OVERVIEW

Design for Sustainability Overview

SInnDesign
Sustainable Innovation through Design

BACKGROUND MATERIAL

Design for Sustainability Overview

SInnDesign
Sustainable Innovation through Design

This module is part of the training materials developed in the SInnDesign project.

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Design for Sustainability Overview

1. Objectives of the module

- To establish the relationship between social, economic and environmental issues with the design, production and product-service
- To explain the importance of life cycle thinking in DfS
- To learn in more detail why DfS is necessary to be considered in the design process
- To present how to implement DfS and SInnDesign didactic material
- To expose the main drivers and motivating factors to develop DfS
- To present different frameworks for DfS: European policy trends and innovation trends in the habitat sector

Key words

Design for Sustainability, sustainable development, lifecycle thinking, motivating factors,

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2. What is Design for Sustainability?

"In most people's vocabularies, design means veneer… But to me, nothing could be further from the meaning of design. Design is the fundamental soul of a human-made creation that ends up expressing itself in successive outer layers of the product or service." -**Steve Jobs**

Design has been cited as a source for sustainable development since the 1970s (e.g., Papanek, 1971).

Sustainable Development: Meeting present needs without compromising the ability of future generations to meet their needs" (World Commission on Environment and Development Report, 1987).

In the 1990s, industry initiatives on product eco-efficiency (*ecodesign*[1]) started (e.g., Cramer and Stevels, 1995) as a strategy to reduce companies' environmental impacts (Brezet and Van Hemel, 1997).

In the 2000s, ecodesign evolved into *Design for sustainability* - which it pretends to go beyond how to make a "green product"– integrating environmental, social and economic considerations (planet-people-profit) in the development of products, their system and related services through their whole life cycle stages, which are jointly capable of fulfilling consumer needs more efficiently and with a higher value for companies and consumers.

Design for Sustainability can be defined as product developing industries and their partners along the product chain considering the environmental and social aspects of their products and processes as key elements of long-term product innovation strategies and daily practices – (Crul and Diehl (2006))

Considering DfS definition these are the main attributes to have in mind when a company decides to integrate DfS considerations in the design process of product or product-services:

1 These terms or expressions are defined in the SInnDesign glossary (available at www.sinndesignproject.eu). The first time they appear in the text, they are in italics

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- To ensure the **interaction between environmental-social-economic issues** from the early stages of the development process including clients' needs or demands as well as societal expectations (stakeholders dialogue), this increases the opportunities to achieve sustainable solutions (see Figure 1).

- To consider **Life Cycle perspective** in the development process avoiding the burden shifting and rebound effects; therefore, quantitative and/or qualitative sustainability assessment methodologies should be used

Moreover, to ensure the success of the whole process, DfS needs to be rooted in existing organization sustainability management practices.

To be sustainable, product innovation must work within a number of frameworks linked to people, planet and profit. (Crul, M., 2009)

Life Cycle Thinking

Life Cycle Thinking (LCT) is about going beyond the traditional focus and production site and manufacturing processes (Figure 2) to include environmental, social and economic impacts of a product over its entire life cycle (lifecycleinitiative.org).

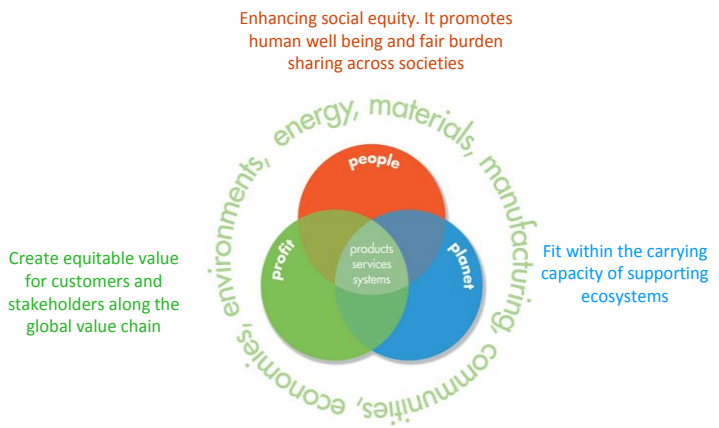

Figure 1: Design for sustainability philosophy
(http://audreybarnesdesign.com/#design-philosophy)

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The life cycle considers the design, manufacture, and use of a product across all life cycle stages: from raw material extraction and conversion; to manufacture, packaging, distribution, use, maintenance, and eventually recycling, reuse, recovery or final disposal, see Figure 1. (EPA)

The life cycle perspective helps to avoid burden shifting. This means minimizing impacts at one stage of the life cycle, or in one geographic region, or in a particular impact category, while avoiding unrecognized increased impacts elsewhere (United States EPA).

Figure 2: Life Cycle thinking product system
(https://en.wikipedia.org/wiki/Life_Cycle_Thinking)

The main goal of LCT is to reduce a products resource use and emissions to the environment as well as improve its socio-economic performance through its life cycle. This may facilitate links between the economic, social and environmental dimensions within an organization and through its entire value chain (lifecycleinitiative.org).

3. Why do Design for Sustainability?

A well-functioning economy depends on, among other things, an uninterrupted flow of natural resources and materials. Disruption in the supply of key materials can actually bring dependent sectors to a halt, and can force companies to lay people off or stop providing goods and services.

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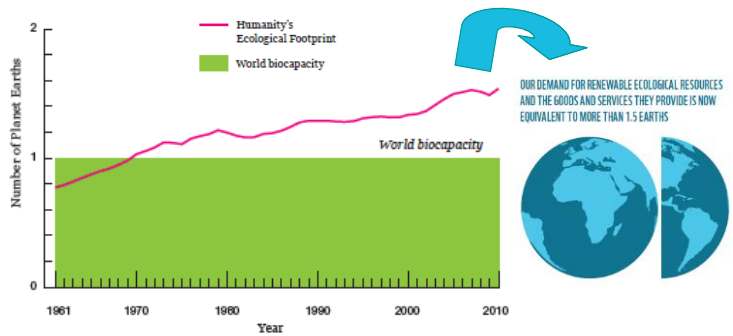

Figure 3: Humanity's ecological footprint
(Living planet report 2014, WWF)

In this sense, society should be aware that it is currently extracting too much already, more than what our planet can produce or replenish in a given period, see Figure 3.

Some studies indicate that in the last hundred years the global consumption per capita of materials has doubled, while that of primary energy has tripled. In other words, every one of us is consuming on roughly three times as much energy and twice as many materials as our ancestors were consuming in 1900. And what's more, there are now over 7.2 billion of us doing so, compared with 1.6 billion back in 1900 (see Figure 4), (EEA, 2014).

The World Bank has described the coming upsurge in consumer demand as a "potential time bomb" (Ellen MacArthur Foundation, 2013). This extraction rate and the way we are using resources is actually reducing our planet's capacity to sustain us.

The United Nations Environment Programme Medium-Term Strategy 2010-2013 adopted by the Global Ministerial Forum in February 2008, states that the global economic growth and development model can not be sustained without a significant shift in global production and consumption trends.

Decoupling economic growth from negative environmental and social impacts will require producers to rethink design, production and marketing paradigms. (Crul, M., 2009)

Consumers will need to consider real environmental and social concerns along a product's life cycle- in addition to price, convenience and quality (Crul, M., 2009).

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In this sense, the DfS is recognised worldwide as the way that companies can improve efficiencies, keeping product quality, and increasing market opportunities while simultaneously improving environmental aspects, social impact and economic benefits (Crul, M., 2009).

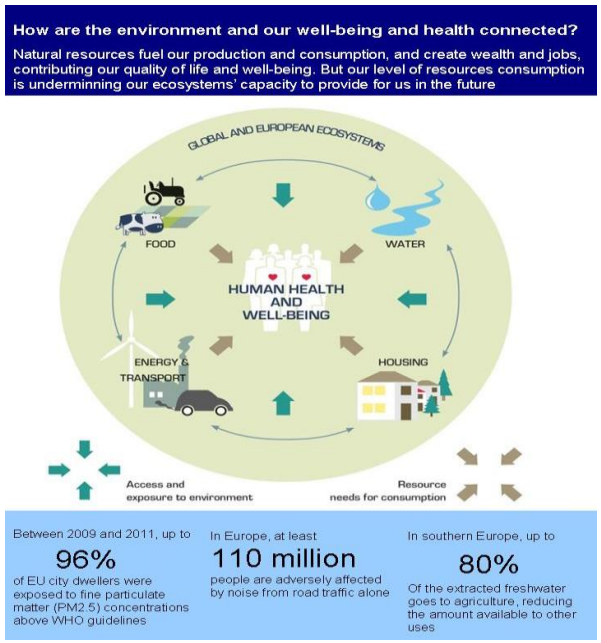

Figure 4: Relation between environment and our well-being and health (EEA, 2014)

4. What are the main drivers and motivating factors of DfS?

DfS can offer organizations the opportunity to enhance their sustainability performance, while simultaneously improving their profitability. DfS can also provide a means for establishing a long term strategic vision of a company's future products and operations.

The motivation to implement DfS may come from within the business itself (internal drivers) or from outside the company (external drivers).

Knowing the most influential drivers can provide valuable information on what are the best types of DfS projects and activities to initiate (Crul et al., 2006).

Table 1 shows the **internal** common drivers.

Table 2 shows the **external** common drivers.

Table 1: Internal drivers for design for sustainability (Crul et al. 2006)

INTERNAL DRIVERS FOR DfS
Social aspects
Social Equity can reduce risk on social and labour problems **Strong Social Policy** can increase employee motivation. **Governance and management systems on social aspects** can make company achievements more visible to stakeholders
Environmental aspects
Green marketing: Environmental value-added elements can boosts brand value and reputation **Environmental awareness** from managers
Economical aspects
Reach new consumers from "sustainable markets" **Product quality improvement:** reliability and functionality often go together with a more sustainable product **Value chain saving costs** **Boosting brand value and reputation** **Product innovation**: find solutions to meet customer needs and wants
INTERNAL DRIVERS FOR DfS
Economical aspects
Brand differentiation **New opportunities for value creation**

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Table 2: External drivers for design for sustainabiltity (Crul et al., 2006)

EXTERNAL DRIVERS FOR DfS
Social aspects
Public opinion: consumers are demanding more information **NGO pressure** for controversial practices and the related impacts, e.g.: boycott campaigns causing damage to a company reputation
Environmental aspects
Legislative requirements force companies to be more proactive **Disclosure requirements** on environmental information towards suppliers and customers **Ecolabelling schemes,** additional element for a companies' marketing **Consumer organization requirements** such as safety, low toxicity and recyclability of products
EXTERNAL DRIVERS FOR DfS
Environmental aspects
Pressures from dedicated environmental groups (e.g. CFCs elimination) **Direct community 'neighbour' pressure**
Economical aspects
Standards on sustainability aspects will become stricter and may force companies to improve products **Subsidy schemes** are available in some countries to improve sustainability aspects of products and production. **Suppliers competition** is evolving to enter or remain in the supply chain, pushing companies to become more sustainable **Customer demand** for sustainable products **Market competition:** industry may look to improve innovative performance, which might include reviewing the sustainability aspects of their products

In spite of these aforementioned drivers, there are trade-offs and in the current state, sustainability almost always leads to greater risk in terms of organizational uncertainty and costs. Therefore the discussion in most companies is highly political.

For instance, you may reduce costs by introducing some kind of "low-cost material", but this can create further uncertainty regarding stability of the materials supply and calculations on the use of that material can be at risk as the material purity can be questionable.

What are the main drivers and motivating factors of DfS in the Habitat Domain?

The main transformations experienced by societies and cities in Europe are considered the key factors and innovation drivers for the direction of the industry and the design of products in the **habitat domain,** which includes the specific SInnDesign sectors. These main transformations are described as follows:

- The fast demographic change and aging of developed societies, the trend towards a growing urbanization, along

with more open and sustainable cities that promotes citizen's involvement and ICT (Information and Communication Technologies) integration, are producing new impacts and changes in people's lifestyle and ways of life.

- New household units appear, the average family size reduces, and new market drivers take hold. In this sense, people experience new ways of purchasing through the development of virtual worlds and social networking becomes day by day more important day by day.
- The use of Internet for information and education makes buying easier, moreover taking into account the time pressure that many consumers suffer.
- The growing interest and importance of reconstruction, conservation and refurbishment of old buildings, at the same time demanding modularity and constant renewability and restyling of spaces (Roland Berger Strategy Consultants, 2010; Frazão, et al., 2006)

5. Which is the impact over the design concept in the habitat Domain?

The direction change can be seen in design for living environments through a range of different values such as:

- The assessment of a product in terms of its **usefulness and long life**, with lasting aesthetics and quality.
- Consumers are demanding **more and more options**, fact that creates a more competitive environment for companies, and that leads to escalating expectations regarding service and product quality.
- Increased **transparency** for consumers: the value transmitted by the company and its products must be clear, coherent and credible.
- The demand for products and services that give the user more **autonomy** (mobility, change, personalization…) through **extreme practicality, easy use and comfort.**
- Consumers want **"smarter" homes**, as technology is moving on.

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- The search of **safe values** is considered a good investment in the world of design.
- The appreciation of products that incorporate a distinctive component from a **reasoned and justified emotionally based on efficiency** (Habitat Trends Report 2010/2011).

The Figure 5 summarizes the main innovation drivers of the habitat domain and new product approaches. It seems clear that the design and development of innovative products is necessary to satisfy the needs and preferences of today's citizens. So, design innovation may become an essential strategic competitive weapon for companies.

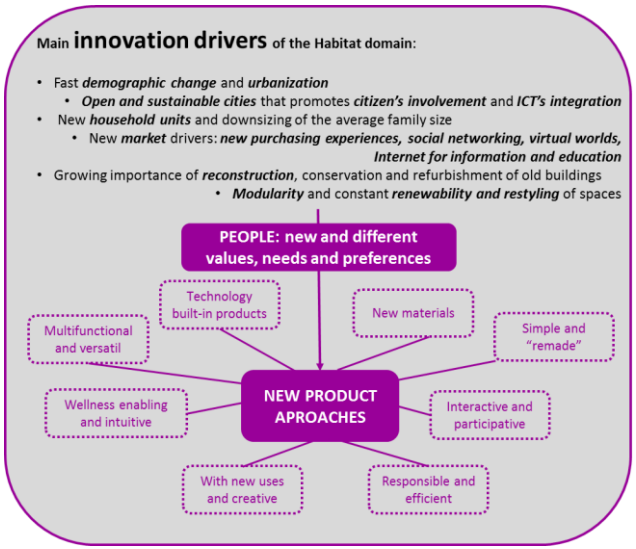

Figure 5: Main innovations drivers of the Habitat domain (Habitat Trends Repor, 2010/2011)

6. Which innovations are covered by Design for Sustainability?

DfS covers strategies ranging from incremental to radical innovation and requires the implementation of a cross-disciplinary design team that is equipped to support the development of an economy based on resource-efficient principles and is involved in all parts of the life cycle of products (Great Recovery project, 2013).

Sustainable innovation and design is not necessarily about new technologies, but about rethinking how to meet the need for growth while at the same time, reducing negative environmental and social impacts.

This kind of work would create new business opportunities, address material risk management issues and contribute to sustainable economic growth along a product's supply chain and through its life cycle. This is what is called the cradle to cradle mentality (Zoboli et al., 2014; EEA, 2014).

7. How to do Design for Sustainability?

The design activity is a creative process. The innovative solutions developed for design problems can never be predetermined; however the methodology will depend on the innovation level required, but it is difficult to systematize it.

For those companies interested to implement DfS in their processes, products or services, it is recommended to start with parts of their products and gradually extend the project to the overall improvement and redesign of their products and may go as far as radical design, including product/service system development processes.

Within SinnDesign didactic material, the DfS processes module has been developed. It pretends to present DfS teams and others stakeholder involved in the development process, how DfS can be integrated in their product development process according to the needs, resources and strategic objectives related to the innovation characteristics of each project. In the module two approaches of innovation are addressed:

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Improvement and redesign of products

Improvement and redesigno f products	
Step 01	DfS Project planning
Step 02	Product analysis
Step 03	Definition of DfS strategies for the product
Step 04	New product concept
Step 05	Product detailing
Step 06	Production and market launch
Step 07	Evaluation of DfS Project and product
Step 08	Follow-up activities

Figure 6. The SinnDesign eight steps approach (www.sinndesignproject.eu)

Radical design, including product/service system development processes.

Radical design & Product Service System development	
Step 01	Exploring opportunities, identifying and analysing the existing reference system
Step 02	Generating PSS ideas and selecting the most promising concepts
Step 03	Detailing selected PSS concepts
Step 04	Evaluating and testing detailed PSS concept(s)
Step 05	Planning implementation

Figure 7. The SinnDesign five steps approach in PSS development and radical design. (www.sinndesignproject.eu)

For more info on innovation and processes, see the Design for Sustainability Processes and Innovation through Design for Sustainability modules. **(www.sinndesignproject.eu).**

8. Initiatives frameworks on DfS

Innovations in the habitat sector

Main innovation trends on three specific sectors can be found in the following figures:

In the **furniture sector specifically**, many innovations are taking place; primarily, these innovations related to materials, products and process innovations, as well as organizational ones, as represented in Figure 6:

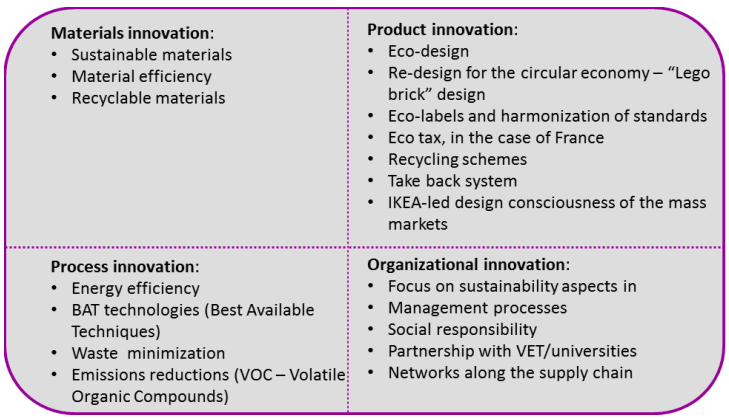

Figure 8. Main innovations trends of the furniture sector
(University of Aalborg, Denmark)

Specifically, as for the **furniture sector**, many innovations are taking place; mainly these innovations related to materials, products and process innovations, as well as organizational ones, as represented in Figure 8.

The **building materials sector** is facing many challenges in the current economic and competitive context. To face these challenges, many innovations are taking place, as defined in the following figure.

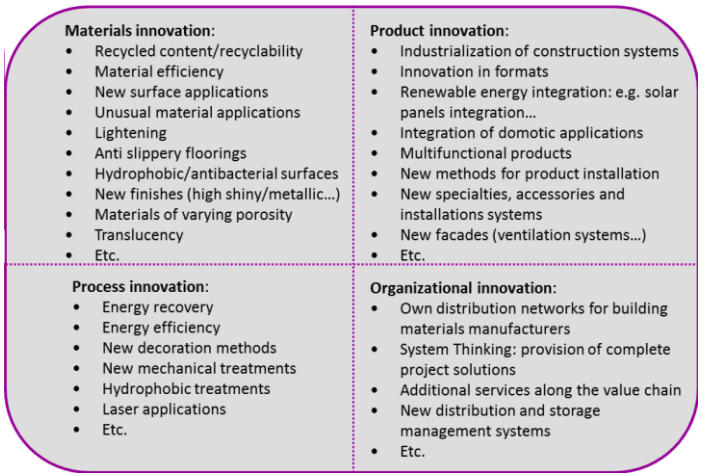

Figure 9. Main innovations trends of the Construction Material sector
(ITC, Institute of Ceramic Technology, Spain)

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In the **textile industry**, as an increasingly diversified and innovation and creativity driven industrial sector, the following main trends are observed:

Applications innovation on technical textiles:
- Aesthetics, functionality, durability and sustainability of textile materials;
- Applications combining lightness, strength and resistance to deformation or acid/ alkaline erosion, pollution, UV rays or even resistance to other materials
- Structural plus functional elements
- Innovative surface covering

Eco-Design Culture:
- High concern on environmental respect and LCA
- Poor eco-design culture
- Increase in "green" credential materials (natural fibres, recycled fibres, etc.)
- Replace PVC por PU

The most sustainable fibres – Environmental Benchmark for fibres (Made-By*):

Class A	Class B	Class C	Class D	Class E	Unclassified
Recicled cotton	*Tencel*	*Hemp*	*PES*	*Cotton*	*Silk*
Mech Rec PA	*Organic Cotton*	*Ramie*	*Poly acryl*	*Polyamide*	*Org Wool*
Mech Rec PES	*Chem Rec PES*	*PLA*	*Modal*	*Cupro Viscose*	*Leather*
Recycled wool	*In conv Cotton*	*Linen*		*Bamboo Visc.*	*Elasthane*
Organic Hemp				*Wool*	*Acetate*
Organic Linen				*Viscose*	*Cashmere*
					Alpaca
					Mohair
					Bamboo Linen

Figure 10 Main innovations trends of the textile sector
(Source: CITEVE, Technology Center for the Portuguese textile and garment industry. *MADE-BY.org)

INTERFACE® is a manufacturer of carpet tiles. Mission Zero is their promise to eliminate any negative impact we have on the environment by 2020.

Figure 11. Scheme of mission zero from interface® and sustainable innovations developed with the aim at reaching zero negative impact in 2020
(Source: www.interface.com)

Legislative framework

The European Union's Environment Council agreed that "the environmental dimension of the Europe 2020 strategy should be strongly reaffirmed". In particular, the Council's conclusions highlight the instruments that can make the economy greener and more circular, such as environmental taxation, green public procurement, eco-design and eco-innovation (European Commission, 2015).

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There are many EU-level initiatives to raise awareness about the need to use scarce resources more efficiently. In the wake of the overarching flagship communication on resource efficiency, deliverables include long-term policy papers on climate, energy, biodiversity, encouraging an economy-wide switch to resource efficiency, and additional plans in sectors such as transport, agriculture, fisheries, raw materials, and energy taxation.

Below are summaries of some of these mentioned EU-level initiatives:

I. A **Roadmap to a Low-carbon Economy by 2050**, analysing options for setting the EU on the path towards becoming a low-carbon economy, increasing energy security and promoting sustainable growth and jobs, while ensuring that the proposed measures are most cost-efficient and do not bring negative distribution consequences.

II. In the latter part of 2011, the Commission presented **Energy Roadmap 2050**, focusing on reducing greenhouse gas emissions in the Union, in the context of the target of an 80-95% reduction in EU emissions by 2050. The Energy Roadmap presents different routes towards the objectives, reviews the current EU energy policy – sustainability, energy security and competitiveness – and focuses on how this can be improved in the transition to a low-carbon energy system.

III. A new **Biodiversity Strategy** should ensure that by 2050 the EU's biodiversity and the ecosystem services it provides – its natural capital –is protected, valued and appropriately restored. This should safeguard the essential contribution biodiversity makes to human well-being and economic prosperity, and ensure that any catastrophic changes caused by the loss of biodiversity are averted.

IV. A Roadmap to a **Resource-efficient Europe** complements these, setting out a coherent framework of policies and actions for a shift towards a resource efficient economy. The aim is to increase resource productivity, decouple economic growth from resource use, enhance competitiveness and promote security of supply.

V. The new strategy to secure EU **access to raw materials** adopted by the Commission. Non-energy raw materials are important for technologies such as electric cars and photovoltaic. The new strategy aims to improve Europe's

access to raw materials, working towards a fair and sustainable supply of them from international markets, fostering a sustainable supply within the EU, and promoting recycling.

VI. The European Commission adopted the Communication **"Towards a circular economy: a zero waste programme for Europe"** establishes a common and coherent EU framework to promote circular economy. Turning Europe into a more circular economy means: boosting recycling and preventing the loss of valuable materials; creating jobs and economic growth; showing how new business models, ecodesign and industrial symbiosis can move us towards zero-waste; reducing greenhouse emissions and environmental impacts.

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Habitat Trends Report 2010/2011, Habitat Trends Observatory. http://blogitc.itc.uji.es/?p=2935 (accessed 23-02.2015)

Further information:

A resource-efficient Europe – Flagship initiative of the Europe 2020 Strategy:
http://ec.europa.eu/environment/resource_efficiency/
(accessed 22-10-2015)

Roadmap for moving to a low-carbon economy in 2050:
http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52011DC0112
(accessed 22-10-2015)

Roadmap for a resource-efficient Europe:
http://ec.europa.eu/environment/resource_efficiency/about/roadmap/index_en.htm
(accessed 22-10-2015)

MADE-BY – European not-for-profit organisation with a mission to improve environmental and social conditions in the fashion industry: www.made-by.org

Moving towards a circular economy:
http://ec.europa.eu/environment/circular-economy/index_en.htm
(accessed 22-10-2015)

The Raw Materials Initiative:
http://ec.europa.eu/growth/sectors/raw-materials/
(accessed 22-10-2015)

Energy initiatives, including the 2050 Roadmap:
http://ec.europa.eu/energy/index_en.htm
(accessed 22-10-2015)

The Biodiversity Strategy:
http://ec.europa.eu/environment/nature/index_en.htm
(accessed 22-10-2015)