinsic rewards.

As we touched upon in relation to the definition of the leisure concept, freedom is usually seen as a core attribute of leisure. Therefore, much literature on leisure has a strong focus on choice and motivations, and the concepts of intrinsic and extrinsic rewards are drawn in from motivational theory. Intrinsic reward comes from doing something for its own reasons, whereas extrinsic reward is about doing something for an external payoff ((Russell 2005) p. 43f). Intrinsic rewards can arise from the simple pleasure of engaging in something, for instance, the enjoyment related to moving the body in dancing, or it can be related to enjoying the feeling of being competent or the pleasure of learning something new. Extrinsic rewards can be related to engaging in something because it is important, for instance, for keeping fit, for being part of a group or for improving one's chances on the labour market. A leisure activity can thus be instrumental rather than an end in itself. Although leisure researchers are aware of the importance of instrumental aspects, they prefer to focus on the intrinsic rewards – seeing leisure activities as emerging from play that is intrinsically motivated and, simultaneously, so decisive for children's development. Through play children acquire physical, cognitive, emotional and social skills (Bull, Hoose, and Weed 2003), p. 28ff). As play often involves a process of progressive expansion into new aspects and skills, it is not surprising that leisure reiterates this pattern: when income increases open up new opportunities for developing leisure activities and skills, there will be a strong motivation to try¹.

Intrinsic rewards are particularly pronounced when a person is strongly committed to a particular pastime, in some cases the main source of personal identity and meaning in life ((Russell 2005), p. 61f). This kind of activities have been termed serious leisure: serious leisure is “the systematic pursuit of an activity that participants find so substantial and interesting that, in the

¹ A special case of extraordinary experiences concerns the increasing interest in extreme sports as well as other extreme or risky activities involving, for instance, the ability to endure pain (e.g. the suspension of the body in hooks). Russell argues that risk in leisure is mainly motivated by intrinsic rewards: “Risk in leisure gives us a sense of freedom, control over ourselves and the environment, and an escape from the ordinary routines of life. We gain the knowledge that we are able to cope with our fears” ((Russell 2005), p. 65).

typical case, they launch themselves on a career centered on acquiring and expressing its special skills, knowledge, and experience” ((Stebbins 1992), p. 3). Whereas serious leisure refers to the most committed form of leisure activity that continues over a long time, requires much effort, and is decisive for self-identification, Stebbins uses the term hobbyists about persons who are also enthusiastic about their pastime, but do not prioritize this above everything else in the daily routine

((Russell 2005), p. 62, (Stebbins 1999)). Further down the commitment scale we find casual leisure where little or no training is needed to take part.

In addition to the intrinsic rewards, the development of more advanced leisure activities offers extrinsic rewards as well. The literature on consumption often emphasizes the importance of status-seeking and identity formation in modern societies. In a status-race perspective it can be pointed out how leisure activities, which were previously a privilege of the few, have diffused widely concurrently with economic possibilities – as exemplified by golf, horse riding and travelling abroad. When these activities no longer function as distinguishing signals of the propertied class, there is an incentive to search for new signs outside the reach of ordinary people – such as luxury cruising. In a broader perspective leisure activities constitute an important part of the modern individual’s efforts to form his or her own identity. Work is still a core part of identity formation, but leisure takes on increasing importance in sending signals about who we are, both within a social group and in relation to other groups. Although social groups differ with regard to the kind of activities that are important, the trend towards increasing demands is shared: the DIY people embark on ever more advanced tasks, the cosmopolitans travel to ever more exotic destinations, and the beer enthusiasts know even more specialized beer types. To contribute to the talking about experiences in one’s social group it is decisive to be able to tell something new and preferably a little extraordinary – the ordinary experience is a quickly exhausted topic. This means that even people, who would be content to continue pursuing the activities in the way they are used to, will experience a certain pressure to change. In consumption sociology this issue has a high priority, but in leisure studies the whole question of positioning seems far less central than intrinsic rewards. Illustrative of this is the very low priority given to Bourdieu’s thoughts by both Russell and Bull et al. This priority fits well with the observation by Warde (Warde 2005) that Bourdieu tends to underestimate the importance of intrinsic rewards.

Extrinsic rewards of leisure do not necessarily concern status and identity, as they can also be related to various specific concerns of everyday life. For example, the busy life that many people experience in modern society increases the importance of weekends and holidays as the time for being together and confirming the links in the family. In particular, when families are separated by work and other activities during most of the week, the demand seems to increase for making the shared family time or time with the partner into something special – something that will be remembered. This calls for activities that tend to be more resource-intensive than ordinary relaxation. For instance, families with teenagers face the problem of how to tempt the young people to participate in family time such as holidays, and

they may be easier to persuade if they are invited to go to nice skiing resorts or exotic travel destinations than to a nearby holiday cottage.

In general, the leisure and consumption literatures complement Linder's observations regarding the interest in exploiting ever more exciting opportunities. In the following we will deal with the environmental implications.

6 Time for leisure

The environmental impacts of leisure can increase in relation to an increase in leisure time, provided that people can afford to spend more on leisure pursuits. What has happened to the time available for leisure?

Leisure in the modern sense of the word – as time left over after work and time to be spent at will – is a relatively recent term related to industrialization. In the early days of industrialization very long working hours left little time for leisure or even for the necessary recovery, and the question of the length of the working day was a core issue for the emerging labour movement. Working hours were gradually reduced, and since the introduction of the 8 hour day in most industrialized societies around the First World War the attention turned towards the introduction and extension of holidays. Whereas the 8 hour day and the first holidays were justified mainly in terms of physiological needs, public health and the related benefits for productivity, the later extensions of holidays were also seen as contributing to personal development and possibilities for a richer life ((Klepp 1993), p. 9f). The number of holidays increased, and after the Second World War this issue was supplemented by the reduction of working hours on Saturday ending up in the introduction of the free weekend in the 1960s. For the long period from the late 1800s to the 1970s leisure time generally increased in industrialized countries. As productivity increases were transformed into a combination of higher incomes and more leisure time, it was also possible to spend more, and consumption related to leisure pursuits has increased dramatically, in particular after the Second World War.

Since the 1970s the picture has become more mixed (Linder actually observes this already in the late 1960s, (Linder 1970), p. 135ff). The statistics are highly disputed (see e.g. (Schor 1997;Schor 2005), but the Americans seem to be the first to turn the trend and increase the number of working hours from the 1970s, followed by the UK and Australia (Bunting 2004;Beder 2000). In many European countries the previous trend towards a shorter working week and longer holidays has either slowed down or come to a halt, and a reversal may be on the way (see e.g. (Bonke 2002;Schor 2005). One of the reasons why the trend is disputed is some groups of full-time employees experience an increase in working hours, while other groups are underemployed and have involuntary leisure time ((Schor 1997), p. 6;(Bonke 2002), p. 41f). A further complication is that the participation rate of women in the labour force has increased dramatically (starting at different times in different countries), and double-income families with children tend to work long hours.

In general, increasing leisure time does not seem to be contributing much to heavier environmental impacts – maybe except for longer holidays in some countries (in other countries, such as the UK, many people do not even take the holidays they are entitled to (Bunting 2004)). However, as people live longer, a larger share of leisure over the lifetime will be in old age, and in an environmental perspective, the factor of increasing time for leisure seems particularly interesting for the group of retired people who are simultaneously well off, for instance, due to the possibility for realizing gains on property.

7 The resource-intensity of activities

On the basis of sections 4-5 above it can be argued that leisure activities, in general, tend to become more resource-intensive over time. In this section we deal with some of the more specific explanations behind increasing resource-intensity as well as the minor counteracting forces. We focus on the phenomenon that more resources are used for a given activity within a certain space of time, whereas the trend towards compressing activities is dealt with in the next section.

The first obvious point is that the increase of leisure time implied the development of market opportunities: time for leisure is time for application of leisure equipment. Bull et al. state: “While many ... home-based activities have been pursued for generations, what is relatively new is the huge demand for associated artefacts and literature and an equally massive industry and related retail business that is ever eager to supply such demand” ((Bull, Hoose, and Weed 2003), p. 61) – and this trends obviously holds for activities outside the home as well. Examples are the explosive development of equipment for sports and DIY activities as well as the variety of toys and media equipment (p. 60ff). As part of this process goods are often specialized and diversified, as illustrated by, for example, the increasing variety of skiing equipment. The specialization can be observed, for instance, in relation to magazines, here for the United States: “Even though many general-interest magazines have failed, there is a growth market for specialized publications based on specific leisure interests such as gourmet cooking, sports, fitness, biking, camping, and travel. For example, just within the sports category you can subscribe to thousands of titles ranging from cheerleading to paintball. For surfing alone, 16 different titles are available” ((Russell 2005), p. 214).

When goods are supplied for the pursuance of leisure activities, these tend to become more materialized. Some activities, which were carried out with little or no equipment, now tend to require various devices. An example can be physical exercises that are carried out in machines and with certain devices, just as playing chess can be supported by training with a chess computer. Other activities have always required equipment, as for example skiing. The process of diversification implies a wider selection of equipment, but variation does not necessarily make a specific activity more materials-intensive per time unit: whether you take the skiing slope with Telemarken skis or snowboard is not so important. However, the wider selection of

specialized equipment tends to imply that each person invests in more equipment to try out different variations of the activity, so the investment per time unit increases, and each person tends to store more things.

The second and related point is the commercialization of leisure activities. Activities that could be carried out outside the reach of the market are drawn into the market through the provision of leisure services. An example is angling that could be carried out freely, but now often takes place in organized put-and-take dams. Or take an American example that still seems surprising to Scandinavians: “take the state park lake beaches in Indiana. Children are not allowed to use inflatable toys, mattresses, snorkels, or fins, or even throw a beach ball around. But an hour’s drive down the road, kids can play with an inflatable raft and other toys at a commercial water park – for 30 dollars admission” ((Russell 2005), p. 345). Russell (p. 193ff) also describes different types of parks that are characterized by a combination of possibilities for nature experience, sports activities and entertainment with a strong commercial strain. Enjoying nature thus becomes intertwined with commercialized offerings such as boat rentals, swimming pools, and zoos, and more space is “enclosed” as areas for commercial leisure activities. Commercialization implies that sellers are interested in attracting customers, and competition calls for a continuous development of leisure opportunities that are exciting and attractive.

Russell relates commercialization to a trend towards increasing institutionalization, in particular of children’s leisure. She argues that “Protective parents, school officials, and lawmakers are gradually building a safety net that threatens to trap children too in a tangle of scheduled worklike activity” ((Russell 2005), p. 344). Children are enrolled in structured recreation programmes, and “among children ages 12 and under, unstructured time declined from 40% of a child’s day in 1981 to 25% in 1997” (p. 345). In Scandinavia, we see the same trend towards increasing institutionalization and organization of children’s leisure – although not as closely integrated with commercialization as in the US. It seems likely that institutionalization calls for increased resource-intensity for suitable premises and equipment, also when the activities are not commercial.

Based on the interplay between consumers’ leisure motivations and the supply of leisure goods and the commercialization of leisure activities, it is not surprising that leisure activities tend to become more resource-intensive. Business offers new ways of carrying out leisure pursuits, and trying these new ways offers both intrinsic and extrinsic rewards. New ways do not necessarily imply increases in resource-intensity per time unit, but commercialization tends to produce this result. Spending more money often implies the mobilization of more resources – although opposite examples can also be found, typically in the case of labour-intensive services.

The dominant picture is that leisure activities become more resource-intensive, but a few counter-trends can also be found. The leisure literature is very sparse when it comes to environmental perspectives, and when environmental questions are actually dealt with, the main issue is the management of natural resorts used for outdoor recreation and tourism. The

growth in outdoor recreation and tourism had increased the pressure on various natural habitats because of construction work, e.g. related to skiing, behaviour such as littering and collecting specimen samples, and general over-use. This development has led to more focus on managing natural resorts to secure the qualities for leisure also in the future ((Russell 2005), p. 188ff;(Bull, Hoose, and Weed 2003), p. 144f). The emergence of eco-tourism is an example of a somewhat broader perspective where the interest in preserving natural habitats, at least in some cases, is combined with the pursuance of energy- and water-savings. Another example of environmental considerations is the reduction of the use of pesticides for the management of golf courses.

8 Activities per unit of time

Whereas the previous section deals with the trend towards increasing resource-intensity for specific activities, this section concerns the trend towards compressing activities in time either by “simultaneous consumption” – doing more things at the same time – or by “successive consumption” where each activity takes up a shorter time so more can be achieved (using Linder’s terms, p. 79). The documentation is overwhelming that such a speed-up is taking place, and there is little doubt that this contributes much to the increased resource-intensity of leisure activities per unit of time.

Naturally – related to the reason for taking on the profession in the first place – leisure researchers are concerned that at least some leisure can be characterized as leisurely, and they express concern that increasing pace tends to make leisure “unleisurely” and characterized by the feelings of rush and duty ((Russell 2005), p. 355). Russell, who is clear in her normative judgements, says: “The consequence of time urgency for leisure can include participating hurriedly in an activity or choosing particular activities because they take less time. This is a malady for leisure. How much real pleasure and satisfaction can be derived from learning to play the guitar in “three easy lessons”, eating dinner in less than 10 minutes, or traveling through Europe in a week? ... Leisure requires tranquility, letting go, not being in a hurry. ... Even in leisure we are on the fast track. Isn’t this all rather ironic?” (p. 352f). She also says: “Although we still use the word “pastimes”, for many of us it is almost impossible to think of simply letting the time pass” (p. 349). Based on a study by Robinson and Godbey, Russell argues that modern leisure is characterized by time deepening (also called multitasking) where multiple activities are piled into the same time frame. For instance, radio is almost exclusively a secondary activity, and television is going the same route (p. 354).

Bull et al. argue along the same lines that key groups in society are ‘time poor, money rich’ and try to make the most of the limited time available for leisure: “People will clearly be prepared to spend additional money to utilise their leisure time more efficiently”, and business is ready to respond to the money rich, time poor situation, for instance, by providing new leisure complexes to cater for those who want several leisure experiences in one location – cinema, bowling, shopping, fast food outlets, pub and nightclub

((Bull, Hoose, and Weed 2003), p. 286). They cite a newspaper article to illustrate how people participate in individual activities for shorter periods of time: “Instead of going to the gym for a couple of hours, people will have 20 minutes on the running machine, 10 minutes surfing in an internet café, see a film and have a meal – all within the same leisure centre.

Others have observed the increasing pace in many different activities. For instance, Southerton refers to Roberts who shows how the tempo of leisure practices has ‘sped-up’ and uses the example of dancing ((Southerton 2005), p. 80).

As mentioned in section 4, Linder observed the paradox that people intend to increase the yield on their leisure time by being more busy, and simultaneously, the busyness tends to undermine the joy of many activities. How comes that people are willing to accept the harriedness? It is not only a kind of suboptimal decisions, as Linder suggests, but rather the long historical construction of a culture of busyness (Beder 2000;Darier 1998).

Recent years have seen a growth of counteracting forces in the form of various movements for slowness, such as slow food, simple living and slow cities. However, this trend is (still) a minor undercurrent in relation to the dominant speed-up.

The trend towards compressing activities in time has consequences for the choice of activities which we will take up in the following section.

9 The composition of leisure activities

Although most leisure activities tend to become more resource-intensive over time, the relative resource-intensity obviously differs widely, so the composition of activities is important for the overall environmental impact of leisure. In this section we will highlight new trends in the development of leisure activities identified in the literature on leisure and consider whether there are any systematic changes towards relatively more or less environmentally problematic activities.

First, leisure researchers identify a fall in time-consuming activities, just as Linder predicts. According to Russell, leisure activities that require a long time to learn are avoided (p. 355), and she deplores this phenomenon: “One sadness of contemporary society is that activities requiring more extensive time are being displaced in popularity by others with a shorter time frame” ((Russell 2005), p. 359). Also Bull et al. argue that problems with leisure time “will make it less easy to devote substantial chunks of time to a particular hobby and thus the level of interest will remain superficial, a state also influenced by the fast pace of modern lifestyles and the constant search for new experiences” ((Bull, Hoose, and Weed 2003), p. 285). Whereas it is obvious that the compression of activities increases the demand for resources, it is less obvious what a relative decrease in “serious leisure” implies for the environmental impact. In some cases, such leisure pursuits can encourage the acquisition of much and advanced equipment (e.g. angling), but this equipment will tend to be used for long periods of time

which keeps down the resource-intensity per time unit. In a dynamic perspective, it can be argued that experts in a leisure pursuit will drive the development of more advanced equipment, and this may inspire others to invest in new things although they are not as enthusiastic about using much time on an activity.

The feeling of time shortage combined with a search for interesting experiences is reflected in a trend towards short vacations. Bull et al. observe that many people now take multiple holidays, often short breaks taken with a particular activity, event, or pastime in mind ((Bull, Hoose, and Weed 2003), p. 231), and these 'short break' holidays are the fastest growing segment in tourism (p. 285). In the US "the trend in vacations is multiple three-day excursions spread throughout the year rather than the traditional two-week trip in the summer" ((Russell 2005), p. 359). In both cases the trend is environmentally problematic.

Not only the time requirements, but also the time flexibility influences the choice of activities. In a study of temporalities in everyday life, Southerton emphasizes how practices conducted with others, particularly those which involved non-household members, required a comparatively high degree of coordination and arrangement ((Southerton 2005), p. 88). Such coordination can be difficult when schedules are tight, and Bull et al. argue that this is reflected in the choice of sports activities: participation is shifting from traditional sports towards fitness activities that "require less regularised commitment and can be organised and reorganised around other work and family commitments as, unlike many sports, they are essentially individual activities" ((Bull, Hoose, and Weed 2003), p. 226). Again it can be difficult to assess the environmental impacts, as long as both types of activities make use of shared facilities. However, fitness activities might move home and thus increase resource-intensity.

As everyday life tends to become more fragmented, much of the free time consists of time slots left over between activities, and this time can be difficult to use in a meaningful way (Larsson and Sanne 2005). Larsson and Sanne argue that this contributes to the feeling of time shortage, and it seems probable that the fragmentation also offers difficult conditions for serious leisure (in particular, for women who experience the fragmentation most clearly).

Although it is difficult to get clear estimates, Russell argues that shopping has developed into a favourite pastime of North Americans: "Visiting shopping malls is for many a preferred form of evening or weekend recreation" (p. 327f). This development is encouraged by the combination of shopping and entertainment. A prominent example is Mall of America in Minnesota, where shopping is combined with theme parks, an aquarium, a Dinosaur Walk Museum, bowling, night clubs, and theaters. It is divided into four themed "streets", for instance, one of them resembles a European train station, another includes features from the 1920s. As Russell says, "shopping and fun go hand-in-hand" ((Russell 2005), p. 328, www.mallofamerica.com).

The popularity of shopping is also encouraged by television feeding consumers with an impressive number of commercials every day. In an interview with Arlie Hochschild in *Journal of Consumer Culture*, she argues that hard work, television viewing and shopping have developed into a total system, “a life-style totalitarianism” ((Wilson and Lande 2005), p. 278). “Many workers put in long hours, and return home exhausted. They turn to television as a form of passive ‘recovery’ from work. In the four hours of television, they’re exposed to thousands of amusing, fun advertisements. Those ads function as a conveyor belt to the mall. At the mall, they spend the money they’ve earned on objects that, I argue in *The Time Bind*, function as totems to a ‘potential self’ or hypothetical self – a self we would be if only we had the time” (p. 277). The last point adds a more complex psychological explanation to the phenomenon that we buy things which we do not have the time to use. It is not only because we underestimate the time necessary for use and maintenance of the goods, as Linder argued, but the result is the same. As Hochschild says: “For many people, there is virtually no life outside work, television and the mall. There is no time for political activism, for civic engagement, for fishing trips with the family, for simple self-reflection” (p. 278). As already mentioned above, the increasing importance of shopping as a pastime will probably tend to increase the resource-intensities of many leisure pursuits, and here it can be added: even when they are not carried out in practice.

For a long time households have tried to free time for leisure by rationalizing the housekeeping chores such as washing, doing the dishes, cleaning the house (sometimes with paradoxical results such as more laundry instead of less time). In societies with large income differentials it has also been possible for the well-off to employ servants to carry out such chores and to take care of children. Some workplaces also try to help their employees with the household work by providing dry cleaning, prepared meals, and help with shopping ((Wilson and Lande 2005), p. 278). A recent trend is that some of the “money rich and time poor” have begun to outsource tasks which have hitherto been considered to be leisure activities and ‘family roles’ such as organizing dinner parties, planning holidays, and assembling photo albums ((Wilson and Lande 2005), p. 288, (Bull, Hoose, and Weed 2003), p. 286). “Real” leisure is condensed to activities where it is impossible to let someone else do it for you without completely losing the joy of the activity (Schmidt 1990). It is not obvious what this shift implies for the resource-intensity of leisure, as on the one hand, it is a means to achieve more and in this sense it is problematic, but on the other hand, it implies an increase in the labour-intensity of the money spent for leisure.

In general, the composition of leisure activities tends to change in a the direction of more resource-intensive activities. However, it is also possible to identify counter-trends, such as, for instance, the impressive growth of gambling, in particular in low-income families ((Russell 2005), p. 271ff).

10 Concluding remarks

In this paper we have tried to bring leisure into focus for an environmental perspective. Although the environmental impacts of leisure

are analysed more indirectly in studies on consumption areas such as mobility, food and household electricity use, we hoped for new insights by focusing directly on leisure activities – and not only dealing with tourism. The basis for possible new insight arises from the call for the application of a time perspective and for dealing with activities rather than categories of consumer spending.

Looking into the leisure literature with an environmental perspective is not encouraging. The dominant trends point towards an ever increasing resource-intensity of leisure as most activities become more goods-intensive, as more activities are compressed within the time set aside for leisure, and as there is a shift towards more from less resource-intensive activities. Leisure time does not seem to increase, but the increasing resource-intensity per unit of time ensures a higher environmental pressure. The efforts to improve the environmental profile of selected activities (eco-tourism, landscape planning) can be relevant and useful, but the results will be marginal in relation to the overall trend. This insight is in accordance with other studies on consumption and environment stating that efficiency achievements are counteracted by growth, sometimes encouraged by rebound effects. The achievement of efficiency gains by providing various services with less environmental impact – such as reduced use of petrol per kilometer, detergents per load of laundry, electricity for lighting a 40 watt bulb – is often followed by growth, for instance, in driving, laundering and lighting.

In addition, the time perspective highlights the costs related to the quality of life: the compression of activities in time leads to hurriedness, the feeling of time shortage and stress. Linder's point that consumption takes time is more relevant than ever. Furthermore, we are facing the paradox that, on the one hand, the puritan barriers to enjoyment have been broken down, and on the other hand, the feeling of duty and obligation encroaches upon leisure because of the busyness. When the environmental agenda is translated into demands for efficiency improvements and conscious consumer behaviour, it can even increase the busyness ((Jalas 2006), p. 64;(Darier 1998)). The time perspective thus invites the idea of a possible "double dividend": if we turn the tide and reduce the pace of everyday life, we can achieve both environmental improvements and a better quality of life. We should aim at 'wealth in time' instead of 'wealth in goods', as Reisch puts it (Reisch 2001). There are many potential advantages of having plenty of time. It is easier to enjoy what one is doing when not under pressure – the so-called 'process benefits' of an activity are not undermined (Reisch 2001;Jalas 2006); leisure researchers would emphasize the improved possibilities for 'serious leisure' and flow experiences where you forget yourself (Czikszentmihalyi 1997). In the terms of Jalas, temporal wealth opens up for autotelic action and intrinsically meaningful time (Jalas 2006). Furthermore, it is easier to follow one's personal rhythms and to adjust to the seasons as well as to the schedules of significant others ((Reisch 2001), p. 377f).

The various slow movements illustrate that some people actually take the consequences and try to arrange simpler lives to improve the quality of life. However, these people still constitute a small minority, and few of them are motivated by environmental concerns (Cohen, Comrov, and Hoffner

2005;Maniates 2002). However, the potential for change might increase due to the surge of stress-related diseases and the risk that this might pose to the economy. Still the stress is nearly exclusively seen as an individual issue as reflected in the many self-help books (Larsson and Sanne 2005), and most individuals try to manage the challenge of the busy life instead of replacing it with a more quiet one.

It is much discussed whether the present feeling of time shortage mainly emerges from the increased pressure at work and to which extent the ambitions in private life contribute (Schor 1991;Robinson and Godbey 1999;Schor 1998). In accordance with Linder's arguments, we will argue that the two aspects are not opposed – they are rather interdependent: when people work hard and earn much, they also have high ambitions regarding their achievements in private life (or they try to compensate their lack of achievements by buying things). So the question is how to break up this 'package'.

In principle, the motor could be slowed down: political decisions to tax the use of resources much more heavily would turn the focus towards increasing resource productivity instead of labour productivity, and real incomes would not grow or maybe decrease. Another possibility could be that people chose to work less and thus to have more time at the expense of more goods. This could be encouraged by time policies such as a shorter work week. Or the two possibilities could be combined.

Presently, it is not easy to see the popular support for such policies. The idea of busyness as something desirable is certainly under attack, but the desire to increase standards and to have ever more exciting experiences is generally not questioned. We wonder whether changes in the thinking about leisure activities could be a key to change – in addition to the frustration related to time shortage and stress.

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TOU; The INVENT-Project – T-EDU Travel and Holiday Styles

Target Groups for Sustainable Tourism

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1 Introduction

Holidaymakers want sun and beach, fun and excitement, relaxation and a break from everyday life. These are core needs and wishes – which cannot and shouldn't be changed. But when masses go on holiday, especially to long-distance destinations, this leads to pollution of the environment and also to adverse social and cultural effects. One of the key ecological indicators is greenhouse gas emission. With a share of just 3.5 percent of the total holiday market, long distance holidays, alone account for 20 percent of greenhouse gas emissions.

Although there are many holidays already on offer that minimize this effect, they are mostly niche offers for tourists particularly interested in and committed to ecological and social issues. The share of these holiday-packages comes to less than one percent of the total German holiday market, which all in all comprises around 147 million holiday trips.

In order to create a more sustainable mass market, however, new solutions are required that are directed at the desires of the average holidaymaker. The basic idea behind the INVENT-Project is therefore to invent innovative marketing concepts that lead towards more sustainability within the mass market. But before I show you the main results I want to introduce the INVENT-Team.

2 The INVENT-Team

- The Institute for Applied Ecology (Öko-Institut), Berlin (Project Management)
- The Institute for Social Ecological Research (ISOE), Frankfurt/Main (Social and Marketing Research)
- The University of Lüneburg (Tourism-Marketing)
- The tour operators AMEROPA-REISEN GmbH (Product development)
- The German Railway, Deutsche Bahn AG (Product development)

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The main emphasis of our efforts lies in the detailed analysis of the expectations and needs of mass tourism.

3 Methods

For this purpose an elaborate social-empirical design was developed:

1. Qualitative Phase (4 focus groups; 60 qualitative interviews)
2. Representative Phase (random sample: 2000; face-to-face interviews)
3. Product Test (4 focus groups)

4 Questions about holidaymaking

- Preferred destinations
- Activities
- Holiday orientations
- Lifestyle orientations
- Destinations in the last two years
- Questions about holidays in Germany
- Attractiveness of holiday packages which are more ecologically oriented

5 Questions about mobility

- Means of transportation used to get to the station or to the airport
- Means of transportation used to reach the holiday destination and to get back home
- Distances travelled
- Means of transportation used at the destination
- Attractiveness of alternative means of transportation

6 Results

The main result is a target group model on travel and holiday styles that was used as a basis to develop innovative holiday products. Let us first take a brief look at the model as a whole.

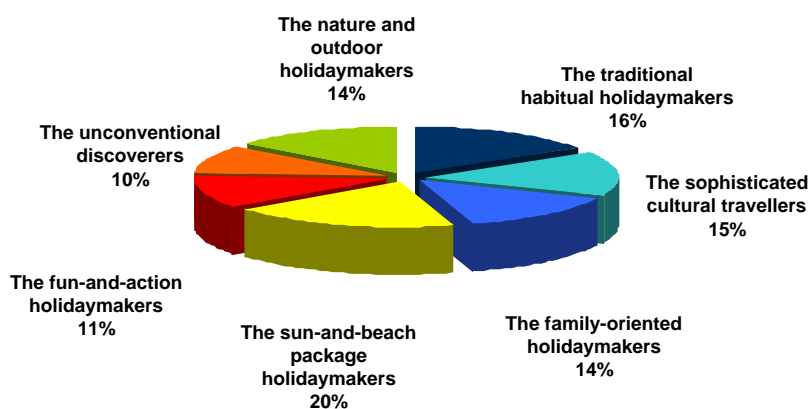


Figure 1: Holiday and travel styles

Now I want to take a more detailed look at the following three groups. First: *Traditional habitual holidaymakers*. Socio-demographic and lifestyle data show: In this group there are more women than men; the majority is older than 60; they have modest school qualifications; a number above average are retired. There is a low level of income; orientation goes towards simplicity, security, conventionalism and reliability.

Travel and holiday orientations show: This group likes to travel to familiar destinations they are accustomed to; important is the security of the holiday destination and cleanliness of accommodation; they prefer holidays within German-speaking countries because they feel insecure with respect to foreign cultures. This is the core target group for holidays in Germany, but also in Austria and the German-speaking part of Switzerland. The number of plane users is below average whereas the number of car users is above average which is also true for the use of trains and coaches. So this seems to be a main target group for public transportation.

Now an extremely different group: *Fun-and-Action-Holidaymakers*. Socio-demographic and lifestyle data show: This is the youngest group within the target group model. Around two thirds of them are men; the majority is single and lives alone; they have an average standard education and below average income; their attitude is self-centered and hedonistic; they want to experience something new and are geared towards fun, action and flirtation. The travel and holiday orientations show: What they want is beach life and sport during the daytime and parties at night. For them, holidays are a chance to meet people. And – this is very important – there is a clear price awareness and tendency to take advantage of special offers. This is a target group for inexpensive beach holidays with an attractive night life. The group also likes short city trips to go shopping and – of course – to have fun at night. It is a target group for last minute offers with an action packed programme. In this group the number of those who travel to long distance destinations and to the Mediterranean is above average. If we look at the means of transport we see that in this group the usage of plane is the highest compared to all other groups.

Again, now a group which is very different in comparison to the previous one: *Nature and Outdoor Holidaymakers*. There is a slight trend towards young and middle age groups – households with children are slightly over-represented. The representatives of this cluster show higher and middle education and higher and middle income. The lifestyle orientation shows a modern appreciation of ecology combined with social involvement. This is a target group for modern ecological offers: Ecology not in the sense of abdication and altruism, but in the sense of ecology as part of an attractive holiday offer and a prerequisite for the enjoyment of nature. They look for activity and change, especially outdoor sports and adventure, but they combine their activities with an orientation towards the family. They like active seaside holidays, but also holidays in the countryside, bicycling, hiking, and also wellness, fitness and winter holidays in the snow.

7 Conclusion

There are three different strategies to influence travel behaviour in a more ecologic way (In order not to complicate matters, the whole problem of the social dimensions of sustainability is left aside):

First Strategy: “Transformation by Packaging”: There are groups which if sustainability is mentioned, are explicitly afraid of paying higher prices and having less fun: The Fun and Action Holidaymakers. They don’t worry much about the destination. It makes (nearly) no difference if they have fun in the Dom. Rep., on Ibiza or in Bulgaria (the weather should be fine, so northern countries are not attractive). The most important thing is: The package should have the right ingredients and it should have the right price. Last but not least – we had to learn this in the project – the tour operator should have the right image. On that condition it is possible to motivate this group to have fun at closer destinations.

Second Strategy: “Convenient Public Transport”: The Traditionalists like to use the train and the bus as well as to visit German speaking countries. But usage of cars is also above average. So tour operators should provide offers which fulfil the specific core needs and wishes of this group:

- The possibility to be in a group with like-minded (not always, but as a change)
- To use train and bus, if transport chain is convenient
- To visit destinations which are familiar
- Feel always protected, secure and supported

Third Strategy I call “Leverage Lohas”: Lifestyle of Health and Sustainability (see the U.S. homepage www.lohas.com/journal): The nature and outdoor holidaymakers.

- They wish to enjoy nature and culture
- A good relationship to nature is not a moral duty but a benefit
- A modern understanding of sustainability can be part of marketing
- his also means: They want to be mobile at the destination – means of transportation should be an authentic adventure (e.g. typical P.T. of the region) or/and high tech environmentally friendly (e.g. bicycle with GPS) and family friendly.

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TOU; Sustainable consumption and production T-EDU in the domestic Chinese tourism market:

*The sceptics' challenge for sustainable tourism
in the Southwestern China biodiversity hotspot*

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1 Introduction

The number of registered Chinese domestic tourist trips rose from about 200 million in 1984 (He et al. 1999) to 1,212 million in 2005 (CNBT 2006). Income from domestic tourism in 2005 was RMB 528,6 billion – which is an increase of 12.2% over 2004 (CNBT 2006). The market for Chinese tourism services is mainly driven by price competition in the volume market. The booming tourism industry in China causes increased energy and resource consumption, and threatens ecologically sensitive areas (CNBS 2003, Han & Ren, 2001). These issues are particularly crucial in southwestern China, which is one of 25 global biodiversity hotspots (Myers et al. 2000), and a popular tourism region in China. This paper aims at achieving a better understanding of attitudinal factors that influence economic preferences of Chinese domestic tourist with regard to sustainable tourism services, i.e. with regard to sustainable consumption and production in the domestic Chinese tourism sector. In spite of the tremendous environmental effects of the booming industry, tourism research has largely ignored demand-side factors such as attitudes on and preferences for sustainable tourism services.

2 Methods

2.1 Background

Sustainable tourism and similar terms (eco-tourism, green tourism, etc.) are as precisely defined as the sustainable development concepts to which they refer. Following Shaw and Williams (2002) we defined sustainable tourism as a form of tourism, in which the economic interests of the tourism industry are embedded in a frame of a broader sustainable development of

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economic, cultural and social issues as well as a careful utilisation of the natural resource base (cf. also WTO 2004).

Chinese tourism research and planning is traditionally conducted from a supply-side perspective (Chen 2005, Sofield & Li 1998). Recent examples focus on regional development issues (Du Cros et al. 2005), inter alia in southwestern China (Ge 2002, Wu 2001, Cater 2000). Also the supply-side of ecotourism has received some attention (Li 2004, Wen 2001). The importance of demand-side factors such as the investigation of tourist motivations and preferences has only recently been acknowledged (Zhang & Liu 2004). Demand-side studies were initiated in the early 1990s by Wu Bihu (1997a/b). To our knowledge, no study has yet been conducted that specially targets sustainable tourism aspects from a demand-side perspective.

2.2 Attitude towards sustainable tourism

Attitude represents an evaluative integration of cognitions and affects, experienced in relation to an object (Ajzen 1988). Attitudes are evaluative judgements that integrate and summarize cognitive, affective and behavioural reactions (Arnould et al. 2002). Attitudes have been shown to influence specific pro-environmental behaviour in consumption choices (Chan 2001), general pro-environmental behaviour (Grenstad & Wollebaek 1998), conservation behaviour (Guagnano et al. 1995, Steel 1996), and travel mode choice (Nordlund & Garvill 2002).

We designed and tested a set of attitude items on sustainable tourism based on variables of the Protection Motivation Theory, a socio-psychology action theory focusing on behaviour in the face of risks (PMT, Rogers & Prentice-Dunn 1997). The items refer to four aspects of sustainable tourism: pro-environmental behavioural restrictions, nature and resource conservation programs, local community involvement, and cost of the offered sustainable tourism services (for example items, see Tab. 1). In all, 19 items on attitudes towards sustainable tourism were included. We used a closed answer format with a 5-point Likert scale (1: totally agree to 5: totally disagree). For details of item construction, please refer to Zschiegner (2006).

Table 1: Examples of sustainable tourism attitude items

<ul style="list-style-type: none">• In my opinion, extra fees for tourism services such as green buses are just an excuse to charge more and rip off tourists.• I am really afraid of losing the future opportunity for travel enjoyment in southwestern China if the tourism development is not done in a sustainable manner.• Making sure the members of a local community can run tourism-related businesses is essential for harmonious tourism development in southwestern China.• Green buses really contribute to keeping the air of destinations clean and keeping the place quiet.
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2.3 A destination choice experiment (CE)

For the quantitative investigation of tourist destination choice, microeconomic destination choice models (Eymann & Ronning 1997) can be constructed based on discrete choice surveys, for example, conducted as CEs (Louviere et al. 2000, Hensher et al. 2005). Answers to hypothetical destination choice questions have been shown to reflect actual destination

choice well (Haener et al. 2001). For recent reviews and manuals on a state-of-the-art application of the CE methods refer, e.g., to Bateman et al. (2002), Louviere et al. (2000), Hensher et al. (2005).

The destination area chosen is mountainous southwestern China, a global biodiversity hotspot and officially designated tourism development area. First, we identified the attributes that characterize southwestern China destinations. To optimise this step, the first author conducted 14 qualitative in-depth interviews with Chinese middle class consumers interested in travelling to southwestern China in spring 2005 (cf. Barkmann et al. 2005). The following attributes were identified to describe nature- and landscape-related trips:

- Convenience (accommodation, travel comfort) at location just outside of attraction site
- Degree of tarnished nature experience, e.g., by visitor congestion
- Cultural attractions of the destination
- Natural attraction of the destination
- Level of sustainable tourism services
- Cost (local transportation, lodging, food and other expenses for a one week trip)

For this paper, the sustainable tourism services attribute is of particular interest. A zero level of sustainable tourism services was characterized by the absence (i) of nature and resource conservation programs, (ii) of efforts for local community involvement, as well as (iii) of restrictions on tourist movements. In contrast in the 'high' level of this destination choice attribute, a scientific conservation program is in place, 'green' busses, bio energy and waste water treatment are used, the local community participates in all tourism matters, and the total amount of visitors is restricted. The CE instrument was iteratively improved by qualitative pre-test interviews, and a pilot study in Beijing (n=50) in autumn 2005.

2.4 Administration the survey

The CE (n=213 middle class respondents) was conducted in two national tourists source areas: Beijing (about 14.8 million citizens) representing east cost agglomerations, and the provincial capital city of Chengdu (Sichuan Province), the biggest urban agglomeration in southwest China with more than 10 million citizens. As interviewers, we employed carefully trained local university graduate students. A quota sampling procedure was applied in six city sub-districts of Beijing and Chengdu characterized by apartments for middle class customers in which public or semi-public spaces (partly in gated residential compounds) were available to contact respondents. Three sampling criteria (quota) were applied: equally distributed genders; age range 20 to 60; monthly income above RMB 1,500 in Beijing and RMB 1,250 in Chengdu.

After explaining the purpose of the study, each respondent was faced eight times with a choice between several "scenarios" representing tourism trips to southwestern China (Cards A and B), and an opt out/buy nothing option. In a final section of the interview, attitudinal and socio-demographic questions were asked.

2.5 Statistical and econometric analysis

A varimax rotated factor analysis with binary squared Euclidean distance and ward-linkage was employed to generate empirical dimensions of attitudes towards sustainable tourism. The factor analysis as well as parametric standard procedures (bivariate Pearson correlation) were conducted with SPSS 12.1.

For the analysis of the choice experiment data, a set of Nested Logit models (NL) was calculated with NLOGIT 3.0. NL model analysis follows the methodological suggestions by Hensher et al. (2005). To test for the influences of the sustainable tourism dimension on preferences, interaction terms between attributes and dimensions were generated. These interaction terms were included one-by-one as single terms into a NL base model. All models include an alternative specific constant (ASC) coded 1 for the generic choices A and B, and 0 for the “opt out/buy nothing” option. The ASC expresses a fundamental propensity to make (or not to make) a trip to southwestern China beyond the information given by the choice cards A and B.

3 Results

Factor analysis singled out three sustainable tourism attitude dimensions (mean±SD, Cronbach's alpha): *in favour of sustainability* (4.04±0.40; 0.84), *concern for losing opportunities* (4.11±0.51; 0.70), and *sceptic attitude on sustainable tourism* (3.52±0.49; 0.58). Tests of bivariate Pearson correlations between socio-demographic variables and the attitudes towards sustainable tourism showed that only income ($p<0.05$) and education ($p<0.001$) significantly influence one of the dimensions, namely *concern for losing opportunities*.

All tested NL models were overall highly significant ($p_{\text{Chi}^2}<0.001$), and all attributes emerged as significant determinants of choice except “sustainable tourism services” ($p=0.781$; data of the base model not shown). While tarnished nature experience, cultural attraction, natural attraction and the cost attribute were highly significant ($p<0.001$), convenience at $p<0.01$. The ASC was also significant ($p<0.001$) indicating a positive propensity to choose a trip to southwestern China.

All three sustainable tourism dimensions yielded significant interaction terms with attributes when one-by-one included in addition to the attribute terms of the base model – although at highly differing frequencies (Table 2). *In favour of sustainability* only influences the importance of the cost attribute ($p<0.05$). *Concern for losing opportunities* reveals a tendency towards statistical significance if interacted with the convenience attribute ($p<0.1$), and with the ASC ($p<0.1$). The *sceptic attitude towards sustainable tourism* dimension influences the importance of all destination attributes on choices. For tarnished nature experience and the cost attribute, the interactions are so strong that the non-interacted original attributes lose their significant influence on choices.

In particular, if the interaction term of the *sceptic attitude* with the sustainable tourism service attribute is included, the non-interacted attribute term (coefficient value: 0.4458; $p=0.042$) as well as the interaction term become significant (coefficient value: -0.1283; $p=0.045$). The positive coefficient of the non-interacted attribute term refers to a constant utility

improvement of 0.4458 for each successive ('marginal') improvement of the sustainable service level. This effect is counterbalanced for each of the improvements, however, by a disutility of -0.1283 times the sceptic attitude score of either an individual or a group of respondents. The model predicts an overall disutility of additional sustainable tourism services for 46 % of respondents with sceptic attitude scores equal to or above 3.75. For the most sceptic 33 % of respondents, disutility reaches a median value of ~350 RMB. The actual average score of the sceptic attitude dimension of 3.52 results in a willingness to pay (WTP) of 160 RMB per marginal unit of the sustainable tourism services attribute.

Table 2: Summary of influences of sustainable tourism attitude dimensions on destination choice ($p < 0.1$; each line represents results from an independent NL model that expands the base model by the interaction term)

Sustainable Tourism Attitude Dimension	interacted with Destination Choice Attribute	Coefficient of Attribute Term	Coefficient of Interaction Term
<i>in favour of sustainability</i>	Cost	-0.0005***	0.0001*
<i>concern for losing opportunities</i>	Convenience	0.4015*	-0.0754+
	[ASC] [§]	1.4591**	0.21089+
<i>sceptic attitude on sustainable tourism</i>	Sustainable tourism services	0.4458*	-0.1283*
	Convenience	0.4385**	-0.0982*
	Tarnished nature experience	0.1393	-0.1041*
	Cultural attraction	0.4554**	-0.0965*
	Natural attraction	0.5794***	-0.0873*
	Cost	<0.00005	-0.0001**
	[ASC] [§]	1.8654***	-0.3599**

***: $p < 0.001$; **: $p < 0.01$; *: $p < 0.05$; +: $p < 0.1$; no indication: not significant; [§] the ASC in brackets as it is a NL model predictor of destination choice but not a destination attribute.

4 Discussion and conclusion

We employed a destination choice experiment to analyse preference patterns of quota sampled Chinese domestic middle class consumers from Beijing and Chengdu. The quota sampling approach prevents claims on the representativity of the sample; in consequence, reported data on absolute willingness-to-pay values must be treated with caution.

On average, the surveyed middle class respondents displayed, at face value, a supportive attitude for sustainable tourism services (mean score of ~4.0 for the *in favor of sustainability* dimension). However, this dimension did not significantly influence any of the non-monetary aspects of destination choice. Likewise, high scores in this dimension are not predicted to result in any increased willingness-to-pay for sustainable tourism services as one may expect. This result indicates a gap between stated *attitudes* towards sustainable tourism services, and the stated *intention* to actually buy the respective services as expressed in the CE. Similarly, Chinese domestic tourists may be afraid that valuable tourism resources could get lost (mean score of ~4.1 for the *concern for losing opportunities* dimension). Also in

this case, we could not detect an influence of this dimension on WTP for sustainable tourism services. These results are mirrored by the clear non-significance of the sustainable tourism services attribute in the NL base model: The average respondent apparently did not care to which degree sustainable tourism services were offered.

A number of empirical studies document a gap between pro-environmental attitudes and pro-environmental behaviour (e.g., Nordlund and Garvill 2002). There are different arguments to explain this gap. Hashimoto (2000) emphasizes that Chinese tourists have a strong image of a destination shaped by poems and paintings. If pre-shaped images dominate tourist perception, a lack of consistency between attitude and behaviour may not come as a surprise. Another perspective is provided by social psychology research on self-efficacy (Bandura 1997). If a single tourist does not think that s/he can actually accomplish anything to improve the situation, very low intentions to act in accordance with sustainable tourism goals are predicted. Free-riding (Cornes and Sandler 1996) could also play a role. Respondents may rather let others pay for sustainable tourism services - from which also the public benefits - than spending on these services themselves.

The results of the interaction analysis with the *sceptic attitude* dimension provide the most specific explanation. In contrast to the previously discussed attitude dimensions, the degree of scepticism expressed towards sustainable tourism services does form a statistically and materially significant interaction term with the sustainable tourism services attribute. Thus, destination choice does depend on the level of offered sustainable tourism services. The influence, however, depends on the extend to which respondents refrain from subscribing to popular sceptic notions such as "sustainable tourism is just another way of charging a higher price".

A highly sceptic attitudes prevents 46.4 % of respondents from expressing any economic appreciation of sustainable tourism services. The choice model even predicts that highly sceptic attitudes can *decrease* the probability to choose "more sustainable" trips compared to other trips at the same price. Even if this extreme result turns out to be an artefact of the specific functional form of the utility function used in estimating the NL model, the fact remains that only respondents with a below-average scepticism score are positively influenced by offers of sustainable tourism services. This is what we call the sceptics' challenge to sustainable tourism in the Chinese domestic tourism market.

Chinese domestic middle class tourists question the benefit of paying for the environmental and social improvements associated with sustainable tourism services. Thus, the generally positive attitude towards sustainable tourism does currently not translate into sustainable consumption and production opportunities. Attempts to protect the ecological (and cultural) integrity of southwestern China mountain destinations by promoting sustainable consumption and production in the tourism sector need to meet the challenge posed by a majority of sceptics. Unfortunately, the investigated correlations between socio-economic and attitudinal factors give little guidance how the sceptics' challenge should best be met. Respondents with a higher formal education have a higher concern for *losing future opportunities*. The same holds for the influence of income on the *losing future opportunities* attitudes. This attitude dimension could not be shown to influence preferences for sustainable tourism services, though.

Carefully targeted marketing strategies may be called for that address the scepticism regarding sustainable tourism services. One promising approach would focus on providing and communicating sustainable tourism services that are clearly important and demonstrably effective. As Chinese domestic tourists have little occasion to positively experience sustainable tourism services today because of limited supply, such experiences may be necessary to gradually overcome the prevalent sceptic attitudes.

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QSAM Beyond business as usual – investigating consumers’ eco-efficiency potentials via social innovation scenarios

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1 Introduction

One of the many challenges in coming to grips with sustainable consumption is the interaction between micro and macro levels. For example, at the level of a single household or of a particular neighbourhood remarkable improvements in the eco-efficiency of consumption can occur. However, the replication of such improvements at a significant scale appears hard to forecast. Vice versa in case of devising new policy instruments, the usual abstraction from concrete wants of people can cause a similar kind of risk of eliciting only limited intended response and sometimes even unintended adverse response.

With the above described dilemma in mind the Finnish scenario study KulMaKunta set off to analyse how consumption in Finland could be made more eco-efficient up to 2030. The study focused on changes that can amount to significant contributions at the macro level compared to a business as usual scenario. The alternative scenarios, in which the changes were implemented, were based on micro level information from interviews with target household types. During a preparatory study, these household types were identified as having the largest (macro) potential for change, due to their numbers and/or their trends in consumption and life style.

Even though a default level of technology driven eco-efficiency improvement was taken into account, the alternative scenarios were designed to investigate social and institutional innovations in particular. Both a socio-economic model and a built-environment model were used to analyse the eco-efficiency effects with respect to nitrate, phosphorus, and carbon dioxide

emissions, energy use, and building materials up to 2030. For households that supposedly change their consumption patterns the household budget allocation by type of household was checked on its consistency and the feasibility of the changes. In the last part of the study was investigated what policy measures at national and local level, as well as in companies (as employers), could be taken to promote the identified favourable changes.

The article will discuss the micro-macro interaction in conjunction with the design of the scenarios, present the main results of the scenarios, and highlight the principal policy recommendations. The results of the study have been used for the preparation of the Finnish sustainable consumption and production strategy (KULTU).

2 Managing realism at micro- and macro-level

The inclusion of realism at the micro-level of quantitative scenario assessments implies the differentiation by type of actor or even by individual actor. This approach ties in with the psychological conceptualisation of behaviour at the unique individual level. The advantage of such an approach is a – potentially – higher accuracy in representation of personal wants and needs, as well as of individualised restrictions. Yet, when modelling for macro level applications, the applied differentiation is of course still only an approximation of the behaviour of various *types* of households. A significant part of the variation remains untreated, which seems however not very harmful for assessments for macro level policy purposes (e.g. Vringer, 2007).

Some social scientists are nevertheless uncomfortable with this kind of policy support studies, either for fundamental reasons related to the multigenic¹ nature of household consumption or because of the continued subjugation into a technical-economic framework. If one wishes to stress the multigenic character of consumption modelling becomes extremely complex (e.g. Shpworth, 2005), whereas there is the risk of relinquishing (multidimensional) optimality objectives for the sake of acceptability at an early stage. The concerns of subjugation (e.g. Shove and Wilhite, 1999) have to do with the argument that as long as current policy is confined within an essentially materialist paradigm ('more consumption is better') no fundamental solutions are possible, since social-economic assessment models tend to evaluate restraints in material consumption inferior even if environmental improvements are accounted for. In this context consumption is conceived as a social construct (e.g. Wilhite, 2001), and consequently sustainability policy should aim for a social-cultural reconstruction of consumption. The cautions of these sceptics are valuable, but there is sufficient experimentation available (e.g. Steg and Gifford, 2005; Perrels et al., 2006). to illustrate that attempts for more sophisticated inclusion of behaviour in (macro level) simulation models do produce more insights as well as more realistic strategies, probably for the reasons highlighted in Vringer et al (op.cit).

The critique on technical-economic modelling dominance has two implications in case one wishes to accommodate some of the critique. The social dimension should be included in the model design right from the

¹. This term is from Wilk (1999).

start and on an equal footing as the other dimensions (economics and environment). In turn this means more detail on individual and group level behavioural dynamics, and on the other hand the inclusion of equity effects (including the status quo ante).

The compromise approach in KulMaKunta was that a certain level of detail in behavioural response was accounted for by:

- differentiation by household type
- inclusion of many variables per household type
- differentiation by type living environment (types of dwelling and municipality)
- interviews of selected household types in order to:
 - map out the eco-efficiency in their current behaviour and
 - investigate their wishes regarding facilities (technical or social/institutional) that would enhance their eco-efficiency or the social dimensions of sustainability

The first three items assist to construct social-economically more accurate scenarios, which also allow for a wider scope of intervention options. The interviews are essential for selecting scenario elements (e.g. innovations) that the considered household types apparently appreciate and at the same time are still relevant for the overall purpose of the scenarios (enhancing eco-efficiency of household consumption). After identification of appreciated technical and social innovations packages of innovations were formulated for each of the main type of alternative scenarios. The uptake of innovations per household type was assessed in side studies, while in various cases it was also possible to benefit from the feedback of the interviews. In various cases it was decided on the basis of pre-study and the interview information to leave a particular household type out of a certain scenario alternative.

The alternative scenarios consisted of two steps. The first had to do with the alternative approaches in the additions to the dwelling stock. Since the living environment is such a fundamental shaping element in consuming behaviour (see also figure 1, derived from Weber and Perrels 2000), the attribution of future dwelling stock by type, location and household type was simulated first. Subsequently, the remainder of the innovation package was implemented by redressing the budget allocation in accordance with the assessed unit-costs of the package, as well as making some other adaptations such as in the ownership and use of the car stock.

All in all the social dimension was included both at the overarching level of infrastructure, or in terms of figure 1 societal 'hyper-structure', and at the level of day to day consumer behaviour, indicated as the 'manifest lifestyle' in figure 1 and predominantly represented by the use of time and money.

The resulting KulMaKunta model system is a typical bottom-up model system (e.g. Perrels et al, 2005; Perrels et al 2006) and with respect to linkage between consumer expenditures and overall macro-economic impacts it has similarities with (Vringer and Blok, 1995; Weber and Perrels, 2000; Ferrer-i-Carbonell and van den Bergh, 2004; Kletzan et al, 2002).

3 The lay-out of the studies and the scenarios

The KulMaKunta project sought to identify and clarify the volume, characteristics and feasibility of a sustainability potential within the realm of household consumption. The study aimed to take account of behavioural and institutional impacts by linking model exercises with case studies based on dedicated household survey information and stakeholder interviews regarding innovations in consumption. Even though default technical development (e.g. regarding energy intensity) was not left out, the focus was on social innovations that can enhance eco-efficiency.

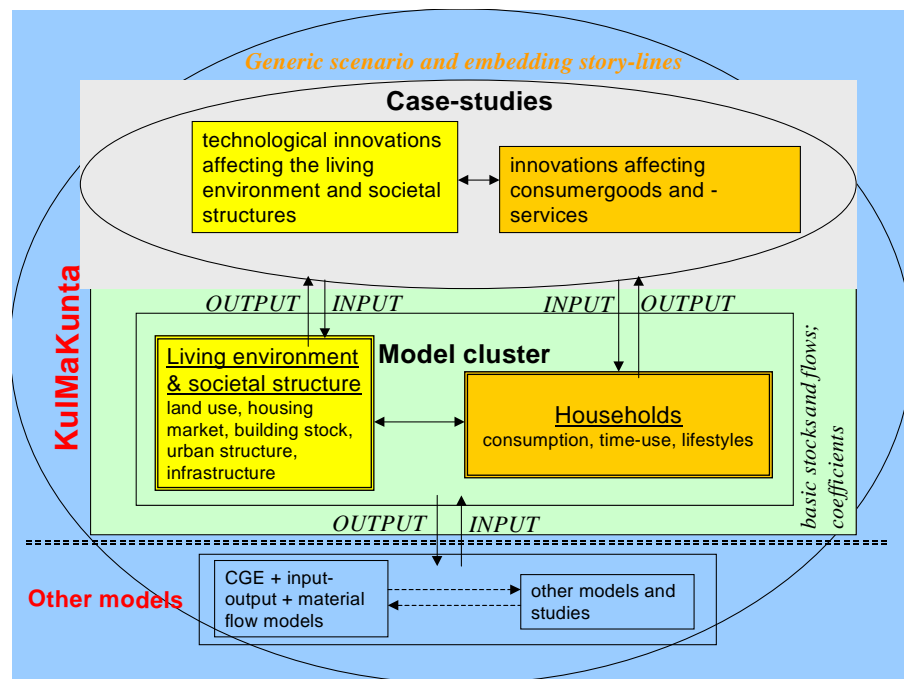


Figure 2: Causal structure of the KulMaKunta project

By means of the cluster of models (see figure 2) overall impacts were analysed with respect to societal structure and household consumption. As regards the technical features of the model system a compromise was found between various conflicting demands, such as between economic equilibrium and innovation shocks. The model is hybrid, consisting of both engineering-economic parts and econometric parts.

Next to a baseline three scenario-options were used that were identified in a pre-study, being:

1. *sustainable village life*
 - tele-working, more use of (shared) local services, reduction of multiple car ownership, heat pumps, energy efficiency
 - this scenario acknowledges the current desire of many to live in more spacious surroundings in or beyond the fringe of the city, but at the same time tries to diminish the negative sustainability effects, while using the opportunity to reinforce local village economies
2. *urban villas*

- relatively spacious homes but densely built in cities instead of the urban fringe, excellent transport connections, reduced car ownership, district heat, more sustainable use of materials
 - this scenario intends to fight urban sprawl not by attenuating its negative effects on eco-efficiency, but by reducing the outflow from cities by building more attractive (larger) dwellings inside cities
3. *senior service homes*
- well serviced housing solutions for seniors (apartments, sometimes terraced houses), energy efficient, car sharing, ...
 - this scenario pays special attention to the growth of the number of elderly and the emergence of a new generation of more active elderly

The household type specific selections of innovations, which were identified in the pre-study as ‘promising’, were discussed during the interviews. On the basis of this, information packages of innovations per household type were assembled. The degree of uptake of these packages was assessed by means of literature study and some model simulation (for example in relation to relevant shares of the building stock).

4 The interviews

The purpose of the interviews was to have the scenarios well rooted in the users’ needs and contextual requirements. Participatory scenario-making for sustainable development has become popular recently, and it aims to gain users’ input and support for sustainable change processes (e.g., Quist and Vergragt 2000; Carlsson-Kanyama 2003). The present study had some further ambitions, as well. Apart from the consumers’ stated preferences for specific solutions, we also wanted to gain an in-depth understanding of their actual living conditions and the physical structure of their everyday lives.

The approach adopted consisted of a combination of focus group discussions (cf. Boddy 2005) and a questionnaire survey on their living conditions and everyday consumption practices, based largely on questions used in a larger survey on household consumption by Statistics Finland. Furthermore, conducting the focus group discussions in the locations where the consumers lived allowed us to make some field observations, and we also collected documentary material such as blueprints and local newspaper clippings.

Focus group discussions were selected because they are a suitable method for discussing changes that involve community-level change (i.e., common services and changes in the physical infrastructure) (cf. Waterton and Wynne 2001). Group discussions also allowed the consumers to think about and elaborate on the novel ideas presented in a social context (cf. Kuhn 2000).

As target groups, we selected two household types with specific needs, which are currently contributing to change in household and urban structure:

- Families with children, which are increasingly moving out of urban centres and acquiring single-family houses in sub-urban or semi-rural locations. Families with children count for approximately one-third of the households, but make up about half of the Finnish population.

About 60% of those families live in a (semi)detached house, and many of the rest would like to do so.

- o Elderly households, which face new housing needs as children leave home and a more physically and social supportive environment is required. At present, about 30% of the population is aged 55 or more, and this group is expected to grow to almost 40% by 2030.

Focus groups with families with children were organized in three residential areas outside Helsinki, with a total of 24 participants. Focus groups with elderly households were organized in special 'senior service homes' at three different locations, with a total of 35 participants. The group discussions focused on the participants' reasons for choosing their current form of residence, its pros and cons, as well as on their views about the 'social innovations' that we were interested in, which are presented in more detail in the following section.

The questionnaires that we distributed focused on physical aspects of the participants' dwellings, on their car usage and travel patterns, on expenditure on different consumption categories, and on other aspects of everyday life such as appliance ownership and leisure activities. We obtained 17 completed questionnaires from the families with children and 21 from the elderly households.

5 Innovation package construction

The present study focused on socio-technical innovations believed to have potential to reduce the natural resource intensity of consumption (Schmidt-Bleek 1998; Hockerts 1999; Heiskanen et al. 2005). Many of those have a close connection with housing. Either they imply changes in housing patterns or urban structure or they can be facilitated by housing solutions (e.g. Halme et al. 2004). For our study, we selected innovations that can be combined into mutually supporting packages, or ones that have a special link to specific life stages or lifestyle choices (Table 1).

As the first group of innovations, we selected service-oriented housing, i.e., senior housing with services for the residents, but also facilities provided near the resident's home, such as common rooms, information infrastructure and conventional services. As the next group, we selected household services that can reduce energy use or the materials intensity of consumption, or facilitate the more efficient use of space. As a third group, we decided to focus on ICT-based services such as tele-work and electronic service access.

Table 1: Innovations considered as a background for the alternative scenarios

Service-oriented housing	Household services	ICT-based services
o Service housing, senior service homes	o Online shopping and service access	o Distance work at home or at a local e-work office
o Service blocks, local services, common rooms and facilities	o Catering services	o Distance work and electronic service access in the context of localized living
o Information and communication infrastructure	o Household cleaning and care services	
	o Transport services	
	o Shared use of products and equipment	
	o Services related to energy consumption and facility maintenance	

During the course of our interview and field study, we found that senior service homes are quite eco-efficient innovations as such. The apartments were much smaller than the residents' previous homes, and hence used less energy for space heating. A good supply of local services made car ownership unnecessary, and the social contacts afforded by this form of housing were much appreciated by the residents. According to the residents, more flexible access to common facilities would make this form of housing even more comfortable, and might also facilitate more sharing of household and leisure equipment.

As a result of our interviews, we found that families with children would appreciate a local facility structure in the immediate proximity, including the possibility to share some larger household and gardening items. Common space for informal leisure activities, preferably mixing children and adults, was also called for. The families with children would also appreciate to extend the use of local services and had even tried to organize new services collectively. One of the ideas suggested was a 'village-janitor' to take care of heavy-duty house maintenance jobs, for example. Tele-work turned out to be an important innovation for these families, as many are commuting over long distances. The families came up with a number of suggestions for how to improve their possibilities to do at least part of their work at home.

We also found that part of the families with children had moved out of town because they actually wanted to live in the countryside, but others had moved simply because they could not find affordable housing of the quality they desired in town. Both groups, nonetheless, sought for access to nature and a stable and safe environment for their children. This gave us the idea for two scenarios, the 'urban villa' and 'sustainable village life'.

We used the data compiled in the focus groups and questionnaires, in combination with national statistics and surveys, to identify the impact of our scenarios on the physical characteristics of housing, on household consumption expenditure and on patterns of daily life. We did this by starting out with individual examples of households, calculating how new expenditure categories and behavioural patterns would influence their overall consumption and household energy and materials use.

All in all the linking of interview information and general social dimension background information to model simulations went through seven steps:

1. identified social (product service) innovations
2. cost information per selected innovation
3. other technical, institutional and practical preconditions and prerequisites
4. budget and use implications for a typical family type (example calculations)
5. translation into average budget category reallocations by household category distinguished in the simulation model
6. initial model input and subsequent adaptations for overall consistency due to feedback effects
7. eventual total system simulation

Table 2: Summary of the translation of the innovations into consumption categories on which can be saved and spent more in the alternative scenarios (for each item amounts in euros were calculated for each household type in each scenario)

Sustainable village	Urban villa	Senior service homes
savings:	savings:	savings:
car purchase and maintenance	car purchase and maintenance	car purchase and maintenance
car use	car use	car use
heating	heating	heating
food during working hours	-	home repairs
additional outlays:	additional outlays:	additional outlays:
public transport	public transport	public transport / car sharing
food at home	food at home	-
heat pump investment	-	-
more energy cost due to tele-work	-	-
home delivery of shopping	home delivery of shopping	home delivery of shopping
home services (cleaning, garden, repair, etc..)	home services (cleaning, garden, repair, etc..)	home services (cleaning, garden, repair, etc..)
-	entertainment & culture	entertainment & culture

6 Simulations and results

6.1 The Baseline

According to the forecast of Statistics Finland the Finnish population growth is expected to slow down and by 2030 the population may start to decline. However, in terms of the number of households the growth will continue much longer, even beyond 2040. With a stabilising total population and a growing number of households the average household size is obviously shrinking. The main reason for this is the increasing share of elderly, who live usually in either 2-person or 1-person households. The sketched trends assume that no substantial immigration of younger or middle-aged people will take place. These demographic developments affect also the growth potential of the Finnish economy. After 2015~2020 labour supply restrictions start to take effect. For this reason it is assumed that pension flexibilisation measures are implemented after 2010 in such a way that about 20% of the people in the age bracket 65-70 will do (part-time) work.

Table 3: The baseline socio-economic scenario 2005-2030

	2005	2010	2015	2020	2030
Annual increase of labour productivity	2,15 %	2,10 %	2,10 %	2,10 %	2,00 %
GDP growth rate	2,15 %	3,10 %	2,27 %	2,06 %	1,46 %
Net wage increase per year	2,15 %	2,23 %	2,22 %	2,20 %	1,92 %
Labour force (x million) *	2,37	2,49	2,51	2,50	2,37
Labour force utilisation rate*	90 %	95 %	99 %	102 %	102 %
No. of employed per household	0,98	0,99	0,95	0,91	0,85

*) The point of departure is that 75 % of the population in the age bracket 18–65 is available for gainful employment . In addition it assumed that in the nearby future, following from pension age revisions, at most 20% of the age group 65-70 will be gainfully employed. This explains why the utilisation rate exceeds 100% in some years.

All in all it means that real wages (and incomes) can continue to rise by about 2,2% per year up to 2020. After that year annual income improvements start to diminish. As regards prices it is worth noting that the price index for housing will start to get in line with average inflation after 2015, whereas housing cost are so far rising faster than the overall price index. Furthermore, as a consequence of climate & energy policies prices of energy carriers (electricity, district heat, motor fuel) are supposed to rise much faster than the average price index. So, also in the baseline the allocation of expenditures over various categories of goods and services is changing because of:

- differentiated impacts of rising purchasing power

- changes in relative prices of various categories of goods and services
- changes in other key features (e.g. age structure, living environment, etc.)

The development of purchasing power by household type from 2005 to 2030 is summarised in figure 3. The development of the time budget in the same period and for the same categories of households is summarised in table 4. From this information can be inferred that retired people are on the whole the only group that gets a much bigger share in total purchasing power, while practically maintaining a large free time budget. For other households, even though purchasing power per household develops usually fairly well, the overall economic weight of the group is either stable or even significantly shrinking (households with children). Up to now the retail sector and other services tend to focus still on families. The demographic changes must sooner or later have significant ramifications for the product mix and client orientation in the service sector.

Table 4: Simulated daily time use per category for people in the working age and retired persons 2005 – 2030, in minutes per day per person by time use category.

categories	2005	2010	2015	2020	2030
working time – 18-65	351	367	372	375	371
working time – 65+	25	31	32	32	26
travel time – 18-65	71	72	72	73	74
travel time – 65+	66	67	67	67	67
sleep – 18-65	495	495	495	495	495
sleep – 65+	530	530	530	530	530
other (free) time – 18-65	524	507	500	496	499
other (free) time – 65+	833	826	825	825	832

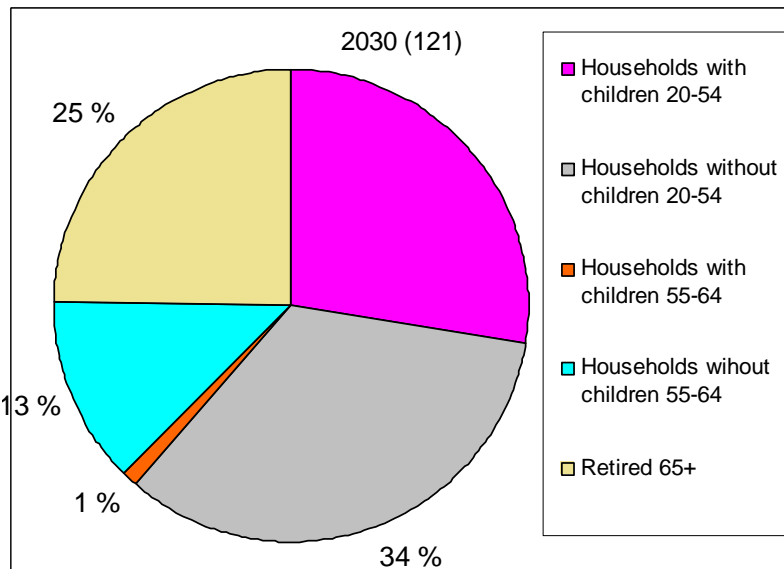
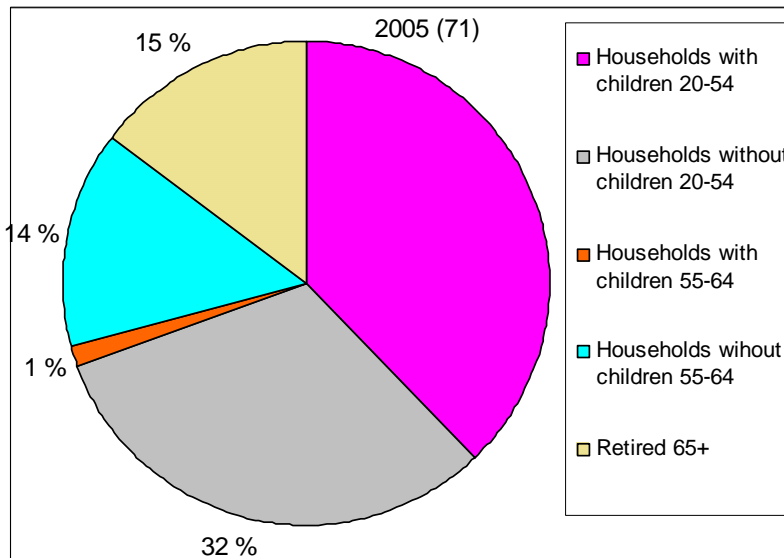


Figure 3: Distribution of purchasing power by type of household in 2005 (upper) and 2030 (lower) (between brackets the total macro-level consumer expenditures in billion euro)

As discussed in previous sections an important influence factor is the living environment, in this case typified by the type of dwelling and kind of municipality. Figure 4 provides an overview of the dwelling stock development in the baseline (and the ‘Sustainable village’ scenario) and in the Urban villa scenario. An important difference is the shift of a good part of the additions to the dwelling stock from the commuter ring to the central cities in the Urban villa scenario, as compared to the baseline. The lion’s share of newly built terraced and detached houses would be realised in a somewhat different fashion (higher densities, slightly less square metres) in the central cities.

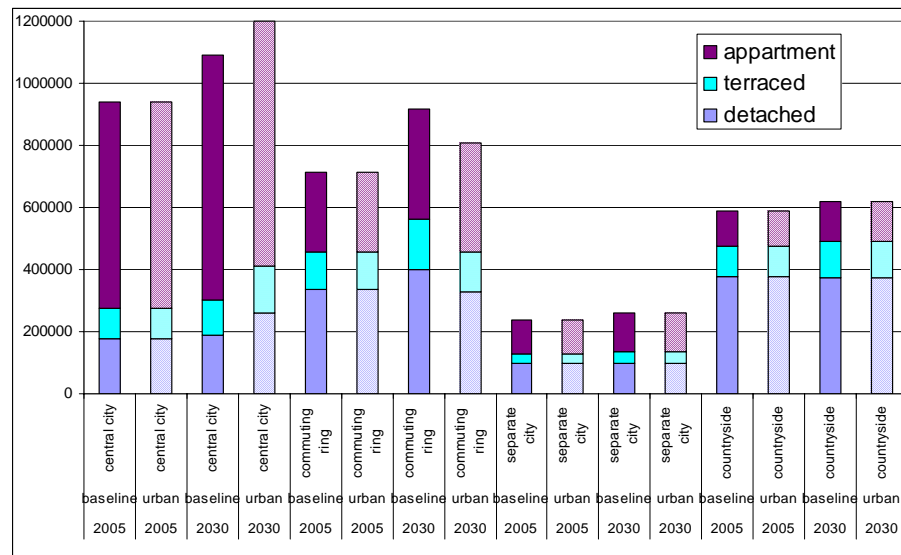


Figure 4: The development of the dwelling stock 2005-203 by type and location for the baseline (and Sustainable village scenario) and the Urban villa scenario

6.2 The impacts in the alternative scenarios

Realism with respect to implementability and acceptability was a guideline in the study. Among others this shows in the social-economic impacts as summarised in table 5. In fact the rearrangement in the consumption expenditures has a slight positive effect on the national economy (+0 to +0,5 billion value added in production). The reasons for this are that (1) the reallocation of expenditures slightly favours categories that have a larger domestic production share, and (2) a tax rebate for home oriented services reinforces this domestic production effect. For the public sector there seem to be no significant threats of unbalance. The combined effects of changes in indirect tax revenues, public transport ticket revenues, and granted tax rebates are on the surplus side in all scenarios, except Sustainable village (-77+218-(+208) = -67). If the scenario options would be combined (while avoiding overlaps) the net balance would remain solidly at the positive side (over 1 billion surplus).

Table 5: Key economic differences between baseline and alternative scenarios

	Baseline	Sustainable village (Δ)	Urban villas (Δ)	Senior service homes* (Δ)
Consumer expenditures 2030 (billion €)	120,6	+0,21	+0,17	0,0
Domestic production caused by domestic consumption 2030 (billion €)	148,7	+0,41	+0,49	+0,01 ~ +0,09
Change in employment - in full time labour years from 2005 to 2030	+21000	~ 0 #	+3900 #	~ 0 #
increase in granted home services related income tax rebates (million €)		+208	+65	-
indirect tax revenues – change from baseline (million €)		-77	+473	-83
public transport - revenues from ticket sales - change from baseline (million €)		+218	+713	+463

*) In this scenario there is some leeway regarding the reallocation options of consumer expenditures, when comparing a standard retired household with one that moved to a modern senior service home.

#) Figures indicate the difference compared to the development of employment in the baseline

Figure 5 summarises the reductions in emissions in the alternative scenarios compared to the baseline. In addition to the effects on emissions a combined implementation of the scenarios would reduce the material flow requirements in the building sector (not shown here). The building material requirement per capita diminishes by approximately 2% in 2030 in the Urban villa scenario compared to the baseline. The Senior services home scenario would still add to that effect. It should be realised that building materials represent a lot of embodied energy per kg material. Furthermore, of the total material requirement attributable to Finnish household consumer expenditures about 37% (in weight terms) is related to housing, whereas the budget share of housing is 22% (based on Mäenpää, 2005).

Next to changes in the dwelling stock and consequent savings on heating and building material use, the ownership and use of passenger cars is affected in all scenarios. In the baseline the number of cars would grow by about 850.000, whereas in a combination of the alternative scenarios this increase could be reduced by 110.000. Table 6 provides a summary of the effects per scenario. In the sustainable village scenario multiple car ownership is reduced to some extent due to tele-working. However, the tele-working solution has even stronger impacts on kilometres driven (and hence

fuel consumption). Interestingly, the urban villa scenario has a larger effect on car ownership, but a smaller one on fuel consumption. Reasons for this surprising difference are a slightly older car stock (due to slower renewal) and a slightly less efficient use of the car in urban areas. To this can be added that urban dwellers are overall somewhat more mobile than villagers (Perrels. 2005), even though the modal split is different.

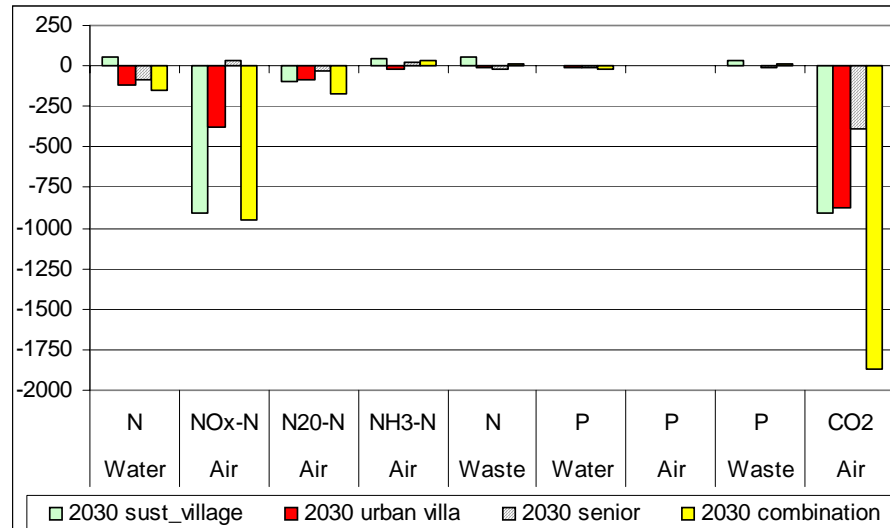


Figure 5: Resulting emission reductions compared to baseline by scenario

Table 6: The impacts of alternative scenarios on the private car stock and transport fuel consumption in % compared to the baseline in 2030

	Sustainable village	Urban villas	Senior service home	Combination
private car stock	-1,1 %	-1,7 %	-1,1 %	-3,4 %
consumption of transport fuels	-6,5 %	-5,8 %	-0,7 %	-10,9 %

7 Recommended instruments and research themes

Even though the above scenarios appear to be attractive both in terms of eco-efficiency and in terms of economic sustainability, society will not automatically follow this pathway due to misperceptions and failing markets. For these reasons existing policy instruments have to be intensified and new instruments have to be added to the portfolio.

Prior to presenting the recommended instruments we first recapitulate what are the main trends and forces that threaten to reduce eco-efficiency. There are four of them, being:

1. the decrease in average household size (in conjunction with a mismatch of households by size and dwellings by size)
2. the spreading of the built environment while density is decreasing ('sprawl')

3. the steady increase in car ownership, including multiple car ownership
4. the upward trend in energy use per household, despite gradually tightening building regulations.

The decrease in average household size is the result of demographics and cultural changes in household formation. Neither of these factors can be much influenced by policy. Even though one could scan whether there would be a re-emerging demand for houses that can accommodate extended (i.e. three generation) households, while respecting modern lifestyles. The dynamics in household size, while overall demand for additional housing is gradually slowing down, underlines the need for more flexible designs of homes, such that rearrangement of space can be organised in concurrence with evolution of the household.

The second trend, sprawl, requires changes in spatial planning practices as well as pricing and taxation of land. The current trend reduces the possibilities to extend district heating systems (based on CHP) and increases the need for (second) cars, while undermining the economic base of public transport.

The third trend, increased car ownership, does not only relate to urban sprawl, but also to a higher demand for mobility and increased purchasing power. In as far as mobility is indispensable for personal development it should not be discouraged as such, but from a balanced sustainability point of view the mobility is preferably handled in the environmentally most benign way, without causing major inefficiencies in another realm. Promotion of alternative modes, including non-motorised ones, accounting for external effects, and facilitation of tele-services can help to contain the growth of the private car stock and car use.

When observing the actual household energy consumption in recent years the trend is upward. Even though the thermal efficiency per m² is improving, the growth in average floor space per dwelling and even more so the quickly rising stock of electric appliances. Furthermore, application of more radical improvements (i.e. so-called 'low energy' and 'passive house' concepts) barely spread via natural market uptake processes. Apparently risk aversion is an overriding criterion.

Based on the above observations and considering the simulation results the following recommendations were presented.

- land use planning should be shored up, inter alia by:
 - truly integrated regional rather than municipal land use and housing planning
 - pricing and taxation of land or land use which produces a more consistent incentive structure (e.g. regarding unused plots, public procurement, parking fees)
- genuine integration of municipal planning at the level of urban regions, involving land use, infrastructure and location of major employment and shopping centres
- establishment of national spatial prospective studies, in order to enable more consistency across regional plans and with respect to national infrastructure plans
- promotion of tele-working, including monitored longer lasting pilot-projects

- tax differentiation with respect to eco-efficiency promoting services (e.g. home repair)
- promotion of mobility management in firms and larger public facilities
- promotion of non-motorised transport modes and including its (own) infrastructure

Apart from recommendations regarding policy instruments the study identified also themes for further research aimed at supporting the development of policy instruments and measure implementation.

For example, tele-working is not merely a technical solution, but has also to do with the way in which personnel is managed in an organisation. A wider application of tele-working presupposes a wider adoption of appropriate management structures and cultures. In order to achieve this further study will be necessary about how to introduce tele-working in various kinds of organisations.

Another example is the need for further study regarding the promotion of energy saving in conjunction with the organisation of retail and wholesale energy markets, retail pricing, and new IT applications for energy use monitoring and feedback.

The financial position of public transport in a future society, where particularly the elderly grow in numbers and car ownership still increases, also deserves special attention, in all scenarios.

Preparatory research for integrated land use and transportation planning is also highly necessary in Finland. A key issue is the redefinition of access. So far, the dominant paradigm is that increase of access is a good thing whatsoever. However, if increase of access produces more environmental and social cost than economic benefits, its level may suffice after all or access has to be improved in other ways than by building classical infrastructure.

8 Conclusions

The study demonstrated that it is possible to include the social dimension in a predominantly quantitative assessment of environmental impacts of consumption. To have a meaningful inclusion the social dimensions should already be present in the design of the assessment system, and not only be an extension of result interpretation or of simulation functions.

The inclusion of the social dimension however puts large demands on the interface between qualitative and quantitative information. Furthermore, it would have been preferable when more people and groups could have been interviewed. The consequence of a larger number of interviews is obviously that this kind of studies becomes rather expensive.

The distinction by household type and type of municipality and living environment enables indeed a much better assessment of the distribution of effects over different groups. This is important as equity is often a crucial issue in the success or failure of environmental policies and measures. Furthermore, the increased precision also indicates for whom, where and under what conditions particular measures are effective and what kind of induced effects may occur (for better or worse).

The largest impacts of the social dimension are mediated via the societal hyperstructure, in particular via the decision making about the so-called 'hard' and 'soft' infrastructure and the extent to which wishes and preferences are taken into account. The concrete environmental ramifications are that choices about the kind and size of the dwelling and its location (and the ambitions underlying these choices) and the way mobility is handled (car ownership and use) predetermine significantly the upper and lower bounds of the total resource use and emission impacts of a household. Only with respect to food the predetermination effect of the hyperstructure is not so prominent. The temporal infrastructure and organisation affects probably the most.

It can be regarded as an important message that significant eco-efficiency gains can be made *without* any significant changes in material welfare levels. Considering the improvement of immaterial welfare in the alternative scenarios, the eco-efficiency promoting social innovations promise to produce net gains in overall welfare. It should be realised that the combination with more radical technical innovations larger gains can be achieved. For the rest eco-efficiency gains are to realised at the supply side, *albeit in conjunction with* the demand side.

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QSAM Pathways towards Sustainable Food Consumption Patterns

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1 Introduction

The Oslo Declaration on Sustainable Consumption (Tukker et al., 2006) has stated that sustainable consumption focuses on strategies for the highest quality of life, the efficient use of natural resources, the effective satisfaction of human needs, and equitable social development. So far, research on sustainable food consumption has focused on energy use, generating knowledge on energy requirements for individual foods, meals, and food consumption patterns (e.g. Vringer and Blok, 1995; Carlsson-Kanyama, 1998; Gerbens-Leenes, 1999; Gerbens-Leenes, 2000; Kramer, 2000; Kok et al., 2001). Those studies have shown that in the western world, large energy reductions are possible. Understanding the food consumption-environment relationship, however, requires more insight into the different dimensions of sustainability. This study proposes the adoption of three sustainability indicators, land, fresh water, and energy use, indicators that take the main functions of the environment into account and address global sustainability issues.

Resource use for per capita food consumption is determined by the amounts and types of foods that are consumed, i.e. food consumption patterns, and by specific resource requirements per food item. The total use of natural resources for food consumption depends on the combined effect of a production and a consumption subsystem. The aim of the study presented here was to indicate transition pathways towards more sustainable food consumption patterns. This is done by assessing land, water, and energy requirements for a food consumption pattern from a developed country, the Netherlands, and by identifying long-term trends. This information provides insight into desirable directions of change. In this way, the study contributes to a better understanding of the food consumption-environment connection, and provides practical information for pathways towards sustainable food consumption patterns.

1

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2 Food systems

Food systems include two subsystems: (i) a consumption subsystem and (ii) a production subsystem. Total food consumption is determined by the size of a population and amounts and types of foods consumed, i.e. food consumption patterns. The production subsystem comprises primary and secondary production, as well as the food industry. Primary production grows agricultural crops. Yields per hectare depend heavily on the type of system applied, leading to large variation. Crops from the primary production systems, such as soybeans, barley, or maize, form the basis for the secondary or livestock production. Resource requirements for single food items can differ considerably. The total use of natural resources for a specific food consumption pattern depends on the combined effect of its production and consumption subsystem. This means that fruitful research on requirements of consumption for natural resources can only be carried out for a clearly defined production subsystem.

3 Data and methods

3.1 Requirements of food for natural resources in the Netherlands

For the identification of pathways towards sustainable food consumption patterns, this paper adopted the three core indicators land, water and energy from Gerbens-Leenes et al. (2003). By combining information on resource use for food items with data on per capita consumption, results show requirements of consumption patterns for natural resources. Data on resource requirements per unit of food is available for the Dutch production system in 1990 (Gerbens-Leenes, 2006; Kramer and Moll, 1995). The study assessed the use of land, 'transpirational' water, and energy for an affluent food consumption pattern, the Dutch pattern of 1990, and made time trends for this pattern over the period 1950-1990. For land and water, the study combined data on supply (kg per capita per year) from the FAO (2006) with data on land and 'transpirational' water requirements per unit of food from Gerbens-Leenes (2006). The calculations were done for seventeen foods from five food categories: (i) *beverages* (beer, wine, coffee, and tea); (ii) *fats* (vegetal oil); (iii) *meat* (beef, pork, and poultry); (iv) *dairy and eggs* (raw milk, butter, cheese and eggs); and (v) *cereals, sugar, potatoes, vegetables and fruits*. In an earlier study, Kramer (2000) showed that energy is needed in all chain links of a food production system. For the assessment of energy requirements, therefore, more detailed information on final consumption was needed. Information on household consumption (kg per household per year) for over a hundred food items was obtained from the study of Gerbens-Leenes (1999) and combined with data on energy requirements from Kramer and Moll (1995).

3.2 Long-term trends in actual land, water and energy requirements

The comparison of long-term trends using data from the 1990 production system provided information on the impact of changes in consumption on

the *relative* use of natural resources. Over this period, though, both the consumption and the production subsystem were changing. For example, agriculture generated larger output per unit of land. Beside an assessment of *relative* resource requirements, this study also made an estimation of developments of *actual* requirements. For land, it estimated actual requirements by using the increasing yield levels of wheat as an indicator. It multiplied 1990 land requirements by the ratio of actual and 1990 land requirements ($\text{m}^2 \text{kg}^{-1}$). For ‘transpirational’ water, changes in the biophysical production subsystem do not affect water requirements per unit of food because ‘transpirational’ water requirements are constant per unit of output (Gerbens-Leenes and Nonhebel, 2004). For energy, historic data on requirements for individual foods (MJ kg^{-1}) are lacking, but information on total, per capita energy requirements over the period 1950-1990 is available from Vringer and Blok (1995). For energy, the study first calculated time trends related to changes of annual, per capita supply using data of the production system of 1990 as input, providing relative results. Next, it evaluated the gap between relative energy requirements for per capita food supply and actual energy requirements for total, per capita food consumption.

4 Results and discussion

4.1 Land use in 1990 and developments for the Dutch food consumption pattern 1950-1990

Figure 1 shows land requirements for Dutch food supply in 1990. The categories of meat, and dairy and eggs, needed 50 percent of total land requirements. For the category of fats, requirements were relatively large, about one fifth of total requirements. For cereals, sugar, potatoes, vegetables, and fruits, requirements were in the same order of magnitude than for beverages, about 14 percent.

Figure 2 shows long-term trends for land requirements over the period 1950-1990. The total requirement results from the combined effect of the consumption and the production subsystem. Consumption changed towards increased per capita supply of more and more affluent foods. The bottom line in Figure 2 shows the impact of these changes on land requirements. If food had been derived from the Dutch production subsystem as it existed in 1990, changes in per capita supply would have caused an increase of relative land requirements of 40 percent, an increase that mainly resulted from larger per capita supply of beverages and meat. However, over the period considered, also changes in the production subsystem occurred resulting in decreasing, actual land requirements per unit of food. This is illustrated in Figure 2 by the decreasing land requirement for wheat. The upper line shows that between 1950 and 1990 land requirements for wheat ($\text{m}^2 \text{kg}^{-1}$) more than halved. The development of actual land requirements is a combined effect of increased per capita supply of more and more affluent foods and larger output per unit of land in agriculture. The middle line in Figure 3 shows the actual development. Over the period 1950-1990, the combination of changes in the consumption and the production subsystem caused a decrease of actual, per capita land requirements by 40 percent.

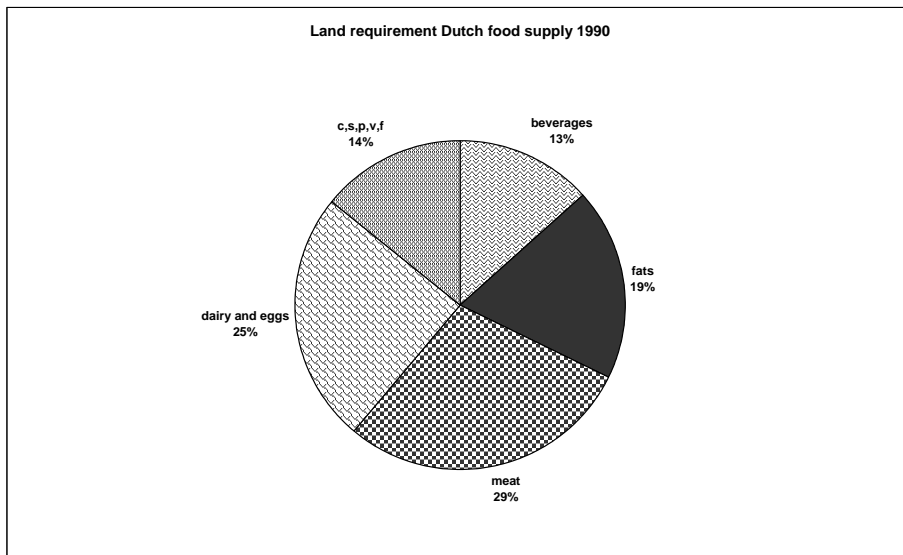


Figure 1: Land requirements for the five food categories of the Dutch 1990 food supply, beverages; fats; meat; dairy and eggs; and cereals, sugar, potatoes, vegetables, and fruits (c,s,p,v,f)

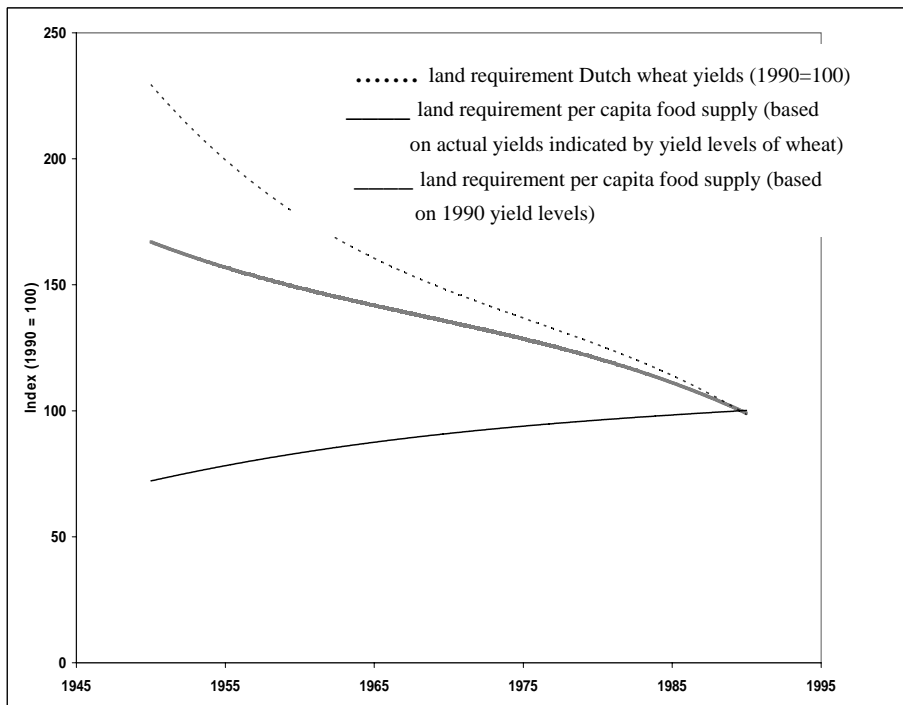


Figure 2: Long-term trends for land requirements for Dutch food supply over the period 1950-1990. The upper line illustrates decreasing, actual land requirements by the decreasing land requirement for wheat. The bottom line shows changes in land requirements due to changes in food consumption patterns using data from the Dutch production subsystem in 1990. The middle line shows the combination of changes in the consumption and the production subsystem

4.2 'Transpirational' water use in 1990 and developments for the Dutch food consumption patterns 1950-1990

Figure 3 shows results of 'transpirational' water for Dutch food supply in 1990. For the category of meat, and dairy and eggs, requirements were relatively large. These two food categories needed almost 70 percent of total 'transpirational' water requirements. For the category of cereals, sugar, potatoes, vegetables, and fruits, 'transpirational' water requirements were about 20 percent. In this category, only two food items accounted for 80 percent of all 'transpirational' water requirements, fruits (41 percent) and cereals (40 percent). The categories of beverages and fats showed the smallest requirements for 'transpirational' water.

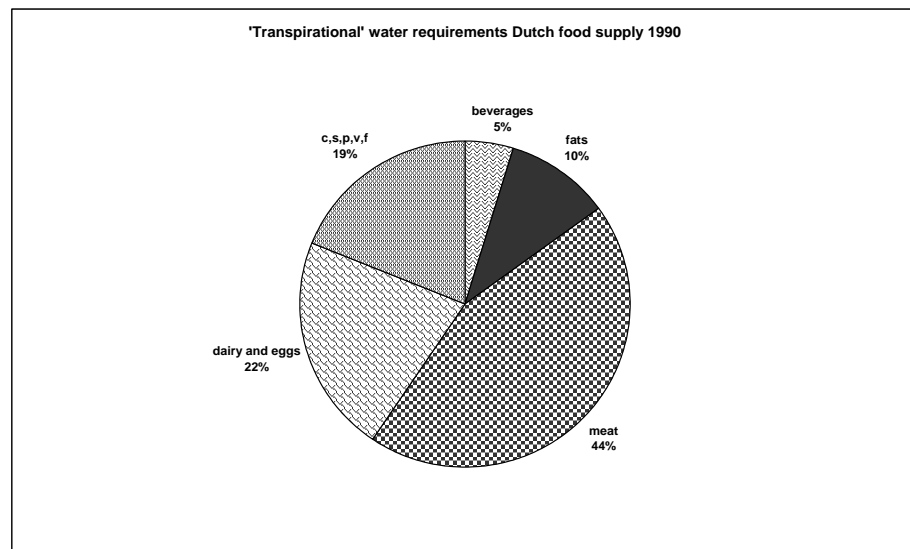


Figure 3: 'Transpirational' water requirements for the five food categories of the Dutch 1990 food supply, beverages; fats; meat; dairy and eggs; and cereals, sugar, potatoes, vegetables, and fruits (c,s,p,v,f).

Figure 4 shows 'transpirational' water requirements for Dutch per capita food supply over the period 1950-1990. Changes in consumption resulted in an increase of requirements by 45 percent. Requirements for the food category of dairy and eggs remained stable, while requirements for the other food categories increased.

4.3 Energy use in 1990 and developments for the Dutch food consumption pattern 1950-1990

Figure 5 shows energy requirements of Dutch household food consumption in 1990. For the category of meat, and dairy and eggs, requirements for were relatively large. Almost half of total energy requirements were needed for these two food categories. For the category of cereals, sugar, potatoes, vegetables, and fruits, energy requirements were about 40 percent of the total. The relatively large energy requirement was caused by energy use in the food chain, such as energy for transportation, production of fruits and vegetables in greenhouses, and industrial

manufacture. The fraction of energy needed for beverages was 12 percent, the fraction of energy needed for fats was much smaller.

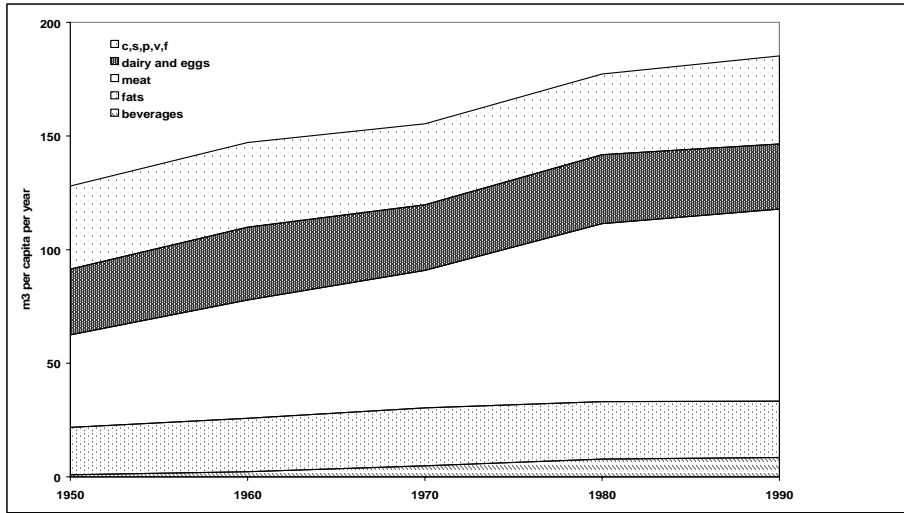


Figure 4: Long-term trends for 'transpirational' water requirements for the five food categories of the Dutch food supply, beverages; fats; meat; dairy and eggs; and cereals, sugar, potatoes, vegetables, and fruits (c,s,p,v,f) over the period 1950-1990.

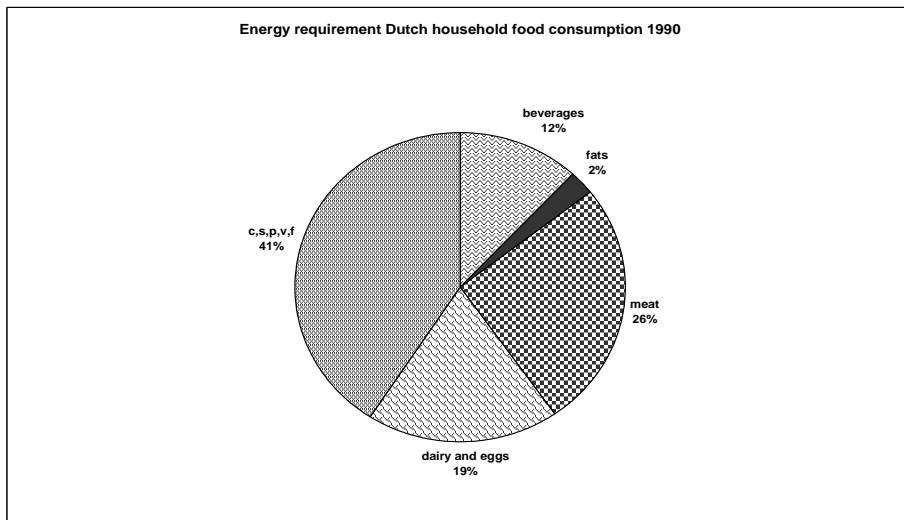


Figure 5: Energy requirements for the five food categories of the Dutch 1990 household consumption, beverages; fats; meat; dairy and eggs; and cereals, sugar, potatoes, vegetables, and fruits (c,s,p,v,f)

Figure 6 shows trends in relative, per capita energy requirements for supply for the five food categories, as well as actual, total, energy requirements for final, per capita consumption over the period 1950-1990. Over the period 1950-1990, per capita energy requirements for supply increased by 60 percent. The main changes occurred for the categories of beverages, fats, and for the category of meat. For beverages, the increase of

requirements was caused by larger consumption of coffee, wine and beer. In the category of meat, the increase was mainly caused by larger consumption of poultry and pork. Figure 6 also shows that, during the forty-year-period, actual, per capita energy requirements increased even more, by 83 percent (+10 GJ per capita per year), causing a widening of the gap between energy requirements related to supply and to final consumption. The increase of this gap is understandable by assuming that more and more energy is needed in links of the food chain, for example, in agriculture, where increasing energy inputs caused an increase of yield levels, for food conservation (e.g. cooling and freezing), and transportation.

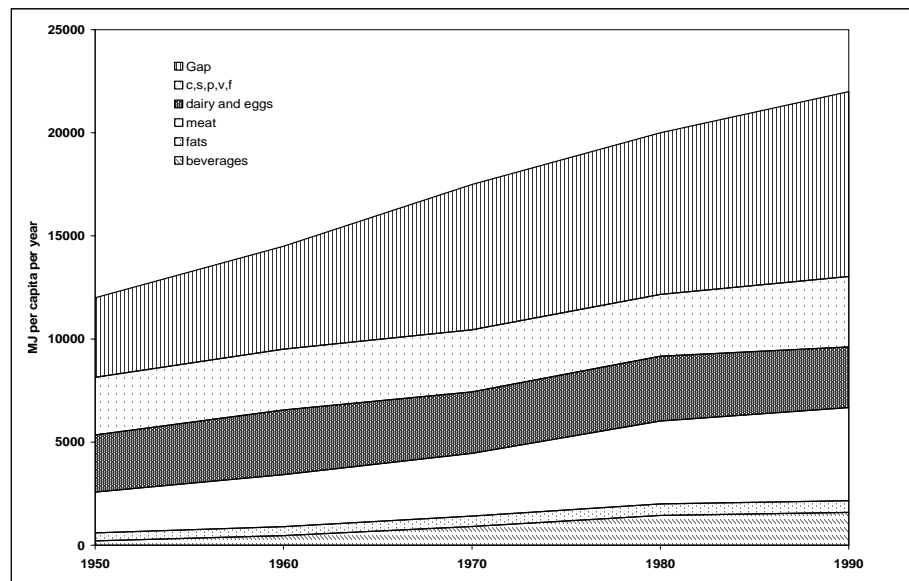


Figure 6: Long-term trends for energy for the five food categories of the Dutch food consumption pattern, beverages; fats; meat; dairy and eggs; and cereals, sugar, potatoes, vegetables, and fruits (c,s,p,v,f). of the Dutch food consumption pattern over the period 1950-1990. The figure shows per capita energy requirements for food supply based on 1990 data for the five food categories, as well as actual, total energy requirements for per capita food consumption

4.4 Comparison of natural resources

When the three resources were compared, the actual trend for land offsets trends for water and energy. Where land requirements decreased by 40 percent, 'transpirational' water requirements increased by 45 percent, and energy requirements almost doubled. For all resources, the effect of consumption changes were mainly related to changes in the food categories of beverages (wine, beer, coffee), meat (beef, pork, poultry), and fats. For water, larger consumption of fruits caused an additional increase of requirements for the category of cereals, potatoes, vegetables and fruits.

4.5 Pathways towards sustainable food consumption patterns

The identification of the impact of different food items and food categories on the use of land, transpirational water, and energy provides a tool to identify and develop pathways towards more sustainable food consumption patterns. Food items with similar functions can differ in their resource requirements. Substitution of foods with smaller resource requirements, therefore, is an option for reduction. Options to reduce the use of energy have been elaborated in depth in Kramer (2000). This study, therefore, focused on land and water use. Options for resource reduction are:

- ▶ **Beverages:** substitution of coffee by tea, or wine by beer.
- ▶ **Fats:** to reduce land requirements, the substitution of soyoil, a basic ingredient of vegetal oils and margarines, by rape or sunflower oil. For water, sufficient data were not available.
- ▶ **Meat:** requirements for land, energy and transpirational water decrease in the following order: beef, pork, poultry.
- ▶ **Dairy and eggs:** there are no options for reduction of resource use by substitution because requirements for milk and eggs are in the same order of magnitude.
- ▶ **Cereals, potatoes, vegetables, and fruits:** differences in land requirements occur. French beans, for example, have 50 percent larger land requirements than carrots. Substitution of vegetables or fruits with relatively large land requirements by foods showing lower requirements, however, is not in line with nutritional constraints that promotes a high diversity of consumption (Whitney and Rolfes, 1999). Staples have decreasing requirements in the following order: rice, pasta and potatoes providing options for reduction.

For food items from different categories, the substitution of food items from the category of meat, and dairy and eggs by high protein foods from the category of cereals, sugar, vegetables, potatoes and fruits, such as peas, cause a substantial reduction of the use of land as well as water.

5 Overall conclusions

Specific resource requirements for foods vary, leading to variation of resource requirements among food consumption patterns. For the affluent Dutch pattern of 1990, the category of animal foods (meat, and dairy and eggs) required 66 percent of total transpirational water, 54 percent of agricultural land, and 45 percent of energy requirements. Beverages and fats required relatively large amounts of land, but less water and even less energy. The food category of cereals, potatoes vegetables and fruits required relatively large amounts of energy, about 40 percent, which can be attributed to energy needed in chains, such as for the manufacture, transportation and conservation of foods. Long term trends for the Netherlands showed that the pressure of consumption on land, water and energy has increased substantially over a forty year period. Especially increased consumption in the food category of meat caused large changes in land, transpirational water, and energy requirements, additional effects were caused by increased consumption of beverages. For energy, the increased energy use in chains was apparent.

Pathways towards more sustainable food consumption patterns include substitution of foods by foods with similar functions but lower requirements, for example, wine by beer; coffee by tea; soyoil by sunflower or rapeoil. In the category of meat, requirements decrease in the following order; beef, pork, poultry, in the category of cereals, potatoes, vegetables and fruits, requirements for staples decrease in the order of rice, pasta, potatoes. Substitution among food categories is possible for food items of the category of meat, and dairy and eggs by protein rich vegetal foods, such as peas. This option shows large resource reductions.

In the next ten years, a large share of the world population will adopt a more western lifestyle, including affluent food consumption patterns. For many people, this will improve the quality of their daily food and contribute to better health conditions. When, at the same time, limited land and water resources, and assimilate capacity of natural systems are respected, changing food consumption should move in the most sustainable direction. A better understanding of the food consumption-environment connection provides practical information for directions of change.

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QSAM Strategy for the second phase of the UNEP/SETAC Life Cycle Initiative

- Bringing science-based life cycle approaches into practice.

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1 Introduction

After the publication of the ISO 14040 (1998) series, a real need for supporting the dissemination and implementation of this approach in industrialized and non industrialized countries was identified. UNEP and SETAC, aware of this need, conjointly began to work on the articulation of existing efforts around Life Cycle Approaches resulting in the setting-up of the Life Cycle Initiative in 2002. This Initiative aims at promoting Life Cycle Thinking worldwide and at facilitating the knowledge exchange of almost 200 experts worldwide and 4 regional networks from different continents.

SETAC commits to provide technical advice and UNEP to facilitate the processes involving all kind of stakeholders and from different regions as well as to communicate achievements (i.e. by means of training and hosting the web site: <http://lcinitiative.unep.fr/>).

UNEP plays the role of the Secretariat of this Initiative, which is running the last months of its first phase that began the year 2002. During this phase three important fields of work (Life Management, Life Cycle Inventories and Life Cycle Impact Assessments) as well as a cross-cutting area (Inclusion of Social Impacts in LCA) were established. Achievements and products from the first phase are being presented and disseminated for open use.

For the second phase beginning in 2007, a renewed mission and goals and action plans have been outlined. This second phase will cover the period

until 2010 and the planned tasks are being articulated with the activities of the 10-year Framework of Programmes on Sustainable Consumption and Production - the Marrakesh Process. The website is <http://www.unep.fr/pc/sustain/10year/home.htm>.

The Marrakesh Process is directly dealing with substantive issues that are within the scope of work of the Initiative (i.e. Sustainable Lifestyles, Sustainable Products, Sustainable Procurement, Sustainable Tourism and Sustainable Building and Construction). The implementation of the Marrakesh Process is being pursued by UNEP and the United Nations - Department of Economic and Social Affairs (UN DESA) and started in 2003. Linkages between the Initiative and the Marrakesh Process are being strength.

2 The Life Cycle Initiative – First phase (2002-2006)

A summary on the growing performance in the Initiative and results until now are given in this chapter.

2.1 Participation in the Initiative and representativeness of the members

Since 2002, there has been a considerable growth in the Initiative membership. Currently, around 1000 interested members are registered in the UNEP Initiative's database, and 200 experts are actively working in three Working Programs (Life Management, Life Cycle Inventories and Life Cycle Impact Assessments) and its thirteen Task Forces.

Around 300 out of 1000 interested members come from Latin America, Africa and Asia. The largest group of members (almost 700) are from other regions/continents like North America, Europe and Asia/Pacific and from international private companies and other organizations. An approximate distribution of the participation of interested members is given in Figure 1.

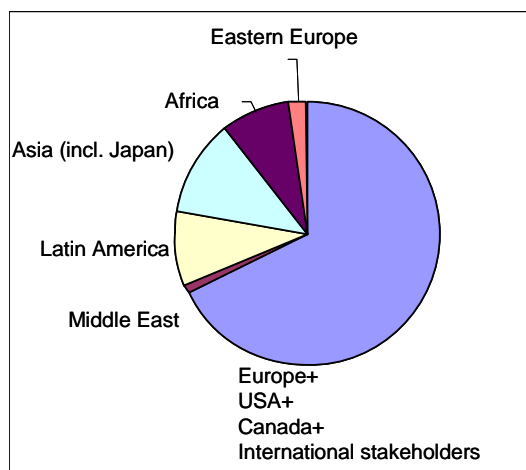


Figure 1: Distribution of regional memberships

80% of the members come from academic and research institutions, 15% from NGOs and consulting firms and 5% from private companies, governmental institutions and other kind of organisations.

It is, hence, evidenced that the Initiative has moved towards a global network; however, there is still the need to intensify actions to include more

members from developing countries and from the private and governmental sector.

2.2 Achievements of the Life Cycle Initiative

The most relevant achievements and deliverables from the Initiative through its Secretariat, its 3 programs and 13 Task Forces are the following ones.

2.2.1 *Achievements:*

- Building capacities and an international Life Cycle community, including more and more developing country experts, facilitating global exchange of information.
- Making available free awareness-raising and training material for global use.
- Setting the scene for Sustainable Product Life Cycle Management based on triple-bottom line approach.
- Enhancing consensus among LCA experts in methodological and data availability questions.
- Providing direct input for the recently launched European LCA platform.
- Supporting the set-up of a Global Resources Panel with the European Commission.
- Raising awareness among Life Cycle experts for the particularities of resources, in particular metals.
- Ensuring that initiatives facilitated by UNEP, such as UNEP Finance Initiative, Global e-Sustainability Initiative, Tour Operators' Initiative, and the Sustainable Building & Construction Initiative take Life Cycle Approaches.
- Being in contacts with Multilateral Environmental Agreements, in particular Basel Convention, to base waste policies on Life Cycle Thinking.
- Providing direct input to the task forces of the Marrakech Process that is being pursued by UNEP and the United Nations – Department of Economic and Social affairs.

2.2.2 *Key Deliverables:*

- Worldwide network of around 1000 members of which 200 experts actively participated in Initiative.
- Regional and national 'centres of excellence' for capacity building and technology transfer.
- Organisation of many workshops on LCA and LCM issues.
- Support of around 50 open meetings on LCA/LCM worldwide.
- Set-up of an open management content system: website ESTIS for the Life Cycle Initiative and its task forces and regional networks.
- Awarding free licenses of LCI databases and LCA software to 22 organisations from 14 developing countries to support LCA case studies.
- Background Report on a UNEP Guide to Life Cycle Management and a related slide show. Both to be downloaded since beginning of 2005 from the UNEP website.

- A more popular UNEP-SETAC LCM guide (draft version).
- Development of LCA and LCM training materials (draft versions).
- Feasibility studies for Extended LCA (incl. social aspects).
- Guidance on how to move from current practices to global recommended practice in LCIA (in preparation).
- Guidance documents on how to set up LCI databases for capacity building in all regions.
- Establishment of a Global LCI database registry located at Research Centre Karlsruhe.

3 The Life Cycle Initiative – Second phase (2007-2010)

3.1 The mission, objectives and work areas of the second phase:

3.1.1 Mission

A renewed mission is: “To bring science-based Life Cycle Approaches into practice world wide”

3.1.2 Objectives

The objectives for Phase 2 are the following ones:

Objective 1: Enhance the global scope of life cycle approaches methodology.

Objective 2: Collect, develop, maintain and disseminate information on successful applications of life cycle approaches (together with the interface to other tools – e.g. certifications) to ‘resources’, including natural resources, chemicals, energy, water, etc.

Objective 3: Facilitate the use of life cycle approaches worldwide by influencing management decisions in business and administration related to key consumption clusters and strengthening product policies and product stewardship programs by working closely with the respective leading actors.

Objective 4: Facilitate sustainable development in emerging and developing economies by creating capacity in the use of life cycle approaches in key public policy and business stakeholders worldwide, in collaboration with regional life cycle networks and other organizations.

Life Cycle Thinking is about widening views by expanding the traditional focus on the production site and manufacturing processes in order to incorporate various aspects associated with a product over its entire life cycle.

Life Cycle Approaches includes a range of life cycle methodology from qualitative to quantitative tools based on life cycle thinking and includes life cycle management.. The quantitative LCA (following the ISO 14040 standards) is included in the life cycle approaches, but life cycle approaches is broader and more inclusive.

3.1.3 Focused work areas

The identified four Phase 2 objectives will be met through projects in four focused work areas (Figure 2):

- a. Life Cycle Approaches methodology (including data, methods, case studies, etc.)
- b. Life Cycle Approaches for Resources (including natural resources, chemicals, water, energy, etc.)
- c. Life Cycle Approaches for Consumption Clusters (structured in housing, mobility, food and consumer products)
- d. Life Cycle Approaches for Development (including institutional empowerment, training, curricular development, etc.)

The Figure 2 below indicates the relationship among the work areas. In this way it is expected that the impact of the Life Cycle Initiative will go beyond the work on methodologies and capacity building, to practical “applications” that make a difference in the real world and thus contribute more effectively to the ongoing international efforts to change unsustainable patterns of consumption and production. The expectations for each of the objectives will be met by having the Secretariat conducting the work and the experts carrying out projects in the four focused work areas.

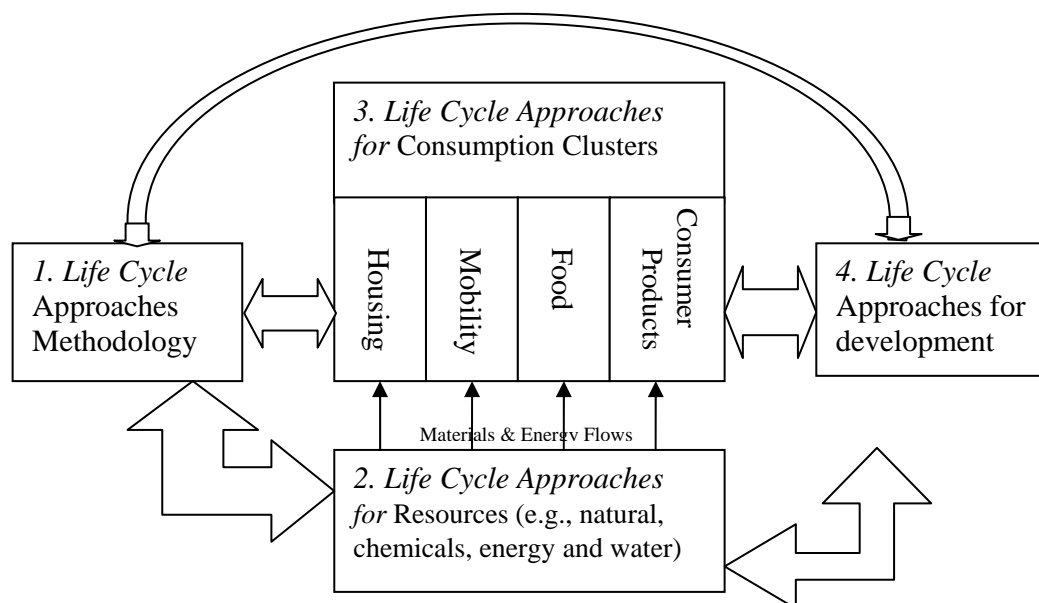


Figure 2: Relationship among the 4 focused work areas chosen for the practical application approach of Phase 2

3.2 New and transitioning projects:

A number of projects have been identified and proposed, and plans are underway to successfully complete or launch them. It is expected, among others, to work on the following projects in the first part of Phase two in the year 2007/8:

Long term development and maintenance of a LCI database registry. This activity will allow structured collection and dissemination of meta data about running database projects and developments.

Dissemination of latest developments in LCA methodology. Participation in the EC Coordinated Action on Life Cycle Assessment (CALCAS) will allow the UNEP/SETAC Life Cycle Initiative to disseminate latest developments and receive feedback on future activities.

Improvement of Characterization Factors in Life Cycle Impact Assessment of Ecotoxicity (Fate – Exposure – Effects) of metals.

Extended LCA: Integration of social impacts into the LCIA framework. This project will identify in what manner social aspects can be integrated into LCA methodologies, and shape the process towards agreement in the expert community (Code of Practice) and towards standardization in the long term.

Further development of LCM concepts on sustainable management along the product lifecycle:

- Including product innovation and development, supply chain management, stakeholder relationships and - communication.
- Consultative Meeting with Business & Industry. Foundation of a Business Roundtable as a forum for exchange of experiences and views; may be in cooperation with e.g. WBCSD.
- Collection of instructive case study examples.

Building Capacity in Global Supply Chains. The focus of the project will be producers in the production chains for extraction and processing of natural resources, primarily in less-industrialized countries and regions.

Partnership with the International Panel on Natural Resources. This partnership will allow the Life Cycle Initiative the articulation of projects on natural resources with scientists and key stakeholders working with the panel as well as an exchange of opinions regarding the activities on this area.

Workshop, co-ordination and consultative meeting with various related UNEP activities:

- *The Strategic Approach to International Chemicals Management (SAICM)* managed by UNEP. A workshop bringing together key participants from SAICM and the Life Cycle Initiative will be held to pursue further areas of collaboration.
- Relationship with *UNEP's Sustainable Building and Construction Initiative (SBCI)*. The SBCI focus is partly to develop and promote economic incentives for a life cycle approach in design, construction and financing of buildings.
- Consultative Meeting with UNEP programme officers on *mobility and food, the Marrakech taskforces (NCPCs) and the Global e-sustainability Initiative (GeSI)*. These meetings will aim at finding ways for an inclusion of life cycle approaches in these activities.

International Conference and network cooperation:

- Co-organizer with the regional Latin American life cycle network of *the International Conference on Life Cycle Assessment, CILCA2007*, 26-28 February 2007 in Sao Paulo, Brazil meeting, where an exchange of experiences with training workshops and presentations of latest developments will take place.

- Co-operation with organizers of *LCM2007* in Zürich, 27-29 August 2007 and other European based networks e.g. NORLCA and SCORE.

Second phase of LCA awarded projects.

- Workshop to recognize the participants, who have been awarded LCA software and data base and to exchange learning, insights, and examples of, how they have used their experiences to build capacity regionally.
- A second round of LCA awards to be initiated.

Capacity building of LCA and LCM in developing countries:

- Regional meetings, where capacity building with the latest UNEP/SETAC materials, will take place.
- Training course on LCA in Vietnam decided.
- Further development of training materials.

Completion of a public web-based information system. This will allow LCA practitioners free access to updated information and knowledge on commercial and free databases and LCA tools.

4 Conclusions

The UNEP-SETAC Life Cycle Initiative's role is consolidating

- as catalyst of efforts on putting life cycle thinking into practice in business around the world,
- as support in the development of international policies that include life cycle thinking in developing and developed economies, and
- as the linking element to promote training and case studies in various areas, including in SMEs.

The Initiative brings together key actors from all the regions, and it is providing the platform and opportunity to share visions on activities for the promotion Life Cycle Thinking worldwide.

Everybody attending this meeting is encouraged to participate in the work and support the Initiative. Please review the Phase 2 plan on our website, examine the focused work areas and expectations against your own interests to identify possible areas of collaboration. Both UNEP and SETAC are not-for-profit organizations, and the Life Cycle Initiative relies fully on voluntary works and on support and sponsorship, especially from government, business and industrial associations. Without sufficient support all these ideas for new projects, I have presented, will not be accomplished.

Therefore, only if the Initiative makes something useful for society and business, it will survive!

QSAM Cooperation and sustainable future markets

Stakeholder engagement and consumer integration for sustainable timber use in the building sector

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1 Introduction

In the debate on sustainable production and consumption renewable resources are promoted as a key for achieving global sustainability. The promotion of renewables is already taking place for a number of markets and policy fields such as energy, chemical and consumer products or building and construction. However, the major part of the market development debate takes place without consideration of sustainability criteria. For example, the emerging markets for biofuels will contribute to land degradation and loss of biodiversity if no sustainability criteria will be applied for their production. Beside environmental concerns, also key stakeholder demands and consumer aspects are rarely taken into account when new markets are developed. Therefore, new approaches and tools are needed to assess and to help govern the integrated consideration of life cycle implications for global sustainability. An important approach is the design of products and markets.

There is a substantial body of research regarding the sustainability effects of products and regarding the diffusion of ecological products. However, how sustainability demands can be integrated in early innovation phases and how new markets for sustainable products and services can be systematically explored are recent and challenging research questions. The paper highlights the related experiences from ongoing research projects on future markets of timber in the building sector, conducted for the German Ministry of Education and Research and the German Environmental Protection Agency.

First, this chapter presents innovative tools for sustainable future markets for “building and refurbishment with wood” at the company level. The tools focus on stakeholder engagement and customer integration. Then, the authors argue for an indicator set for the entire value chain as a crucial basis to realize, monitor and govern a change of markets towards sustainability. The methodological approach and steps towards this indicator set are outlined. Finally an indicator set will be presented, which enables the assessment of sustainability risks and opportunities in the entire value chain.

Proceedings: Sustainable Consumption and Production: Opportunities and Threats, 23-25 November 2006, Wuppertal, Germany. Launch conference of the Sustainable Consumption Research Exchange (SCORE!) Network, supported by the EU's 6th Framework Programme.

Conclusions will be drawn on improved stakeholder engagement in life cycle management and consumer integration as conditions for the development of sustainable future markets for building with wood.

2 Exploring future markets: Innovative tools for stakeholder engagement and consumer integration

Within this paper we see markets as social arrangements that allow buyers and sellers to discover information and carry out a voluntary exchange of goods or services. Further actors and activities are linked to the market through the life cycle of the related product or service. New markets (or “future markets”) are those that are in the process of emergence or those that will emerge in the future (see Fichter et al. 2006).

Research on how sustainability can be integrated in the development of future markets is limited; the topic has been addressed within the recent research project SUMMER (see www.summer-net.de). One key result of the project is that the identification and development of sustainable future markets depends mainly on the effective innovation alliances (actor cooperation) and the early interactive integration of users and customers in the process of innovation (consumer integration). Through those processes demand-side related requirements (such as specific preferences, real added-value for the user) as well as environmental and social aspects of product use can be considered timely and systematically (see Fichter et al. 2005).

Taking these results forward, the ongoing project “Holzwende2020plus: Sustainable future markets for building with wood”, conducted for the German Federal Ministry of Education and Research (BMBF) addresses the value chain specific context and focuses on building and refurbishment with wood. Different tools have been chosen to support enterprises and networks to actively develop sustainable future markets in building and refurbishment with wood. Tools have been selected which

- support the creation of new or the development of young markets,
- enable productive interactions among market actors,
- secure the sustainability of planned, developing and applied techniques in the sector and
- are innovative because they are new or hardly applied in the building sector yet.

Table 1 presents these tools and their classification into four different functional classes (see Fichter et al. (2006) for a more detailed description). Tools for *user and customer integration* aim at the consideration of preferences of these groups into the product innovation process. Customers are not seen as buyers, they are the users of the future product. This means they can contribute to the understanding about specific problems and they can formulate needs and requests. The consumer can support the development of new ideas and help evaluate products and ideas. For the case of building and refurbishment the “users” could be planners, builders, constructors or house inhabitants. Tools for *interactive marketing* address the information of decision makers and customers about innovations and potentials for timber products in an interactive manner. For example, planners could be confronted with new product ideas in a decision-making workshop, they could use internet-based product catalogues or they could

communicate the strengths of their products directly in the realisation phase of the building at the construction site. Tools for *network management* are especially important for SMEs (small and medium enterprises), which often lack the capabilities for activities outside their normal business. However, through cooperation between SMEs synergies can be used for increased competitiveness and market creation. Neutral network coaches can be important for the development of efficient networks. The following subchapter will address the function of the fourth class of tools, the *sustainability assessment*, and will specifically focus on the development of a sustainability indicator set for the entire value chain.

Table 1: Overview of selected methods for the development of sustainable future markets for building and refurbishment with wood (adopted from Fichter et al. 2006)

Tool	Objective of tool	Market access strategy			
		User and customer integration	Interactive marketing	Network management	Sustainability assessment
Lead-user-method	Developing innovative ideas cooperatively with trend-setting users and customers	X			
Focus groups	Identifying demand of and acceptance for new products and services; examination of communication and marketing strategies	X			
Construction process research	Accompanying assessment of influencing factors, opinions and estimations of the constructors towards timber and towards co-operating firms	X			
Decision-maker workshops	Attacking prejudices and conveying knowledge to planners, investors, authorities and other key decision-makers		X		
Internet-based product catalogue	Enabling an easy and simple access to standardised and certified sustainable timber for architects		X		
Interactive construction site	Promoting publicity for pilot schemes through interactive media presentations and on-site events		X		
Innovation workshops	Creating ideas and innovative projects for sustainable new business fields, systems, products, services and processes			X	
Network coaching	Creating powerful networks through neutral network coaches which help to resolve conflicts and to establish goal-oriented, productive interactions			X	
Resource efficiency analysis	Assessing a product's life-cycle-wide use of natural resources as a solid, comparable ecologic basis for decision making				X
"Sustainability Check" for the entire value chain	Internet-based evaluation of strengths and shortcomings of firms in the value chain "building and refurbishment with wood" regarding the contribution to sustainable development				X
Ecological product design	Integrating ecological aspects (energy and resource efficiency, reduction of harmful substances and waste) in the product design process				X

3 Developing an integrated indicator set to assure the contribution of emerging markets to sustainability

This section will highlight the value of cross-sectoral sustainability indicator sets for exploring sustainable future markets for wood in the field of building and present a methodology to develop such an indicator set.

3.1 The challenge of value-chain-wide sustainability indicator sets

As the world is increasingly dominated by economic activities and faces at the same time severe problems in areas such as resources, pollution or unfair allocation of benefits, it is apparent that future markets need to

integrate sustainability aspects. However, the theoretical concept of sustainability has to be translated into concrete measurable and applicable targets and recommendations in order to be a guiding principle for planners, entrepreneurs and other relevant actors. Such information should enable the product designers integrate sustainability aspects in product and market development. Aspects to be considered could be for example

- advantages and disadvantages of substitution (e.g. services instead of new products),
- fault tolerance, flexibility, reversibility of applied technology, avoidance of lock-in effects (see e.g. Weizsäcker and Weizsäcker 1984 or Simonis, 1999),
- limitation of the intensity of negative effects, avoidance of hazardous technologies (see Gleich 1997) or
- accompanying measures to avoid psychological, technical or growth-related rebound effects (see Paech 2005).

The advantages of an integrated approach to social, environmental and economic effects of corporate action have been shown in the literature (e.g. Hroch and Schaltegger 2001 or Figge et al. 2001) and gradually companies do recognise the value of detailed sustainability performance information. It can support the management at the operational level to make their firm benefit from cost-saving potentials and to comply with existing and forthcoming regulatory frameworks. At the tactical level it improves products and services and at the strategic level it benchmarks the company against competitors and gives guidance on investment decisions. Here indicators are needed as communication tools.

Within this project's context, the sustainability assessment aims at the steering of future markets in the whole value chain of "building and refurbishment with wood" towards ecological, economical and social sustainability. The geographical focus should be Germany. The indicator set covers the entire value chain and should aid corporations ensuring a sustainable market success e.g. through securing natural resources, protecting the climate, evading harmful substances and improving quality of life.

3.2 Methodology for indicator set development

Sustainability as an overall concept is too abstract and broad for a direct and all-encompassing formulation of indicators. A methodological approach from the social sciences called conceptual specification or dimensional analysis (see figure 1) is used to break down the concept into dimensions, categories and aspects (see Kuhndt and Geibler 2002).

This approach was applied for the development of the indicator set (for further applications see Geibler et al. 2006, or Kuhndt et al. 2004). Four methodological steps were taken to obtain the indicator set. As the set should represent the whole value chain, first the value chain "building and refurbishment with wood" has to be specified. Then, based on a literature and stakeholder analysis, a preliminary indicator set is formulated. Ultimately through a process of stakeholder feedback the final indicator set is attained. These steps are described in more detail below.

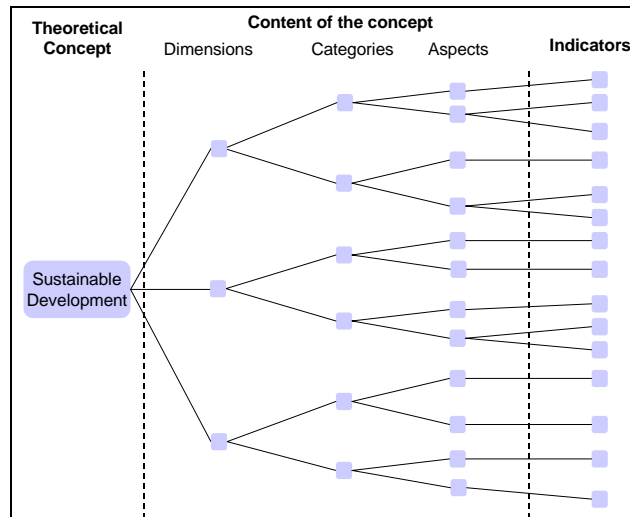


Figure 1: Concept specification for sustainable development (Source: adopted from Köhler 1987: 85).

3.3 The process of indicator set development

The value chain “building and refurbishment with wood” consists of a highly complex network. Basically, it can be split into six stages: resource extraction (forestry), wood and timber processing industry, construction of buildings with timber, maintenance of buildings, refurbishment of old buildings and finally recycling and disposal. The chain is connected through the activities of trade and logistics (see figure 2).

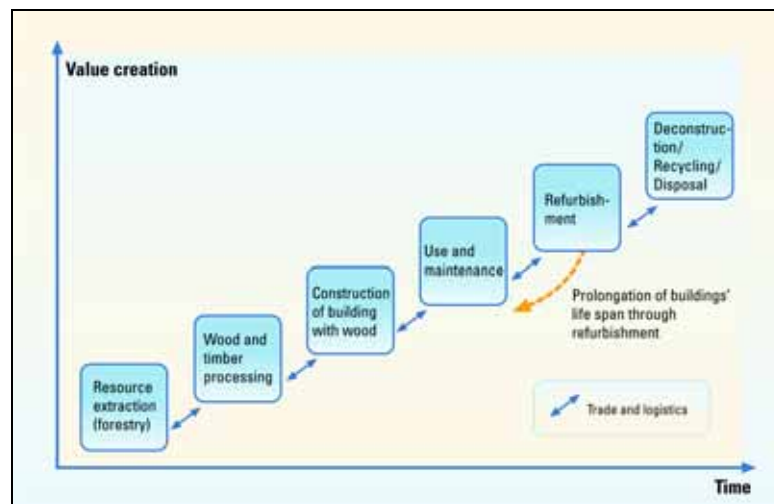


Figure 2: The value chain “building and refurbishment with wood” (Source: own compilation)

The next step is the literature and stakeholder analysis for drafting an indicator set. The different chain-relevant actors (persons and institutions from science, the economy, networks, etc.) are identified. Positions and knowledge of these actors and a wide range of initiatives are assessed

regarding their objectives and indicators for (parts of) the value chain. Furthermore relevant scientific literature has been reviewed (see e.g. Wallbaum 2002). Some national and international initiatives are listed in table 2 (see also Kristof et al. 2006).

Table 2: Initiatives along the value chain “building and refurbishment with wood” analysed for indicator set development (examples)

Value chain phase	Sustainability initiatives (examples)
Resource extraction (forestry)	<p>UN Agenda 21, Chapter 11 provides guidance on how and why to combat deforestation.</p> <p>Ministerial Conference on the Protection of Forests in Europe (MCPFE) addresses issues on forests and forestry and declares recommendations for the protection and sustainable management on forests in Europe.</p> <p>German National Forest Programme (NWP) analyses environmental, social and economic benefits of forests in line with national priorities. Strategies and measures for sustainable forest management are published.</p> <p>Forest Stewardship Council (FSC) sets international standards for responsible forest management and accredits independent third party organizations.</p> <p>Programme for Endorsement of Forest Certification Schemes (PEFC) promotes sustainably managed forests through independent third party certification and provides an assurance mechanism to purchasers.</p> <p>World Business Council for Sustainable Development (WBCSD) aims at providing business leadership for change toward sustainable development and promotes a sustainable forest products industry as responsible managers of carbon.</p>
Wood and timber processing	<p>Chain of custody certification certifies wholesalers, manufacturers, distributors, and retailers, who handle wood coming from forests certified according to standards such as FSC or PEFC.</p>
Construction of building with timber	<p>German Federal Ministry of Transport, Building and Urban Affairs aim with the guidelines for sustainable construction to support planers with an instrument to systemically implement sustainability in the construction.</p> <p>natureplus label European seal of quality for building products, construction materials and home furnishings that are environmentally friendly, do not have negative health effects and properly perform their function.</p>
Use and maintenance	<p>Holzabsatzfonds (German Timber Promotion Fund), central marketing institution of the German forestry and wood processing industries, supports the sector with cross-regional and regional marketing measures.</p>
Refurbishment	<p>Action Program Environment and Health North Rhine Westphalia (APUG NRW) aims to strengthen the links between environmental and health protection; promotes to take health-related aspects in refurbishments (incl. pollutant-free indoor air) into account.</p>
Deconstruction/ Recycling/ Disposal	<p>Waste Wood Ordinance (AltholzV) lays down requirements for the recycling and energy recovery as well as for the disposal of waste wood on the basis of the Closed Substance Cycle and Waste Management Act.</p>
Value-chain-wide aspects	<p>Federal Ministry of Food, Agriculture and Consumer Protection promote in the “Charter for Wood” measures for an increase in the use of wood.</p> <p>Global Reporting Initiative (GRI) creates guidelines and standards in corporate sustainability reporting.</p> <p>Integrated Product Policy (IPP) of the European Commission seeks to minimise environmental impacts by looking at all phases of a products' life-cycle and taking action where it is most effective.</p>

A review of the chain highlights that the entire chain is linked to significant sustainability impacts, which can be illustrated by taking the import of illegal timber and the building sector’s resource intensiveness as examples.

The import of tropical wood from illegal sources has been analysed in a study by the Federal Research Centre for Forestry and Forest Products (see Dieter und Küpker 2006). In 2005 an estimated amount of between 0,7 and 1,3 million m³ wood has been imported into Germany originated from these sources. These figures respectively represent 34 to 65 percent of the overall

German import of tropical wood. For Russia, a country which is covered by the third biggest area of old forests worldwide, the WWF expects that between 25 and 50 percent of the lumber derives from illegal sources (WWF 2004). On a global scale, about 350 million people who live within or adjacent to dense forests depend on them to a high degree for subsistence and income (World bank 2004).

“Construction and habitation” is the field with the biggest material input in Germany; it comprises of one third of the nations total material use. This corresponds to 76 tons of biotic and abiotic material per year and citizen (Wallbaum, Müller, Kaiser 2005). Hence this field is an important starting-point on the way to a more sustainable resource use (German Federal Environment Agency, 2005). Of all renewable commodities in the construction sector wood is used the most (Deimling and Vetter 2000: 1). Furthermore its processing is comparatively low in energy intensity and environmentally sound (German Council for Sustainable Development 2004). Consequently, wood and timber should play an important role in the substitution for non-renewable materials in the building sector.

Within the chain, a number of initiatives have emerged to promote sustainable development. Criteria and standards have been set up. However the full coverage of the entire chain has rarely been achieved. Two far reaching approaches are the chain of custody approach for forest certification and the natureplus label which reach the chain up to the point of sale. However, consumption issues or end of life aspects have not yet been integrated into indicator sets.

Through an intensive process of discussions about and balancing of the material, the first draft of indicator sets covering the entire chain (incl. the use and end-of-life phases) has been established. However, the process of identifying key aspects and indicators is a matter of subjective choice and there is a risk that relevant issues are not considered or irrelevant issues are included (see Rennings 1994: 144; Fürtjes 1982: 38). Thus, the results have been reviewed based on a triangulation approach, i.e. the findings have been double-checked through another empirical method. Accordingly the draft has been put through a process of interview-based stakeholder feedback for modifications. Interview partners representing different links in the chain, from a broad societal spectrum and having knowledge about the German as well as international situation have been selected. Guided interviews of 45 minutes up to two hours were held with 16 persons and transcriptions were checked with them. The results of the interviews have been analysed qualitatively and quantitatively to reassess and adjust the draft indicator set.

4 The indicator set

On the basis of the results of the stakeholder feedback, an indicator set for the value chain “building and refurbishment with wood” was developed for direct application for corporations and key actors in the chain. This indicator set is presented in Table 3. Additionally, a second indicator set has been developed which addresses policy making (see Kristof et al. 2006).

Table 3: Indicator set for the value-chain “construction and refurbishment with wood” for companies (adopted from Kristof et al. 2006).

Targets and indicators for the distinct tiers of the value chain	
1. Forestry	
Sustainable forestry	Forest management according to sustainability certification scheme, externally verified
Efficient market exploitation	Development of synergetic effects through clustering
	Tailor-made supply of high-quality timber products for the building sector
	Activities for the development of new market segments (e.g. tourism)
2. Industrial and handcraft timber and wood processing	
Processing of regional/ certified wood	Ratio of used regionally produced wood and timber
	Ratio of used certified wood and timber
Benchmarking / product labelling	Ratio of used certified wood products according sustainability labelling scheme
Use cascades	Ration of recyclable wood products
3. Sustainable construction and refurbishment with wood	
Sustainability in the phase of planning	Planning construction and refurbishment for increased wood utilisation
	Supply of flexible design solutions/ modular systems
	Integration of consumer, builder and constructors in the planning process
	Integration of the use phase aspects in the evaluation of planning alternatives
	Planning of regular survey of refurbishment requirements
Utilisation of sustainable wood products	Ratio of regional wood-based construction material
	Ratio of certified wood-based construction material
	Environmental and healthy surface treatment
	Utilisation of recyclable and reusable wood construction material
Sustainability during the construction phase	Effective management of construction and interface management between different actors involved
	Use of rationalisation potentials, e.g. by pre-fabricated solutions
	Documentation of material use in construction and refurbishment
4. Use and maintenance of buildings	
Improvement of living quality and safety	Living quality (indoor air quality, noise emissions)
	Safety (toxicity in case of fire, long-term static stability)
Cost efficiency in the operating stage	Expenses for operation and maintenance
	Expected life time and intervals for refurbishment
	Opportunities for maintenance and repair incl. own contribution by inhabitant
5. Sustainable disposal of used building material	
Sustainable disposal	Controlled energetic use of non-recyclable wood
	Environmentally sound disposal of wood, which cannot be reused
Value-chain-wide targets and indicators	
Sustainable business management	Sustainability business mission and monitoring of goal achievement
	Use of environmental an or sustainability management systems
	Reduction of material, energy and water consumption
	Ratio of the utilisation of renewable energy and resources
	Reduction of emission and pollution
Sustainability management in the value-chain (incl. commerce and logistics)	Sustainability requirements for suppliers
	Reduction and optimisation of transport requirements
	Market analysis and consumer integration in sustainable product development
	Target-group specific information on the construction material wood
Empowerment, cooperation and networking	Orientation of marketing on sustainability targets
	Regular staff training on construction and refurbishment with wood
	Cooperation through (regional) cluster management or networks
Competitiveness and innovation ability	Cooperation with R&D institutions (knowledge and technology transfer)
	Process and product innovations (incl. product-service system solutions)
	Creating and securing regional employment
	Quality assurance
	Utilisation of subsidy opportunities

In order to turn this indicator set into an operational tool, a tailor-made internet-based “Sustainability Check” is currently developed. The “Sustainability Check” should support entrepreneurs to evaluate the sustainability performance of their existing or future products without the necessity for direct and time-consuming contact with relevant stakeholders or consumers.

It became apparent that most of the organizations in the value chain are small and medium-sized enterprises. Furthermore, most of the practitioners in the chain and potential users could be described as novices in the field of the sustainability future markets. This can be explained by the lack of resources to employ a specialist and the relative novelty of the topic in the sector. Consequently, the Internet tool has to provide explanatory content and fulfil an educational purpose for the target audience. Questions are posed for each indicator and an immediate aggregation of the results will allow a timely assessment even for product development phases with limited data availability.

5 Conclusions and next steps

The paper highlighted that effective innovation alliances (actor cooperation) and the early integration of users and customers in the process of innovation (consumer integration) are conditions for the development of sustainable future markets. A number of tools at company level have been presented to develop sustainable future markets for building with wood. The paper specifically addressed the development of an sustainability indicator set for the entire value chain of “building and refurbishment with wood”. This is a novelty since other related indicator sets have only covered some part of the value chain. Especially the consumer and end-of-life phase has been rarely considered. It turns out that stakeholder involvement and the consideration of consumer needs can help to identify key issues in the chain and facilitates the consideration of sustainability in emerging markets.

The developed indicator set as well as other presented tools for sustainable future markets will be presented as Internet-based instruments at an Internet learning platform on the project’s homepage (www.holzwende2020.de). All tools will be described regarding their specific approaches, conditions for successful use and benefits for the user and sustainable market development.

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