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Ecodesign for a resource-efficient economy

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Ecodesign for a resource-efficient economy

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Foreword

How will we manage – even with growing world population and a generally higher standard of living – to cut down our use of resources and reduce our impact on the environment? For the human race this will be a question of survival. There is a limit to the level of pollution our planet can cope with before the damage becomes permanent and incalculable. Global warming is a direct consequence of our fossil fuel consumption.

A number of ways have been proposed for a more careful management of our resources and of our environment: we can increase process efficiency, recycle waste, use renewable energies and raw materials, or revise our consumer habits. One particularly effective lever is product design. Ecodesign takes account of resource consumption and environmental stress with regard not only to the manufacturing of products but also to their subsequent use.

There are enormous possibilities for optimisation, particularly during the use phase of a product; a longer use phase – resulting, for example, from robust or modular construction – is already one way of saving resources. Ecodesign can also be extended to service concepts, leading to new, sustainable business models which are concerned not merely with selling as many products as possible but which aim to sell “utility value”.

This publication from Hessen-Umwelttech offers an introduction to the field of Ecodesign, without claiming to give a complete account of all its different facets. Many examples from everyday practice are used to underline the great variety of possible concepts. I wish you very enjoyable reading and hope that you will find a wide variety of interesting ideas – whether as a developer and provider or as a buyer of innovative, resource-efficient products and services.

Tarek Al-Wazir
Minister of Economics, Energy, Transport and Regional Development, State of Hessen

1. Preliminary remarks

This brochure explains why companies and developers engage in Ecodesign, what Ecodesign is and how it works in practice. The following pages contain many practical examples and helpful cross-references to methods and tools, sources of information, framework conditions and funding instruments.

Companies which are interested in Ecodesign but have not yet put it into practice will find a useful preliminary survey, together with cues for further action. Companies which are already active in the field can draw comparisons with the approaches of other companies, gather ideas for further extension of their own Ecodesign approaches, and get informed about current framework conditions and practical developments.

Chapter 2 below gives an introduction to the field of Ecodesign. Chapter 3 offers an account of Ecodesign requirements and framework conditions already in existence. Chapter 4 describes the major Ecodesign strategies. Chapter 5 analyses a typical Ecodesign process and indicates useful methods and instruments. Chapters 4 and 5 contain practical examples, mostly from Hessen, showing how companies have already put Ecodesign successfully into practice. Chapter 6 offers a conclusion, and Chapter 7 provides a service section in which the reader will find many references to helpful institutions, further literature, websites, funding opportunities, Ecodesign-relevant product labels and contests, and other useful information.

2. Introduction to the field of Ecodesign

2.1 ECODESIGN SAVES RESOURCES

Every human enterprise has an impact on the environment, and every human being leaves a larger or smaller ecological footprint on our planet.[1] Out of sheer self-interest we should take care not to destabilise the ecological balance of our planet, since vital biological functions – the so-called ecosystem services – are at stake.

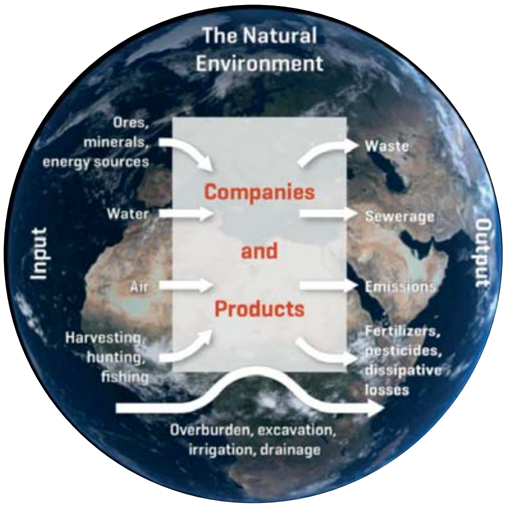
An ecological footprint is created when raw materials are extracted from nature, put to use in the technosphere and then returned in a more or less altered state to the environment, for example in the form of waste material, waste water or emissions. There are many materials which are moved without making any useful contribution to the economy, but which nevertheless cause enormous damage to nature – especially excavations and overburdens in the mining industry. Whether in the production process or during use, re-use and disposal, all products involve consumption of energy and resources, environmental stress from transportation, and emissions and wastes which are harmful to human beings and nature. Our present levels of environmental consumption and stress are already too high. According to calculations from the Global Footprint Networks, we would need four to six times our planet if everyone in the world enjoyed the same standard of living as the inhabitants of the industrialised countries.[2]

TIP

Work out your own personal ecological footprint at **http://footprintnetwork.org/de/index.php/GFN/page/calculators/**

Three areas of consumption in particular are responsible for 80 percent of all environmental impacts in the industrial countries of the West: food/agriculture, mobility/tourism, and homes/energy consumption in buildings.[3] The major ecological and social crises and challenges for which companies and consumers must prepare themselves, are climate change, depletion of resources, loss of biodiversity, environmental pollution and social imbalance.

Figure 1. Ecological footprint: Environmental stress from companies and their products.
Source: Tischner



A complete rethink would also be of advantage from the economic point of view. In view of rising prices for energy and raw materials, it would be more sensible to save resources and energy than to concentrate merely on reducing personnel costs. After all, material costs are the largest pool of costs for companies in the processing industry, making up as much as 44 percent.[4] And with an eye to the growing environmental awareness in large sectors of the population in the industrialised nations and also in emerging markets, companies should focus more on the environmental and social benefits of their offerings. A large number of studies have already shown that firms making sustainability a serious part of their company strategy are also more successful economically.[5]

1 Cf. www.footprintnetwork.org and www.footprint-deutschland.de.

2 Global Footprint Network (2013): The National Footprint Accounts, 2012 edition. Global Footprint Network, Oakland, CA, USA.

3 European Environment Agency (2007): Environmental pressures from European consumption and production, EEA publication TH-78-07-137-EN-D.

4 Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit *[Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety]* (BMU)/Umweltbundesamt *[The UBA]* (September 2011): Umweltwirtschaftsbericht 2011, Daten und Fakten für Deutschland.

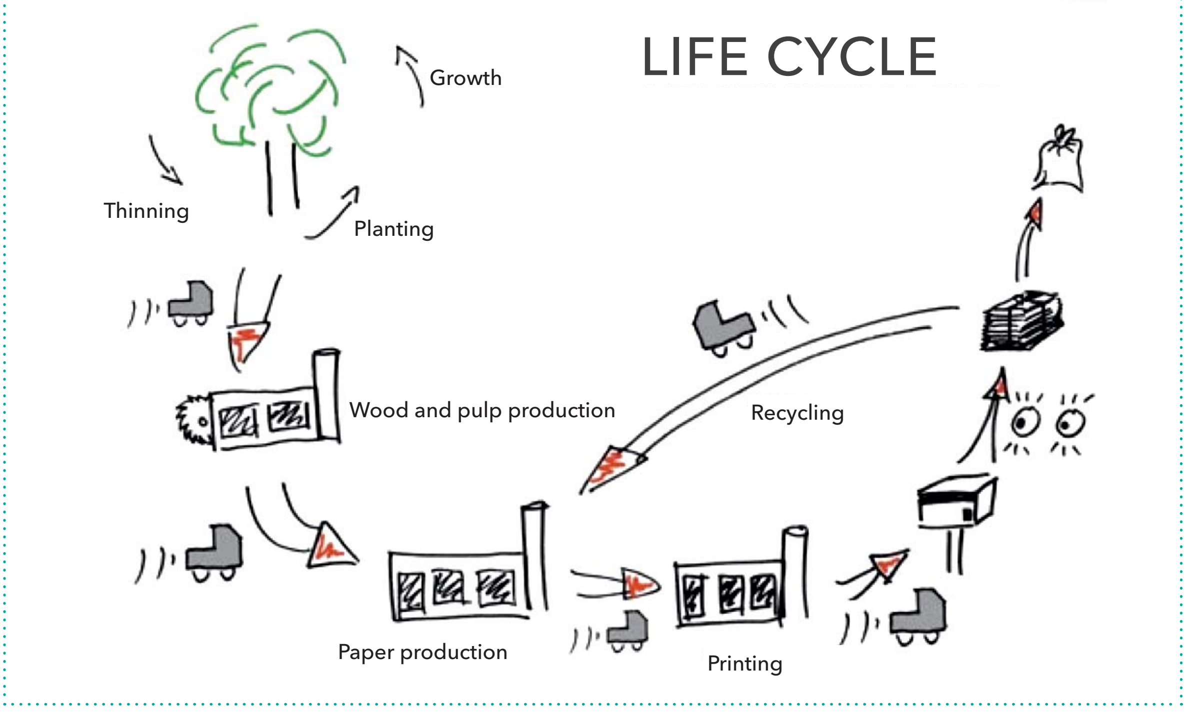
5 Cf. Holliday, Chad/Schmidheiny, Stephan/Watts, Philip (September 2002): Walking the Talk: The Business Case for Sustainable Development, Berrett-Koehler, San Francisco, CA, USA, United Nations Environment Programme, 2014: The Business Case for Eco-innovation.

The earlier a company starts to integrate environmental and social aspects into its strategic considerations the more likely it is that its efforts will bear fruit. A common rule of thumb states that about 80 percent of the total costs involved in a product are determined during the product development and design phase.[6] Much the same applies for environmental characteristics in general. If, during the drafting phase, strategic planners, product developers and designers have the right information available, use the right tools and ask the right questions, they will be in a position to design goods which make sense both ecologically and economically. This procedure is called Ecodesign and will be defined in more detail in the next section.

2.2 WHAT IS ECODESIGN? A FEW DEFINITIONS

Ecodesign (also known as green design or sustainable design) aims primarily to reconcile ecological and economic advantages by means of good design solutions. Ecodesign follows a systematic procedure in order to integrate ecological aspects as early as possible into the process of product planning, development and design and to implement them throughout the entire life cycle of the product. This means that the classic criteria of product development (such as profitability, safety, reliability, ergonomics, technical feasibility, aesthetics) are now being joined by environmental demands. The idea behind the term Ecodesign is that ecology and economy must be brought together during the Ecodesign procedure by means of good design.[7]

Figure 2: Diagram showing the life cycle of a product, in this case a newspaper.
Source: Manuel Gamper, Andrin Häfeli, Sandro Macchi, students at the ZHDK Zürich



[6] Cf. for example Schäppi, Manfred/Andreasen, Mogens M./Kirchgeorg, Manfred/Radermacher, Franz Josef (2005): Handbuch Produktentwicklung, Carl Hanser Verlag, Munich/Vienna, p. 300.

[7] Tischner et al. (2000): Was ist Ecodesign, Birkhäuser, Basel, Boston.

Definition:

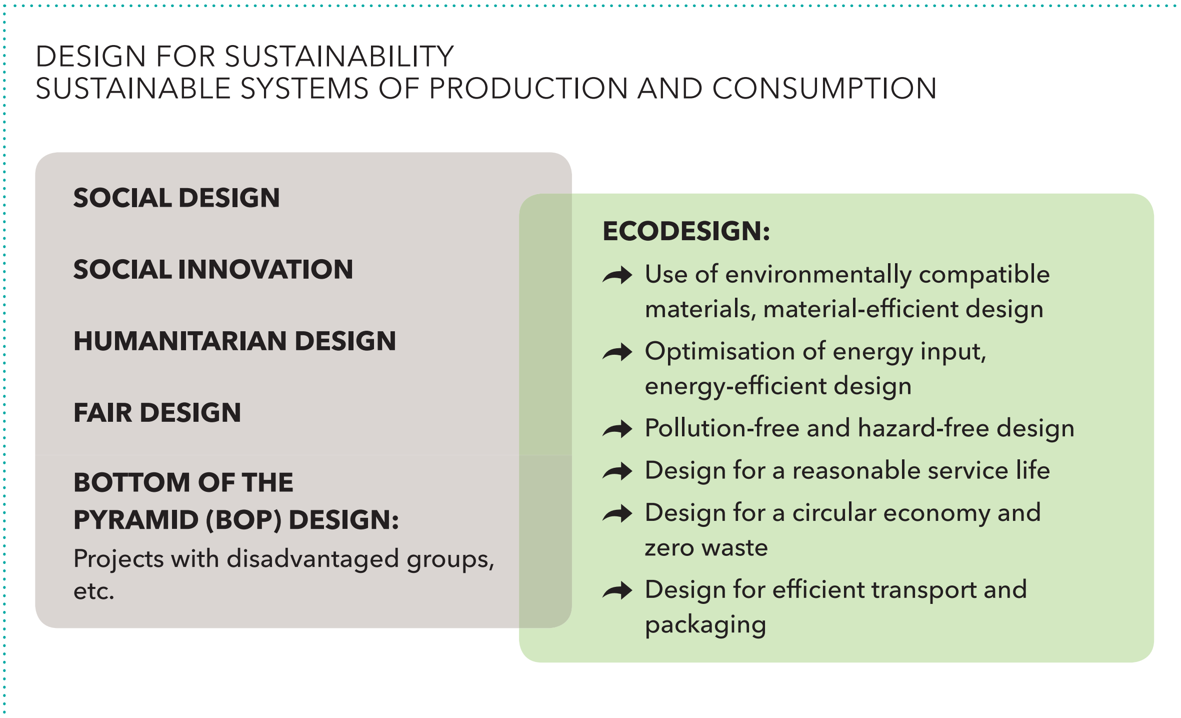
Ecodesign means designing products in an ecologically compatible way. It leads to solutions which achieve the desired benefit as effectively as possible while keeping adverse environmental effects to a minimum (consumption of limited resources, energy and land; use and emission of harmful substances, wastes, etc.) or even solutions with direct advantages for the environment[8] – and all this throughout the entire life cycle of the product.

Although Ecodesign aims principally at the optimum harmonisation of ecological and economic advantages, it should also take the social dimension into account as far as possible during the product creation process.

The term "Ecodesign" merges into the broader terms "sustainable design" and "design for sustainability" (DfS), which are closely associated with the overall principle of "sustainable development". Figure 3 presents the umbrella term "design for sustainability" and shows how it covers the other areas of design.

"Design for sustainability" integrates the three dimensions social/ethical aspects, ecological aspects and economic aspects and seeks to combine them by good design. The focus is usually more systemic than that of Ecodesign. Entire systems of production and consumption are analysed in order to bring about more radical changes. The umbrella term "sustainable design" can be subdivided into design approaches aiming rather at social advantages, such as humanitarian design, which is concerned with improvements for the poorest of the poor, or base of the pyramid (BOP) design, which focuses more on ecological issues. Ecodesign itself can be broken down into subcategories such as material-efficient design, energy-efficient design, pollution-free design, hazard-free design, and so on. A more detailed account of the major Ecodesign strategies is given in Chapter 4.

Figure 3: Various design strategies focusing on social and/or ecological sustainability.
Source: Ursula Tischner



[8] An example of positive environmental effects is the compostable coffee cup (with integrated seeds of native plants), which can be buried as an aid to reforestation, see "Reduce. Reuse. Grow" at www.planttrash.com.

2.3 POTENTIAL BENEFITS OF ECODESIGN. WHY SHOULD COMPANIES PRACTISE ECODESIGN?

Ecodesign requires a strategic decision and a critical review of existing processes. But if properly practised it will pay off in many ways: Ecodesign helps to save costs, minimise risks, and offer more attractive products - and also makes it easier to attract investors. It enables management, employees and customers to identify more closely with the company and its activities. In detail, this means:

With Ecodesign companies are better able to fulfil demands from various external parties, for example:

- legislation, such as product take-back regulations, emission and immission control, control of hazardous substances, WEEE, RoHS, REACH[9], etc. (proactive environmental protection efforts by companies reduce the pressure for legal action, see also Chapter 2)
- expectations of commercial and public sector customers pursuing green purchasing strategies as well as expectations of private consumers with regard to ecological and social product qualities
- critical media – also social media – and NGOs which openly criticise companies with environmentally harmful products, for example Öko-Test, Stiftung Warentest and Greenpeace
- investors and banks, which are increasingly coming to inquire into company strategies for minimising ecological and social risks

With Ecodesign, companies can achieve the following cost savings and competitive advantages:

- cost reductions within the company due to lower material and energy consumption and avoidance of waste and harmful substances in the production process
- cost reductions for customers due to lower energy consumption during use or to higher efficiency in the handling of operating resources
- improved market position, due to an innovative edge over the competition or to a better image in the eyes of customers
- favourable headlines in the media, word of mouth advertising from enthusiastic customers (also in the social media) – cost-free promotion
- reduced liability risk, for example by avoiding harmful substances. Preventive environmental protection is cheaper than environmental clean-up.

With Ecodesign, employees can be better motivated because

- they realise that they are helping to preserve a liveable environment for their children and grand-children and can identify with the business objectives of the company,
- they are working not merely for the success of the company in the short term but also for a successful company strategy over the long term,
- they work with greater enthusiasm and commitment in an environmentally conscious and responsible company and are less often ill.

Ecodesign and green business strategies are also of interest for the economy as a whole. Recent figures from the Federal Ministry for the Environment show that technologies in the service of ecoefficiency and the environment boost economic growth both nationally and globally and create new jobs: the global market volume for environmental and efficiency technologies amounted to around 2.5 trillion euros in 2013 and will grow to more than 5 trillion euros by 2025. This means an annual growth rate of approximately 6 percent. Germany is among the leaders in this area, with a domestic market volume for environmentally oriented technology of 344 billion euros in 2013. Forecasts indicate that it will rise to about 740 billion euros in 2025.[10] Sustainability strategies appear to be of particular interest for start-ups. According to the Start-up Monitor of the Borderstep Institute and the University of Oldenburg, "green economy" is a development driver for start-ups and employment. From 2006 to 2013, about 170,000 companies were set up in the areas of renewable energies, energy efficiency, circular economy and climate protection, making up 14 percent of all start-ups in Germany. These green start-ups have created 1.1 million new jobs.[11]

[9] WEEE: WEEE Directive 2002/96/EC on waste electrical and electronic equipment; RoHS: Restriction of Hazardous Substances – Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment; REACH: Registration, Evaluation, Authorisation and Restriction of Chemicals – Regulation (EC) No. 1907/2006.

[10] Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit *[Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety]* (BMU) (ed.), July 2014: GreenTech made in Germany 4.0, Umwelttechnologie-Atlas für Deutschland.

[11] Weiß, R. & Fichter, K. (2015): Green Economy Gründungsmonitor 2014. Grüne Wirtschaft als Gründungs- und Beschäftigungsmotor in Deutschland. Berlin: Borderstep.

3. Framework conditions for Ecodesign

Ecodesign – or the ecologically responsible designing of products – has long played a role in the context not only of laws, directives and standards, but also of product labels, even if not all possible aspects have been covered by these. Distinctions must be drawn between statutory orders, specific implementation requirements and voluntary measures such as self-commitments or the use of ecolabels. In general, companies can be confronted with product requirements from any stakeholder, for example in the form of binding delivery terms, new customer needs, or conditions imposed by banks to minimise risks. The following section gives an introduction to legal and normative framework conditions for Ecodesign which companies come across in their everyday activities. An answer will also be given to the frequently asked question as to the various types of labelling in existence and as to when an (environmental) label makes sense.

TIP

Further information can be found in the service section from p. 44 onwards.

3.1 DIRECTIVES, LAWS AND STANDARDS

The Ecodesign Directive is the most widely known of all European Directives, mainly because of the ban on light bulbs.[12] It not only contains a legally valid definition of "Ecodesign" but also the requirement that possible environmental effects be taken into account over the whole of a product's life cycle.

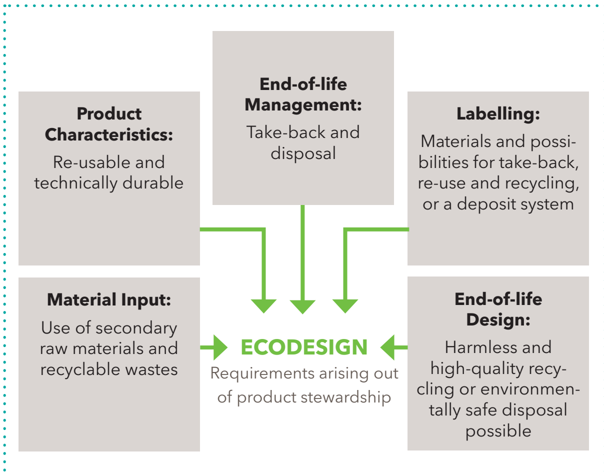
Ecodesign Directive Article 2: Definitions

'Ecodesign' means the integration of environmental aspects into product design with the aim of improving the environmental performance of the product throughout its whole life cycle.

This Directive was implemented in Germany by the Energy Consumption Relevant Products Act (EVPG) and the associated executive order (EVPGV). This law focuses mainly on reducing the energy consumption of products in the use phase and applies equally to energy-using products and to products which have an effect on energy consumption, such as windows. The law also covers the obligation on manufacturers to provide a label indicating the energy consumption of the equipment.

Long before the energy discussion, the responsibility of manufacturers for their products was laid down in 1996 in the Kreislaufwirtschaftsgesetz or Waste Management Act (replacing the earlier Kreislaufwirtschafts- und Abfallgesetz). According to Section 23 (1), products must be developed in such a way as to reduce the amount of waste accruing in production and use, and any such wastes must be disposed of in an environmentally safe way. Requirements with regard to product development or Ecodesign are given in Section 23 (2):

Figure 4: Ecodesign requirements in the German Waste Management Act. Source: Maike Hora



[12] Directive 2009/125/EC of the European Parliament and the Council of 21 October 2009 establishing a framework for the setting of Ecodesign requirements for energy-related products.

These general Ecodesign requirements are specified in product-related laws and regulations such as the battery regulation, the packaging regulation and the end-of-life vehicles regulation. The packaging regulation imposes take-back obligations for the various types of packaging, defines the labelling of the materials and sets limit values for heavy metals in packaging materials.

The European Union directed the spotlight on electrical and electronic equipment in the WEEE and RoHS Directives, since the waste fraction of electrical equipment was recognised as highly problematic. These Directives lay down requirements for the materials used in electrical and electronic equipment and for their recyclability; they also hold manufacturers responsible for ensuring that their appliances are really being recycled and require them to furnish evidence of specific recycling quotas. In Germany, they are implemented in the Electrical and Electronic Equipment Act (ElektroG).

A movement which started out primarily in the area of consumer goods has continually widened its scope and now extends also to capital goods. Requirements for the materials, the design, and the take-back or recycling of individual product groups are set out, for example, in the packaging regulation and the end-of-life vehicles regulation.

To regulate the handling of chemicals – especially that of hazardous substances in goods or products – the EU REACH Directive was passed in 2007. The aim of these requirements was to prevent "substances of very high concern" (SVHC) from coming into circulation and to replace them.

From a certain quantity onwards, chemicals must always be registered and controlled. Further regulations for particular product groups can be found in the Cosmetics Regulation, the Toys Safety Directive, the Pesticides Directive, etc.

To sum up: a large number of legal regulations are already requiring companies to engage in Ecodesign activities, inasmuch as they prescribe certain requirements for different phases of a product life cycle.

Various Ecodesign requirements and procedures are already contained not only in laws and directives, but also in standards. By now, national and international standards institutes have drawn up a number of standards, directives or guidelines which are centred around Ecodesign and can serve to support Ecodesign activities in companies.

The ISO 14000 series on environmental management includes several standards with a bearing on Ecodesign. The most important of these are shown below:

- ISO 14006: 2011 Environmental Management Systems – Implementing Ecodesign in Environmental Management Systems (specified in France, for example, in particular standards for machine construction and the electronics sector)
- ISO 14020 Environmental labels (see Chapters 3.2 and 7.3)
- ISO 14040 and 14044 Life Cycle Assessment (definition, inventory analysis, impact assessment and interpretation, see Chapters 5.2 and 7.8)

Table 1: Legal requirements with respect to Ecodesign

Product life cycle phase / **Ecodesign requirements (selection)**	Raw materials	Manufacturing/ production	Use	Recycling/ disposal
EU Ecodesign Directive			x	
Life Cycle Management Act	x	x		x
WEEE	x			x
RoHS	x			
Packaging Regulation	x			x
REACH	x	x	x	

Other standards, draft standards or directives in support of Ecodesign:

- DIN EN 50598 ff.: Ecodesign for power drive systems, motor starters, power electronics and their driven applications
- VDI Standard 2243 "Recycling oriented product development"
- VDI Standard 2343 "Recycling of electrical and electronic equipment"
- VDI Standard 4070 "Sustainable management in small and medium-sized enterprises – Guidance notes for sustainable management"
- VDI Standard 4075 "Production-integrated environmental protection"
- VDI Standard 4800 "Resource efficiency"

In addition to the standards institutes, a number of companies such as Siemens and Kärcher have developed their own internal standards.

3.2 LABELS AND QUALITY MARKS

The positive characteristics of environmentally compatible products are rarely evident at first glance. One way of distinguishing them from conventional products is the use of so-called ecolabels, which make their positive environmental features immediately clear to consumers and customers. Ecolabels are a voluntary action on the part of industry, by means of which companies commit themselves to comply with particular requirements. The most familiar ecolabels in Germany are the "Blue Angel" (the UBA and Federal Ministry for the Environment) and the EU organic logo for foodstuffs.[13] A research report prepared on behalf of the Federal Office for Agriculture and Food (BLE) was presented recently by the Öko-Institute and the Institute for Ecological Economy Research (IÖW). This report discusses the possibilities of a sustainability label for consumers and gives an account of the public and political interest in product labellings of this kind.[14] At the same time there are growing doubts about new labels, since more and more of them are constantly appearing in the market and their sheer number is a source of confusion for consumers, customers and companies. At a rough estimate there are over 1,000 labels in Germany bearing some reference to sustainability or social value.[15] Authenticity, transparent award criteria and procedures, and serious testing are the fundamental elements of successful labelling. Claims and "homemade" labels with meaningless statements such as "protects the climate", "biological" or "natural" are quickly spotted and exposed by critical observers, and they create no added value.

Ecolabels document nothing other than certain environmental characteristics of an individual product, without reference to design criteria or to a company's overall environmental strategy. Requirements for environmental characteristics are developed as a rule for particular products or product categories, as in the case of the Blue Angel for paints or DVD players. ISO 14020 distinguishes between three different environmental labels: Type 1 (certified environmental label), Type 2 (self-declaration) and Type 3 (product declaration – EPD). All three types have their own ISO standard for realisation and use (see Table 2).

Life Cycle Assessment

Life Cycle Assessment is a method of estimating and assessing the environmental aspects of a product and of potential product-specific environmental effects. The environmental aspects and potential environmental effects are calculated over the entire product life cycle – raw material sourcing, production, use and disposal (from cradle to grave).[16]

[13] Dr. Grieger & Cie. Marktforschung (2015): Bio-Lebensmittelmonitor 2015: Repräsentative Befragung von Verbrauchern zu unterschiedlichen Aspekten rund um das Thema „Bio-Lebensmittel".

[14] Untersuchung zur möglichen Ausgestaltung und Marktimplementierung eines Nachhaltigkeitslabels zur Verbraucherinformation – Endbericht – *[Study on the potential design and market implementation of a sustainability label as consumer information - final report]*, Öko-Institut e. V. *[Institute for Applied Ecology]* and Institut für Ökologische Wirtschaftsforschung *[Institute for Ecological Economy Research]* (IÖW), on behalf of the Bundesamt für Landwirtschaft und Ernährung *[Federal Office for Agriculture and Food]* (BLE), 2009.

[15] Lichtl, Martin (2014): Label, in: CSR NEWS, accessed on 29 January 2015, URL: csr-news.net/main/?p=48880.

[16] Cf. ISO 14040 Environmental Management - Life Cycle Assessments.

Table 2: Environmental labels – Label types according to ISO 14020. Source: Maike Hora

Label type according to ISO 14020	Examples
Type I (ISO 14024) Ecolabel, licensing with labelling programme	
Description: A Type 1 environmental label is a certification by an uninvolved third party, the criteria being established in an independent stakeholder process. The label is awarded to products which show a better environmental performance than others of comparable quality (made of recycled materials, low-pollutant, etc.). As a rule, several different criteria must be fulfilled. **Suitable for:** Communication with users and consumers, public/sustainable procurement	
Type II (ISO 14021) Self-declaration by producers	
Description: A Type 2 environmental label is a self-declaration by a company or association, without certification by a third party. The criteria are laid down by the company on its own. The label is granted to products which have achieved improvements in at least one environmental aspect, for example as compared with earlier products. **Suitable for:** Communication with users and consumers	
Type III (ISO/TR 14025) Environmental label/ declaration	
Description: A Type 3 environmental label is a product declaration based on the outcome of a life cycle assessment. The procedure and individual elements are developed and fixed to some extent by independent institutions as so-called Product Category Rules. The label designates environmental data for the entire product life cycle and is thus suitable for comparions between products. Several different criteria are assessed by the life cycle assessment. **Suitable for:** Communication with users and consumers, suppliers and business clients, public/sustainable procurement	

An ecolabel which addresses the strategies "consistency" or "ecoeffectivity" and takes into account the environmental activities of the company is the cradle-to-cradle label. This label cannot be definitely assigned to any one of the three ISO labels referred to above, but with its "multi-criteria" approach and certification by an uninvolved third party it is similar to a Type 1 label.

Source: EPEA Hamburg

The assessment covers the materials contained in the product, the use of renewable energies, re-use and recyclability, water stewardship and social fairness. Instead of the classic limit value criteria, it has a rating system with basic, silver, gold and platinum levels.

Ecolabels are a helpful communication aid for marking the ecological quality of products. Another advantage is that label criteria can also be used for describing technical specifications for the purpose of public sustainable procurement. Cradle to cradle, for example, is recognised as a quality mark for certifications in connection with sustainable building. The type of ecolabel a company finally chooses will ultimately depend on a number of different factors. Quite apart from the question of whether an ecolabel is available at all for a particular product, the choice will be decided with a view to the market and the competition and to the needs of customers and suppliers.

4. Ecodesign strategies

Many goods designed today are still far from being environmentally friendly, let alone sustainable. And this despite the fact that the required methods and tools have long been available, and that many examples of ecologically and socially useful products and offerings already exist and have proved successful on the market.[17] *Fleeting trends and short-lived products run counter to ecoefficient production and consumption systems. Management and employees often have too little scope or too limited budgets to give thought to new and radically improved business models and offerings. Further obstacles are the much-cited complacency and conservatism of some of the players and the "we've never done it that way/we've always done it that way" mentality. And finally, the failure of many Ecodesign projects is due to inadequate planning of marketing and communication strategies, resulting in very little demand. And yet, for many companies and products the implementation of Ecodesign strategies presents no major difficulties at all.*

The box below gives an overview of general Ecodesign (and social design) strategies. The most important of them are explained in greater detail in the following sections and illustrated by practical examples.

Sustainable goods fulfil the following criteria as far as possible:

TIP

They are
- **practical:** fulfilling a function, solving a real problem,
- **efficient and effective:** in their input of resources, energy and land,
- **solar:** making use of renewable energies during production and use: sun, water, wind, geothermal energy, muscular energy or sustainably produced biofuels,
- **safe:** hazard-free, healthy, even "foolproof", ergonomic, and harmless for the natural environment/pollutant-free
- **reasonably long-lasting:** short-lived or durable (depending on function), but always within reasonable limits, and if short-lived, must be particularly recyclable (see below),
- **recyclable:** waste becomes a nutrient, closing technical and natural cycles,
- **as regional as possible and reasonable:** minimum transport and packaging
- **social:** good for the socio-cultural environment, enhancing the quality of life, securing employment, produced under (regionally) acceptable working conditions,
- **high-quality:** reasonable price-performance ratio, well appreciated by the user, securing the economic livelihood of the supplier.

These characteristics should all be considered in terms of a product's entire life cycle. It is often difficult to fulfil all of the criteria equally well during the design and development process, for example regionalisation versus efficiency – compromises must often be made. The aim is to identify the most readily feasible and marketable combination of ecological, economic and social characteristics.

4.1 THE MOST IMPORTANT ECODESIGN STRATEGIES IN DETAIL

The Ecodesign Strategy Matrix (see Service Section, p. 45) gives an overview of the most important strategies and shows how they can be implemented in the life cycle of a product.

The major criteria for ecological requirements in product design are:

- Optimise material input (reduce material input, choose suitable material, close material loops, avoid waste)
- Optimise energy input (energy efficiency, use of renewable energy)
- Minimise land use
- Minimise pollutants and hazards
- Maximise benefit

The most important phases of a life cycle are:

- Raw material sourcing and product manufacturing
- Use

[17] Cf. for example Tischner et al. (2000): Was ist Ecodesign, Birkhäuser, Basel, Boston.

- Upcycling, re-use and recycling
- Disposal
- Distribution during all phases

The Matrix is intended as a reference tool with recommended activities and strategies for each phase of the life cycle and for each major criterion. A producer, for example, who has been asked by a customer to improve energy efficiency, will find guidance to this effect in the Matrix (life cycle phase "Raw material sourcing, product manufacturing", major criterion "Optimise energy input").

Important higher-level design strategies enabling the main criteria in the Matrix to be fulfilled in the various life cycle phases are presented in the ensuing sections. The examples given here were chosen on the basis of key aspects, though as a rule several strategies were followed at the same time. For example, lightweight construction ensures material efficiency in the production phase and energy efficiency in the use phase.

Efficiency, consistency and sufficiency strategies

There are basically three higher-level strategies: efficiency, sufficiency and consistency.

Ecoefficiency means that equal or greater benefit is achieved with lower resource input. The aim is to increase resource productivity, in other words a more efficient utilisation of energy and materials.

Consistency is concerned with environmentally friendly technologies utilising materials and services of ecosystems without destroying them. Use is made of re-usable raw materials and renewable energies. Material cycles are closed as far as possible and emissions of harmful substances avoided.

Sufficiency aims at an absolute reduction of resource and energy consumption through changes in behaviour habits and reduced demand for goods. Longer use phases are a decisive factor here.[18]

On the following pages, one or more of the three symbols below are placed next to the practical examples to indicate the higher-level strategies to which they can be assigned.

EFFICIENCY: 

CONSISTENCY: 

SUFFICIENCY: 

4.1.1 OPTIMISING MATERIAL INPUT

Careful research is needed here – commonly accepted prejudices will have to be questioned, and new materials often still have to be discovered. New materials must be sought and found which fulfil all product-relevant specifications as effectively as possible with at most only minor negative – and preferably positive – effects both within the product system and over the entire life cycle of the product.[19]

Quite apart from resource efficiency, we will have to examine certain aspects of material availability. Social aspects, for example, will have to be considered, such as whether raw materials are being used to keep wars going or are destroying people's livelihoods. In the case of renewable raw materials, we will have to check whether they are being obtained sustainably.

Table 3 lists the major criteria for selecting environmentally compatible materials.

18 Linz, Manfred (2004): Weder Mangel noch Übermaß. Über Suffizienz und Suffizienzforschung *[Neither scarcity nor excess. On sufficiency and sufficiency research]*. Wuppertal Papers Nr. 145, July 2004.

19 One example of a material with a positive influence on the environment is cork. Use of sustainably harvested cork from the Mediterranean region serves to preserve the valuable cork oak forests which, like the cork industry itself, is acutely threatened by the introduction of alternative wine bottle closures.

Table 3: Criteria for the choice of sustainable materials. Source: Ursula Tischner

8 CRITERIA FOR THE CHOICE OF MATERIALS	
1	Give priority to materials which use up as few resources as possible (including water and land), and opt for renewable materials wherever practicable.
2	Give priority to materials produced by using energy-efficient methods and renewable energies.
3	Give priority to materials which involve as few harmful substances and emissions as possible.
4	Check the origin and choose regionally produced materials wherever practicable, minimise transports and give priority to sustainable means of transportation.
5	Choose materials with optimum durability for the expected or desired use of the product.
6	Choose materials suitable for a circular economy, maximise re-use or recycling and minimise waste; use compostable materials wherever practicable..
7	Choose materials which increase biodiversity and are of advantage for the protection of natural areas, for example which do not require monocultures or destroy valuable biotopes.
8	Take account of social aspects, such as working conditions during cultivation and material sourcing.

The examples below illustrate strategies for optimised material input in production (Carus LED lamps), material efficiency during the use phase (coffee capsules from Swiss Innovation Products GmbH), lightweight construction (body from EDAG), use of environmentally friendly materials (Biowert's AgriPlastBW material) and design for a circular economy (Köhl, waste containers from the ESE Group).

Material efficiency in production

The aim here is to make more efficient use of materials in production by better product design, and by avoidance or re-use of production wastes with the aid of optimised manufacturing processes. New production technologies such as 3D printing or intelligent production methods (Industry 4.0) open up fascinating possibilities here (see also Section 4.2.3).

EXAMPLE:
Material efficiency in production – redesign of LED lamps

Carus GmbH & Co. KG, a medium-sized enterprise in Marburg, conducted an ecological analysis of commercially available LED lamps with the aid of a disassembly study and benchmarking, and used the results to develop a radically improved product design. This new design comprises major savings in materials, a reduction in the number of different materials used, easier recyclability, and a longer service life due to optimisation of the cooling space. An additional objective was to achieve resource and energy efficient automated production in Germany. Carus was able to draw on the know-how of the parent company Seidel in the design of packaging for the cosmetics industry.

"Ecodesign is important for the success of the energy turnaround.
We are glad to make a contribution with our material efficiency approach."

Dr. Andreas Ritzenhoff, Managing Director of Carus GmbH & Co. KG, on the subject of Ecodesign

The new LED lamp has the following innovative features:

- Product made up of only seven components with interlocking connections
- No adhesives or solder, hence completely dismantlable and recyclable
- Reduced material mix: the lamp consists of plastic, aluminium and electronics
- Weight reduced from 180 grams to 80 grams
- 50 percent less aluminium than in conventional lamps with cast bodies due to use of deep drawn aluminium sheet, leading to an annual saving of 260 tonnes of aluminium
- 90 percent less raw material consumption over the whole supply chain and 50 percent less energy consumption in production, compared with conventional lamps
- Expected service life increased to 25 years due to better cooler element design and dimmer function as protection against overheating
- Automated production in Germany with greater resource and cost efficiency

Local production in Hessen creates or safeguards jobs and, with an annual production of 20 million lamps and distribution throughout Europe, saves 400 container deliveries per year from the Far East. This is the equivalent of over half a million tonnes of carbon dioxide.

www.carus-world.de

EXAMPLE: Material efficiency in the use phase – Stainless steel coffee capsule

One ecological drawback of capsule coffee machines is the consumption of resources for the production of the capsules and their disposal. Pads made of normal filter paper can be composted and are therefore an unproblematic organic waste fraction, but aluminium or plastic capsules with coffee still inside after the brewing operation can in practice be disposed of only as residual waste.

With this in mind, Swiss Innovation Products GmbH in Switzerland developed “mycoffeestar”, a stainless steel capsule which is very long-lasting and is filled up time and again. A two-person household, in which each person drinks two cups of coffee a day, will save over the course of the year 1,500 waste capsules and approximately 1.5 kg of aluminium. In comparison, the capsule of medical stainless steel weighs 21 g. The product was granted the Red Dot Design Award.

www.mycoffeestar.com

reddot design award

Material efficiency in the use phase

In the case of goods which involve the consumption of material and energy during use, it is often the use phase of their life cycle which very largely determines their environmental relevance. The use phase can be optimised by reducing the amount of water or other resources needed for the product. One of the great challenges for producers is to promote efficient use without actually having any direct influence on the behaviour of the user. By conscious employment of what is known as product language or product semantics, designers have considerable opportunities to acquaint the user with the efficient use of a product. Examples of this are large and small toilet flush buttons indicating the water consumption, or “consumption meters” giving the user easily understandable information on material (and energy) consumption.

Material efficient design – lightweight construction

Material efficient design is a strategy for using the right materials in the right way. In addition to a deliberate choice of materials with a view to obtaining special product characteristics or utilising renewable resources, lightweight construction is a combination of constructional and material-specific measures and as such is a possible strategy for developing material-saving constructions and favourably influencing the characteristics of a product in other phases of its service life. Weight is an important factor in particular for means of transportation and the associated energy consumption.

EXAMPLE: Lightweight construction as a design strategy

A variety of lightweight construction strategies are used by EDAG Engineering GmbH in Hessen for optimising body and interior components for cars, in particular electric cars. Weight plays a decisive role in automotive construction with regard to fuel or power consumption. Use is made for this purpose of innovative fibre reinforced constructions, lightweight steel construction, or additive manufacturing methods and joining technologies.

The body of the 16th Concept Car of EDAG, the "Light Cocoon", which was presented at the 2015 Geneva Motor Show, is based on biomimetic structures and was produced by additive manufacturing (SLA), a method with great potential for efficiency in production.

The new thing here is that the body is not considered as a closed surface. Material is used only where necessary in terms of function, safety and stiffness – on the basis of the biomimetic principle. This has resulted in a stable, branch-like load-bearing structure which fulfils the constructional requirements but needs significantly less material than a conventional body. This approach had already been used beforehand on the engine bonnet of a production car in order to quantify and calculate the potential of lightweight construction. The fulfilment of constructional requirements such as pedestrian protection or torsional and flexural stiffness had to be ensured. The result was a cobweb-like hollow aluminium body structure with a 25 percent saving in weight as compared with a conventional engine bonnet. The conception for the outer skin was taken from a biomimetic "lightweight construction principle" like that of a leaf, which has an ideal structure with a lightweight outer skin stretched over it. The material for the outer skin, which is needed only for weather protection and aerodynamics, consists of a weatherproof, elastic and extremely light material, Texapore Softshell, a three-layer polyester jersey material developed by Jack Wolfskin in Idstein.

EDAG Light Cocoon, www.edag.de

Use of environmentally friendly materials

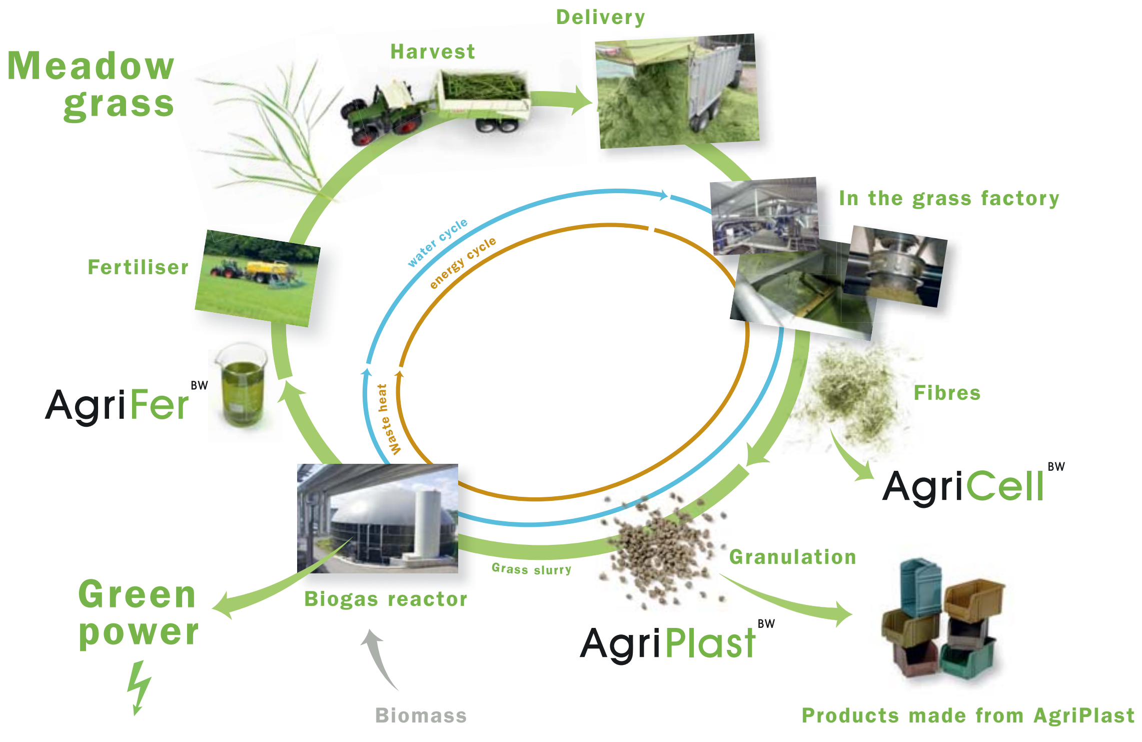
The purpose of this strategy is to make use of natural raw materials as sustainably as possible. They should originate from sustainable forestry or agriculture, be obtained without adverse effects on biodiversity and used in such a way that they can be returned free of harmful substances to the natural cycles.

EXAMPLE:
Material made of renewable raw materials

AgriPlastBW, a composite made of grass fibres and plastic, contains up to 75 percent cellulose obtained from regionally produced meadow grass. The cellulose is embedded in a thermoplastic matrix, which can consist of recycled plastics, PP, PE, PCL or biodegradable plastics. The material is equally suitable for injection moulding and extrusion. A life cycle assessment conducted by the Swiss firm ESU-services showed that the ecological footprint is 75 percent lower than that of conventional HDPE. Due to its composition, AgriPlastBW possesses special characteristics such as extremely high form stability at high and low temperatures, which becomes particularly noticeable where PLA, LDPE and PP are used for packaging purposes. In addition, the robust natural fibres provide high abrasion resistance, which greatly reduces wear and tear, most of all in mechanical engineering and the construction sector. When specially conditioned, the cellulose provides natural, environmentally friendly fire protection, particularly for injection moulded parts. Despite its high fibre content, AgriPlastBW has very good flow properties, which also makes it suitable for thin-walled moulded components, such as stackable boxes or casings for technical appliances, and can be produced in any colour required. AgriPlastBW is produced by Biowert Industrie GmbH, a company based in the Odenwald area. In the so-called biorefinery in Brensbach, the renewable raw material grass is processed into a variety of products, reducing the use of plastics, carbon emissions and environmental impact. The necessary energy in the form of electricity and heat is provided by the adjoining biogas plant, which is fuelled by the accumulated by-products and waste materials. The water needed for separating the grass fibres is extracted from the process cycle at the end, filtered, purified and reused as process water. Production itself is an example of resource-efficient circular economy.

Biowert Cycle, production and AgriPlastBW packaging for the cosmetics industry, www.biowert.de

THE BIOWERT CYCLE



Design for a circular economy

Waste is re-usable material in the wrong place – and it is wasted money. Product design can help to avoid wastes by the re-use or further use of products or components. One way is to collect wastes during production and then to restore them to use or sell them at a profit. Another way is to provide for possible further use and re-use as part of the product design. With an accompanying take-back system, these possibilities can be integrated into a service concept and ultimately lead to a successful business model. "Waste" becomes a technical or natural nutrient, as proposed in the cradle-to-cradle system[20] (cf. Chapter 2.2). Technical products are re-used or further used in the technosphere and natural cycles can be closed if products made of pollutant-free natural materials are returned to the natural cycle.

One element of circular economy is **"recycling-friendly design"** – nowadays almost standard procedure for goods which are subject to take-back and recycling legislation, such as cars, electronic appliances and packaging. In general, preference should be given to types of construction which can be easily disassembled, to a reduction in the number of different materials used, and to recyclable materials. The cost effectiveness of recycling depends, for example, on the time and effort needed to disassemble a product, the amount of energy required and the possible earnings or savings accruing from the recycled material. Another important factor is the availability of a recycling infrastructure. For example, it makes a very great difference whether recycling takes place in an automated shredding plant or whether products are disassembled manually. Allowance must be made for this in the design of the recycling processes.

EXAMPLE: Recycling-friendly design of office furniture

The office chairs from Köhl in Rödermark are 95 to 100 percent recyclable. Care is taken at the development stage to limit the number of different materials used. Recyclable materials are sorted by type and used in such a way as to allow rapid and unproblematic dismantling. The various chair series

- consist mainly of interlocking components
- can be correctly sorted by type in only 7 steps for recycling
- can be dismantled in less than 5 minutes
- use upholstery fabrics with high ecological standards (including the Cradle to Cradle Certified® fabric Climatex) and can be refurbished, which means that seat, arm rest and back rest can be easily replaced without any tools thanks to an interlocking system.

Good for health, and hence socially sustainable, is the innovative Air-Seat system, which consists of an individually adjustable two-chamber air cushion to promote dynamic sitting and prevent back pain.

The materials for all seats are environmentally friendly and compostable, and have been shown by tests to contain no harmful substances. These materials include leather from the Alpine region, which is free of chrome and heavy metals, and wood from sustainable forestry. The chairs are not only recyclable in themselves, but also contain recycled materials. Thanks to the modular construction, production of the various chair types is material and energy efficient, with materials and design being based, among other things, on biomimetic principles. Since most of the suppliers are from the region, it is possible to reduce transport distances and packaging.

The recycling strategy is more than just recycling-friendly design and the use of recycled materials. The company also offers individual components as refurbishing elements, together with a take-back system. All furniture items are dismantled and recycled locally.

www.koehl.com

"With our activities we should like to contribute to a change in general thinking. The sustainability and the added value of a product are decisive for users."

Management Board of Köhl GmbH

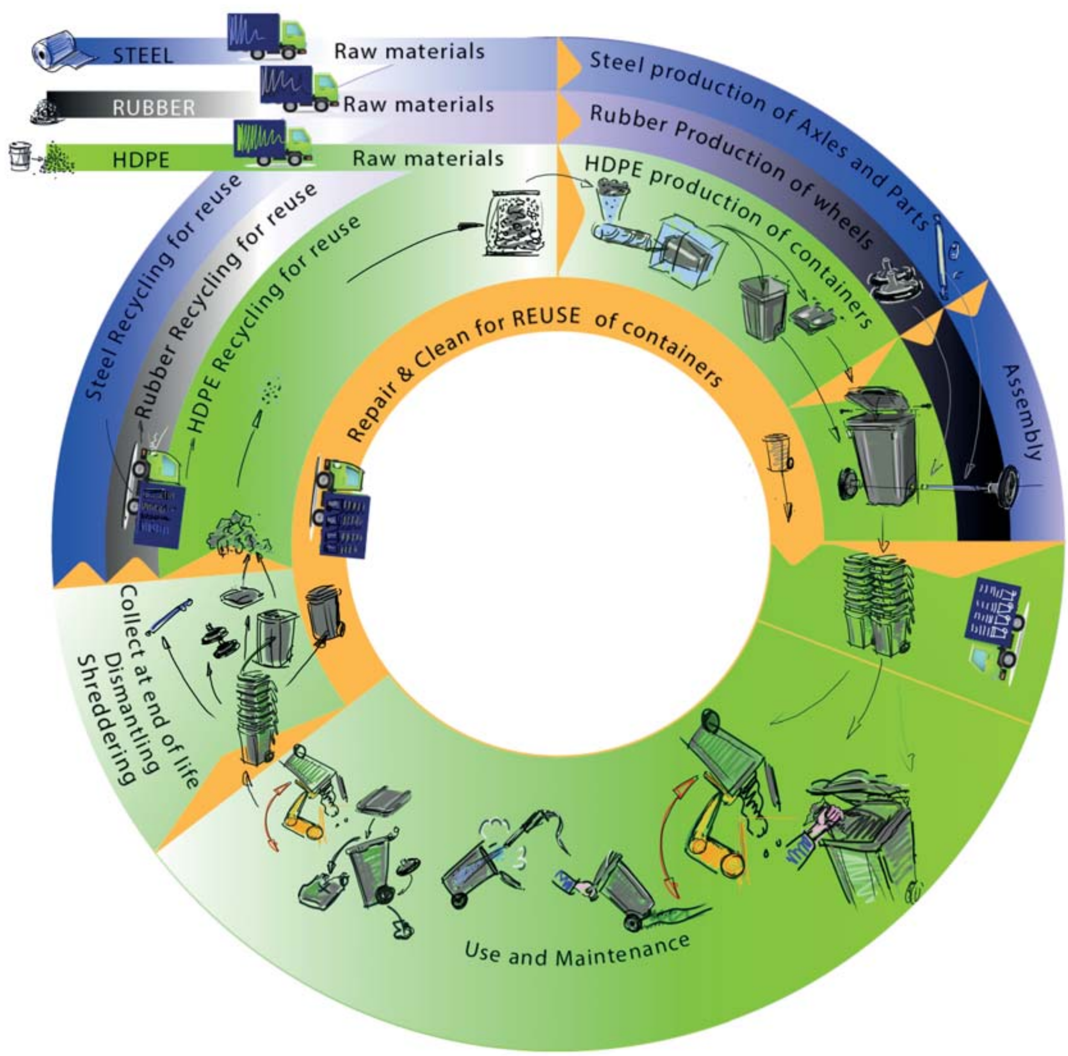
[20] Cf. also McDonough, W./Braungart, M. (2002): Cradle to Cradle. Remaking the way we make things, North Point Press, New York.

EXAMPLE:
Container made of recycled plastic – material cycle for the waste containers of the ESE Group, Maastricht, NL

The ESE recycling service for waste and recycling containers which have reached the end of their product life is a special project in Europe enabling highly sustainable production of plastic containers. Bins no longer needed are collected at a central point and ground down for recycling directly on the spot by specially developed mobile units. For transportation to the nearest ESE production facilities ground materials take up less space than bulky containers. Waste removal expenditure is reduced, transport routes, carbon emissions and costs are minimised. Millions of containers have already been successfully fed back into the material cycle in this way. The materials are cleaned, dried and reprocessed at the manufacturing facilities, and converted to high-grade raw material of the same quality as new plastic.

A container made of recycled material scores significantly better in the life cycle analysis than one made of new material. More than 200,000 tonnes of plastic are used every year in Europe for producing waste and recycling containers. As a result of intensive research and development, ESE is also able to process recycling material from other sources, which puts it in a position to produce containers with up to 100 percent recycling material.

The ESE material cycle, www.ese.com



4.1.2 OPTIMISING ENERGY INPUT

The aim of energy efficiency is to cut down energy consumption over the entire life cycle of a product. Renewable energies, ranging from solar energy to muscle power, can also be advisable, though care must be taken to ensure that renewable energy resources are obtained in an environmentally acceptable way. Energy efficiency can be achieved by passive measures, such as better insulation of buildings resulting in the reduction of energy required for heating and air conditioning, but also by active measures, such as more energy-efficient product design, for example in the form of consumption-reducing technology.

Heat exchanger door of the e^3 cooling system

"High performance data centres are becoming an ever more important infrastructure for business, science and administration. At the same time energy is being unnecessarily wasted in data centres. If we could bring the 500 largest data centres in Germany up to the efficiency standards which can be achieved with our solutions, this would mean savings of almost one million tonnes of carbon dioxide per year. The development of sustainable system solutions pays off at all levels."

Alexander Hauser,
CEO, e^3 computing GmbH

EXAMPLE:
Energy and space efficiency in the use phase – sustainable cooling and designing of data centres

e^3-computing GmbH has developed a sustainable cooling system for data centres. The major innovation was to change the operating principle and replace air cooling by water cooling, since the heat storage capacity of water is 4,000 times higher than that of air. Google, for example, cools its server rooms in Finland with sea water. According to a study from the Borderstep Institute in Berlin, data centres were responsible for about 1.8 percent of all German energy consumption in 2011, of which up to 50 percent can be needed for cooling the servers. This ecoefficient concept results in savings of up to 90 percent of the energy for cooling compared with conventional systems – which is an advantage both ecologically and economically.

The particular feature of the cooling system is the direct cooling with passive heat exchanger doors on the back of the rack system using water, together with a special spatial arrangement of these cooling elements, resulting in the following effects:

- Up to 80 percent lower carbon emissions for cooling
- Great reductions in the space requirements of data centres, since less room for air is needed (in raised floors, partitions and between the servers) and there is no necessity for compact intermediate floors
- Compact design and modular construction resulting in more economic use of resources for premises, buildings and outdoor facilities
- Uniform temperature control and prevention of hot spots, resulting in higher operating safety and longer service life for the computer elements
- Electricity consumption of data centres reduced by more than one third compared with the overall average for Germany

Water flowing in a closed cycle conducts the waste heat away directly at the source in the specially constructed rear sides. In this way the air coming out of the racks has already returned to ambient temperature. The absorbed heat is given off via a further heat exchanger into the open cooling cycle with a wet cooling tower, in which recooling takes place by evaporation and the heat escapes into the surrounding air. In Hessen, data centres of the GSI Helmholtz Centre for Heavy Ion Research in Darmstadt and of Frankfurt University have been equipped with this technology.

www.e3c.eu

4.1.3 POLLUTION-FREE AND RISK-FREE DESIGN

Many products still harbour great risks for human beings and the environment. Particular problems are presented by the diffusion of hormonally active or carcinogenic substances and the release of allergens. The synergistic effects of a wide range of different substances are already demonstrating very alarming consequences. Ultimately, many of the harmful substances escaping into the environment do not only contaminate the ecosystems but also find their way into our organisms indirectly via the food chain. Existing legislation (such as REACH and RoHS, see Chapter 2) covers some of these substances but by no means all of them. Product design must ensure that the risks for human beings and the environment are eliminated or minimised. Developers should also ask what risks are likely to be encountered at the preliminary production stages and during recycling or disposal.

EXAMPLE:
Thermal insulation made of hemp and free of harmful substances

Capatect System Natur+ is a composite thermal insulation system (CTIS) consisting of a hemp fibre panel, a mineral reinforcing compound and fabric, and a mineral finishing coat. The CTIS is manufactured by DAW in Ober-Ramstadt. The insulation system is recyclable and made of a fast growing renewable raw material produced regionally without pesticides or fertilisers. Hemp has a positive life cycle assessment: while still growing on the field the plant draws significantly more carbon dioxide from the atmosphere than is released during cultivation, harvesting, processing and transport. The hemp fibre panel does not need any chemical additives. In addition to its efficient thermal insulation, the material provides good soundproofing and heat protection. Among other awards, it received the German energy efficiency prize Perpetuum 2015.

www.caparol.de

Biodegradability and compostability of plastics

Conventional plastics based on petroleum and other chemical substances and additives are as a rule not biodegradable but rot very slowly and can harm flora and fauna if not correctly collected for recycling or disposal. In the meantime there are a large number of biodegradable plastics on the market. Materials and chemicals are generally considered to be biodegradable if they can be removed from the environment by microorganisms or enzymes and restored to mineral cycles, for example in soil or water. However, there are also materials which, although disintegrated by biological processes into small particles, are not completely decomposed and present problems when the small particles are dissipated into the environment. The so-called "oxo-biodegradable" or "oxo-degradable" plastics, for example, with additives which consist mostly of metal ions (cobalt, manganese, iron, zinc) and speed up chain degradation in plastics, are problematic because they disintegrate into very small, barely visible fragments which do not biodegrade and find their way into our food chain.[21]

The term "bioplastics", on the other hand, refers to a group of plastics which are produced (partly) from natural materials, such as starch from potatoes, sugar cane or maize, or are biodegradable, or both.[22] Many bioplastics are compostable, but they need certain conditions such as heat or a particular pH value before they can truly be reintegrated relatively quickly into the natural cycle. This means that they cannot be composted at home in the garden. They are often sorted out even in industrial composting plants because they do not decompose quickly enough and can spoil the quality of the compost.

The OECD Test Guideline for biodegradability[23] distinguishes between "ready biodegradability" (rapid and complete biodegradation), "inherent biodegradability" (limited, but still basically possible degradation) and, in the case of bioplastics, "compostability". A material is recognised as compostable only if at least 90 percent of the materials are biodegraded within 12 weeks in an industrial composting plant in accordance with European Standard EN 13432. If the matter is taken seriously, the terms biodegradable or compostable should be used only for plastics of this kind, and further information on the time frame, the degree of degradation and the necessary ambient conditions should be provided.[24]

[21] Cf. Endres, Hans-Josef/Siebert-Raths, Andrea: Technische Biopolymere. Hanser-Verlag, Munich 2009.

[22] Cf. http://en.european-bioplastics.org

[23] Cf. www.oecd.org/chemicalsafety/testing/

[24] Cf. http://en.european-bioplastics.org/wp-content/uploads/2011/04/fs/Biokunststoffe_de.pdf.
European Bioplastics recommends that the unambiguous claim "compostable" should be used where possible. Evidence must then be provided with corresponding references (ISO 17088, EN 13432/14995 or ASTM 6400 or 6868), a certification and labelling (Vinçotte Seedling logo and DIN CERTCO, Vinçotte OK compost logo).

4.1.4 MAXIMISING BENEFIT: DESIGNING PRODUCTS FOR A REASONABLE SERVICE LIFE

The simple calculation in Table 4 shows that marked advantages for environmental efficiency can be obtained by increasing the lifetime and the service life of potentially long-lived goods which do not involve consumption during the use phase, such as furniture.

Table 4: Simple model calculation for resource efficiency and lifetime

Wooden chairs compared: lifetime and resource efficiency		**Resource efficiency, assumptions on material input normalised to Chair A**
Chair A: Own purchase; lifetime estimated at about 15 years in all		Assumptions: lifetime 15 years divided by material input factor 1 Result: Resource efficiency factor 15/1 = 15
Chair B: Inherited from mother; service life by 2015 already about 65 years		Assumptions: lifetime 65 years divided by material input factor 2, since heavier and more solid than Chair A Result: Resource efficiency factor 65/2 = 32,5
Chair C: Inherited from grandmother; service life by 2015 already about 100 years		Assumptions: lifetime 100 years divided by material input factor 1.5, since slightly more solid than Chair A Result: Resource efficiency factor 100/1.5 = 66.67
Overall result: With products which require no consumables during the use phase, a marked increase in resource efficiency can be achieved by simply lengthening the lifetime and the service life.		

Whether there is good reason to replace a particular item must be examined more carefully for products which use up energy, water, paper, ink or the like – with the aid, for example, of life cycle assessments or life cycle cost analyses (LCCA). For such items there can come a moment in the lifetime phase when there is good reason to buy a new and radically more efficient product, even if the old one still functions. This will be the case only if the amount of consumables saved by the new product cancels out the new production and the disposal of the old product in a very short time. In contrast, the environmental payback periods will be very long if the efficiency during use does not offset the expenditure for manufacturing.

Go on using it or buy a new one?

A study conducted by the Öko-Institut and Fraunhofer IZM on behalf of the UBA on the optimum service life of notebooks showed that the efficiency of new appliances would have to be very greatly increased (> 70 %) if the greenhouse emissions from the energy and resource expenditure incurred by their production were to be offset in less than 10 years.[25]

The service life of products can be influenced, among other things, by the following product characteristics: robustness of components, repairability, maintainability, modular construction, and adaptability to changed user requirements.

[25] Prakash, Siddharth et al.: Zeitlich optimierter Ersatz eines Notebooks unter ökologischen Gesichtspunkten *[Optimising the service life of a notebook according to ecological aspects]*, UBA-Texte 44/2012, Berlin 2012

Obsolescence

Obsolescence is understood to mean the premature aging of products due to deficiencies in construction that are either caused by negligence or even deliberately planned. Technical breaking points shorten the product service life. HTV, a company in Hessen, awards a mark of excellence for durable products which do not contain measures for the intentional reduction of product service life (see Service Section).

EXAMPLE: Durability and multifunctionality

A distinguishing feature of the Green Label diaper bag developed by Lässig GmbH in Hessen is its multifunctional design. All necessary functions (like cooling baby food or keeping it warm) are integrated, complete with changing mat and wet pocket, and the bag is easy to clean. Although the bag has fittings for fastening to the pram, it is designed in such a way that its more or less temporary primary use is not immediately recognisable. This means that it can also be used as a business bag, thus lengthening its service life. In addition to its modular design, functionality and durability, 93 percent of its material consists of recycled PET and is free of PVC and pollutants such as phthalates and nickel. The bag was granted the Red Dot Design Award.

www.laessig-fashion.de

reddot design award

4.1.5 SOCIAL ASPECTS

The social aspects of design include health issues and social questions regarding the impact of various products on society. Product design should also take account of working conditions at the production and preproduction stages (fair wages and working hours, human rights), questions of gender equality, cultural aspects, protection of indigenous populations, etc. Fair Trade models can be developed, with better product design as a way of solving social problems and improving the quality of life for as many people as possible, particularly the disadvantaged. In the food, electronics and clothing industries, issues of this kind have already been under discussion for quite some time among the many different parties (including customers) and taken into consideration by companies. Fairphone (see Chapter 5) is an example which shows that the supplier chain can be organised in the fairest possible way, and that such strategies can successfully reach different customer groups.

4.2 STRATEGIES GOING BEYOND ECOLOGICAL PRODUCT DESIGN

Ecodesign at the product level alone will not be enough if we are to cope successfully with the challenges of increasing resource consumption, as already mentioned at the beginning. Enhanced efficiency is frequently offset by so-called "rebound effects": because products are more efficient, consumers make less sparing use of them, or because more of such products come into use. All in all, global economic growth and growing consumption cancel out the savings achieved at the product level. For this reason, stakeholders are becoming increasingly interested in the design of comprehensive Product Service Systems (PSS)[26] and changes in production and consumption systems (Sustainable Consumption and Production, SCP)[27].

[26] Cf. www.suspronet.org and www.mepss.nl

[27] Cf. www.score-network.org

Attention is also being directed to what are known as "social innovations". The hope behind these strategies is that, by sustainable reorganisation of the entire systems and by exerting influence on the major interfaces between producers, consumers and stakeholders, it will be possible to bring about much more far-reaching changes in production methods and consumer behaviour and prevent rebound effects.[28]

The rebound effect

The term "rebound effect" means that, in spite of – or as a consequence of – the greater resource and energy efficiency of a product, a higher rate of consumption may be triggered which can eat up part of the savings achieved. In the worst case, savings can even be over compensated (backfire effect).

This effect can take place not only at the individual level or in private households but equally well in companies or in the economy as a whole. The underlying mechanisms are, for example, cost savings resulting in higher consumption; psychological effects, where good conscience leads to higher consumption; accumulation of consumer goods, where second appliances are purchased because of their greater efficiency; or increased economic growth due to efficiency technologies which make raw materials cheaper or which enable the use of technologies which had up to then been too expensive.

One example here is the introduction of laptops, which are more efficient in terms of material and energy than a regular desktop computer. However, many users nowadays make use of both together, so that the improved efficiency fails to bring about an absolute reduction of materials and energy in computer use.

4.2.1 PRODUCT SERVICE SYSTEMS (PSS)

The objective of this strategy is to devise concepts for entire product service systems in order to bring about improvements in the ecological – and partly also in the social – aspects within the overall system, and to do this more radically than would be possible in conventional product/sales systems. PSS is generally subdivided into three categories:

a) Product-related strategies: the product continues to be sold, a change of owner takes place. In addition, efficiency enhancing services are offered, such as a delivery service and repairs, lifetime extension services or consultancy.

b) Use-oriented strategies: these are centred on the use of the product; no more selling takes place. Car sharing and hiring services are included here. Payments are made for the use of the product, but the product itself remains the property of the manufacturer or the service provider.

c) Result-oriented strategies, such as energy services or chemical leasing. Here the customer pays for particular results, in the case of energy services for good lighting or heating, and in the case of chemical leasing for a varnished or painted product. Another example is pest control on fields. How the service provider brings about the result is of no concern for the customer. The service provider usually possesses much more know-how than the customer and can therefore achieve the result more effectively and with more economic use of materials.

[28] Cf. Tukker, A./Tischner, U. (eds.) (2006): New Business for Old Europe. Product-Service Development, Competitiveness and Sustainability. Greenleaf Publishing, Sheffield; Tukker A. et al. (eds.) (2008): System Innovation for Sustainability 1: Perspectives on Radical Changes to Sustainable Consumption and Production, Greenleaf Publishing, Sheffield; Geerken, T./ Borup, M. (eds.) (2009): System Innovation for Sustainability 2: Case Studies in Sustainable Consumption and Production – Mobility, Greenleaf Publishing, Sheffield; Tischner, U. et al. (eds.) (2010): System Innovation for Sustainability 3: Case Studies in Sustainable Consumption and Production – Food and Agriculture, Greenleaf Publishing, Sheffield; Lahlou, S. (ed.) (2010): System Innovation for Sustainability 4: Case Studies in Sustainable Consumption and Production – Energy Use and the Built Environment, Greenleaf Publishing, Sheffield.

EXAMPLE:
Systematic textile management

MEWA, a company based in Wiesbaden, has been providing a sustainable service system for industrial textiles for over 100 years. Re-usable industrial cleaning cloths and work apparel are supplied to companies together with full service. After use, the textiles are collected from the customer, washed, where necessary repaired or replaced, and sent out again for delivery. MEWA provides industrial cleaning cloths in different qualities for specific uses, such as the metalworking industry, printers or workshops. The soiled wipers are washed under environmentally friendly conditions at the MEWA facilities, after which the washed-out contaminants are energetically recycled.

The processes have been ecologically devised and optimised so that washed-out oils and grease can be used for generating energy, thus covering 80 percent of the energy needed for handling the cleaning cloths. The washing water is re-used several times using cascade technology, waste heat is recovered, and the company's own wastewater treatment plants ensure that the wastewater is purified up to 99.8 percent and returned to the water cycle. Other sustainable solutions for transportation and storage of the products are the use of durable safety containers and textile laundry bags. A four-person household handles about one tonne of washing every year, whilst MEWA washes about 313 tonnes of textiles every day throughout Europe. Every year, the returnable system of MEWA textile management avoids considerable amounts of hazardous wastes (disposable cleaning cloths) and conserves resources.

The MEWA system pursues a number of approaches:

- Principle of "use it, don't own it"
- Ecologically optimised multi-cycle system
- Latest environmental technologies, including heat recovery and wastewater treatment
- Recycling of raw materials
- Use of the thermally recyclable contaminant fraction for energy generation
- Reduction of special waste by using re-usable instead of disposable cloths

MEWA was founded in Saxony in 1908 under the name "Mechanische Weberei Altstadt GmbH". From the very beginning it manufactured and supplied cleaning cloths for the cleaning of machines and industrial plants. The cleaning cloths were washed originally in cooperation with laundries, then in the company's own facilities, and replaced when worn out. The sustainable product service system can boast of a long history. Since 1968, MEWA has also offered a service for work apparel in addition to cleaning cloths. In 2013 the textile management company received the National German Sustainability Award "Top 3" and is constantly improving its ecological and economic performance.

www.mewa.de

"We are continually searching for ways to achieve the best possible performance using fewer and fewer resources, i.e. by constantly reducing our consumption of energy, water and detergents."

Ulrich Schmidt, Director of Technology and Production, MEWA Group

Cascade technology in the cleaning process at MEWA

4.2.2 SUSTAINABLE CONSUMPTION PRODUCTION (SCP) AND SOCIAL INNOVATIONS

This relatively recent approach to overall production and consumption systems is well able to bring about radical changes, but because of its systemic perspective and the many different stakeholders involved it could present a much more difficult challenge.[29] Its essential aim is to draw up critical analyses of existing systems such as nutrition (production and consumption of foodstuffs), mobility (moving people and goods from A to B) or habitation (dwellings, together with all infrastructures and goods contained in them), to identify the major weaknesses and levers in the system, and to develop strategies for the radical redesigning of systems or consumption patterns towards greater ecological and social sustainability. As a rule this can only be done by involving a number of different players; it often requires changes in the infrastructural, institutional and political spheres, and partnerships between companies, consumers and other stakeholders. Companies find these approaches highly interesting when they are looking for radical innovations in existing markets or are planning to open up new markets.

Radical changes of this kind can be technology-driven, or they can come about in the context of social innovations. The term "social innovation" is not new – it finds use in various fields such as sociology, design, politics and economy, and has been a subject of intensive study and discussion in recent times.[30] What the various approaches have in common is that "social" means "of societal provenance" (as opposed to technological or economic provenance) and at the same time "good for society", hence "socially sensible". In this context, "innovation" means a new kind of solution for a social problem, which is developed primarily by the people directly affected, is of advantage for them, and changes "social practice". In this sense, "social" refers to both the process and the final outcome of the innovation. Technologies and companies can play an important role as enablers of social innovations; in many cases non-profit organisations are involved, and social innovations sooner or later lead to more professional organisational forms or business models. Car sharing in Berlin started off as a private initiative among acquaintances who shared cars with one another, and finally turned into a business model which has now become established worldwide. Purchasing cooperatives for ecological and healthy foodstuffs which were set up by private individuals have since become professional organisations thanks to the internet. These examples show that socially conscious citizens are prepared to tackle urgent social and ecological problems and find ways of solving them in cooperation with other like-minded persons. Information technology and the Internet have enabled private initiatives to greatly widen their radius of action, and, with financing models such as crowdfunding, initiatives can obtain the necessary backing from dedicated private persons or professional investors.[31]

4.3 DESIGN IN THE CONTEXT OF INDUSTRY 4.0 AND INDIVIDUALISED ADDITIVE MANUFACTURING

As a result of the digitalisation and networking made possible by the internet, the economy stands on the threshold of a fourth Industrial Revolution. Industry 4.0 aims at greater flexibility, resource efficiency and ergonomics, and at integrating customers and business partners into business and value creation processes. Computer aided planning and the so-called Internet of Things will enable individualisation of production down to lot size 1 under highly flexibilised production conditions.

Further interesting possibilities are opened up by additive manufacturing methods based on 3D printing, which are used for rapid and cost-efficient production of models, samples, prototypes, tools and end products. For the additive manufacturing process, individual moulded parts are produced out of powders or liquids by chemical or physical processes, and all that has to be done is to transfer the CAD program data directly from the computer, without any need for special tools or the construction of moulds. In this way the production of small series or individual items

[29] Cf. for example the EU Sustainable Consumption Production Action Plan of 2008 (eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:52008DC0397&from=EN), proposing a whole series of measures to be taken by various players. The aim behind all this is to increase the sustainability of production and consumption in Europe and make the European economy more competitive.

[30] For the various definitions of "social innovation", cf. Rüede, Dominik/Lurtz, Kathrin (2012): Mapping the various meanings of social innovation: Towards a differentiated understanding of an emerging concept, EBS Business School Research Paper Series 12-03, downloadable at ssrn.com/abstract=2091039.

[31] The open innovation platform for sustainability www.innonatives.com offers among other things crowdsourcing and crowdfunding for sustainability relevant solutions.

becomes economically very interesting. Decentralised, individualised production opens up opportunities to shorten transport distances, make warehousing unnecessary, reduce material consumption and generate individualised products with a very high value creation for the individual user. These methods of production will enable decentralised peer production in digital space and revitalise the "do it yourself" culture, thus resulting in exciting co-design and co-production models. If these new technological possibilities are to be of advantage for sustainability, the conditions under which additive processes are integrated into production will have to be specifically designed to this end.[32]

EXAMPLE:
Mass customisation of sandals

The myVALE company offers sandals made of sustainable materials, with customised footbeds and in a selection of different colours. The freely selectable straps can be individually positioned. Mass customisation means that no more shoes are produced than are actually ordered and worn – without any over-production or goods in stock.

The concept was developed by combining computer technology with the company's own know-how in the field of made-to-measure orthopaedic shoes and inlays. The intention was to create a sustainable range of products for a fashion-conscious target group which could not be reached via the traditional distribution channels. The newly developed design and production process follows the customer's wishes (design and material) with the aid of an individual 3D footprint taken directly from the customer.

The whole process takes three to four weeks after receipt of the complete order and consists of the following steps:

- The individual design is selected in the configurator ("Designer"), where over 35 million different variants are available.
- The footprints, together with the toe thong position, are taken in a transportable foam box which can be ordered via online shop, telephone or in the store.
- The footprint is analysed, captured by a 3D scanner and modelled into an orthopaedically optimised footbed on the computer.
- The footbed is milled from EVA foam in a specially modified CNC milling machine, after which the sandals are produced in 25 production steps.

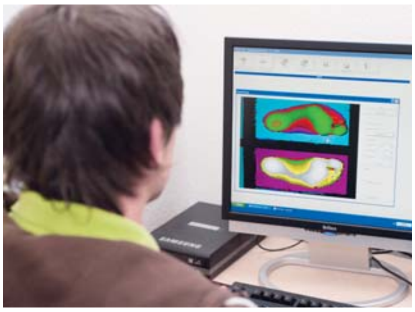
The products and processes belonging to the system possess the following ecological features:

- Avoidance of overproduction by customised production
- Low-waste production due to extensive recycling of product scraps
- Longer shoe life thanks to repair options, re-design by exchanging straps and soles, also durable, slip-resistant rubber outer soles and easy cleaning.
- Leather from welfare-oriented animal husbandry
- EVA foam (used for the footbed) fulfils the requirements for medical devices, is 100 percent skin-friendly and allergen-free
- Material for the straps made partly out of production waste and specimen materials
- Regional production for shorter transport distances and job creation

The myVALE brand was created in 2008 by the traditional family firm "Schott Orthopädie-Schuhtechnik" in Homberg/Efze (Hessen). The firm has been in existence since 1888 and is at present managed in the fourth generation by Markus Schott. The processes are certified to ISO 13485, a quality management standard for the design and production of medical devices. The product has been granted the Red Dot Design Award.

www.my-vale-shop.de

[33] Cf. Petschow, Ulrich et al. (2014): Dezentrale Produktion, 3D-Druck und Nachhaltigkeit. Trajektorien und Potenziale innovativer Wertschöpfungsmuster zwischen Maker-Bewegung und Industrie 4.0, IÖW Text Series 206/14.



"Although still a young brand, we attach great importance to continuously optimising the sustainability of our product. This is why we have always set very high standards for origin and production when selecting our materials and are constantly seeking new, innovative ideas."

Markus Schott, CEO, Schott Orthopädie-Schuhtechnik GmbH & Co. KG Ulrich

4.4 RECONCILING CONFLICTING AIMS AND SETTING PRIORITIES

Many of the strategies referred to above overlap and have certain elements in common. Some of them can be contradictory. For example, lightweight construction may entail the use of high-tech materials which are hard or impossible to recycle. A compact and robust form of construction can reduce transport costs and lengthen the life of the product, but it may sometimes create difficulties with dismantling, and hence also with repairing and recycling. If dismantling is complicated, this will also present difficulties for repairing and recycling. If a product is highly durable, it can hinder the integration of new efficiency technologies; reductions in material input may result in less stability and cause defects to emerge earlier.

To identify and reconcile these conflicting aims, the product life cycle and the product system must be clearly defined and included in the analysis. This will enable the various strategies to be combined in the best possible way in all product life cycle phases, thus resulting in a successful overall concept. The correct priorities must be set where the greatest potentials for ecological and economic improvement lie, and an improvement in one phase must not be allowed to bring about any change for the worse either in other phases or in the system as a whole (trade-offs).

An account of these Ecodesign procedures will be found in Chapter 5.

TIP

Avoiding misapprehensions of ecology

A number of commonly held ideas about environmentally advantageous strategies must be subjected to critical examination: natural materials are not always necessarily more ecological than artificial man-made materials; local products are not necessarily more environmentally friendly than imported products, wood is not always better than plastic.

In many cases it will be necessary to carry out a close analysis of the product life cycle, the product system and the possible alternatives before the ecological and economic optimum can be identified.

5. Implementation at company level – From problem analysis to product design to effective communication

5.1 INTRODUCING ECODESIGN

In principle, companies pursue one of two approaches to Ecodesign: either "top-down" or "bottom-up". In the top-down approach, management makes the decision to implement Ecodesign and formulates the tasks of the various departments. In the bottom-up process, Ecodesign is triggered perhaps by employees in product development, or by customer demands made known to the sales department or aftersales service, resulting in suggestions addressed to management by one or the other department that the company should engage more in Ecodesign. Ideally, the two approaches should be interlinked: management should back up the Ecodesign approach, develop an overall Ecodesign philosophy together with the associated objectives, and allocate the necessary budgets. At the same time, all relevant units of the company should be involved and won over. They should also be given opportunities to initiate activities of their own.

Once the decision has been taken in favour of Ecodesign, the company's activities will usually comprise the following steps:

- Identify the ecological (and social) challenges in the company and throughout the life cycle of the goods or in the overall system (raw material sourcing, production, use, recycling or disposal)
- Define the objectives and opportunities, with an eye on the most urgent need for action
- Take measures to achieve the objectives:
  > assign responsibilities
  > initiate a pilot project
  > obtain the necessary information
  and resources
  > establish partnerships wherever expedient,
  for example with suppliers, customers,
  competitors or disposal companies
- Evaluate experience gained from the pilot project and the initial activities, draw up a systematic course of action and introduce a continuous improvement process
- Communicate successes inside and outside the company, motivate and train the staff
- Pursue further Ecodesign projects

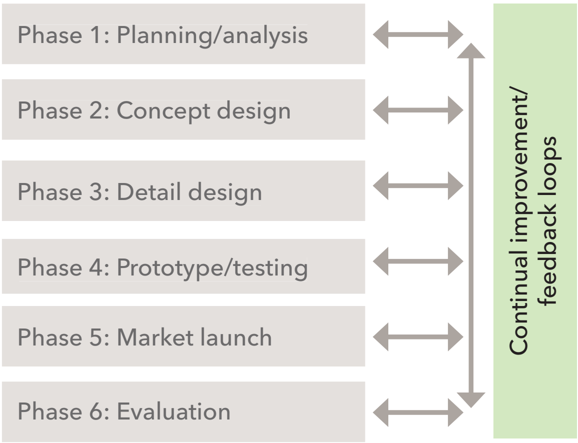
Companies with a high degree of vertical integration and low-complexity products can usually establish Ecodesign relatively quickly and easily. For companies with complex products and highly diversified production chains it would be advisable to adopt a pragmatic strategy and move towards Ecodesign in small steps.

It is desirable that the company's strategic planning level critically analyse their own offers from the ecological and social viewpoint and at the same time give consideration to ecological system innovations and service concepts. In addition, the relevant departments, such as product development, design and procurement, should work out possibilities for continuous ecological and social improvements in the existing product lines, with a view both to process optimisation and to sustainable re-designs.

The marketing department should also be involved in the Ecodesign activities. Experience in practice has shown that neglect of marketing is often a serious hindrance to the success of Ecodesign projects. If marketing experts are not called on at a sufficiently early stage, they might not be prepared to give the Ecodesign concept their full support or to communicate it adequately. Apart from this, market research is of fundamental importance.

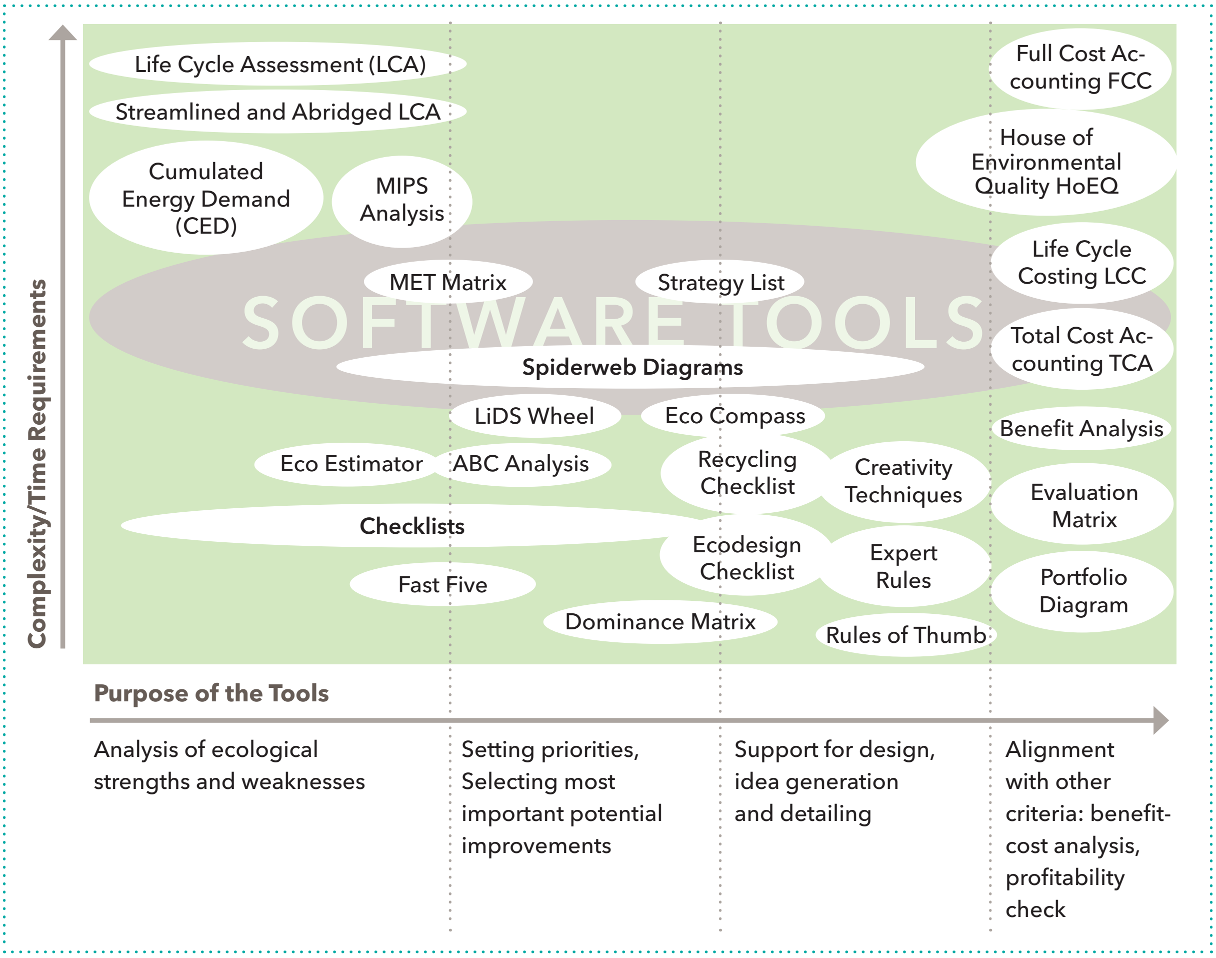
5.2 A TYPICAL ECODESIGN PROCESS

Figure 5: A typical Ecodesign process.
Source: Tischner, based on ISO TR 14062



The product development process shown here in a simplified diagram is typical of such processes, whether in greater or lesser detail or in a more or less formalised manner.[33] Ecodesign takes ecological aspects into account at each stage of this process, and for this purpose helpful tools are available. Figure 6 below shows a selection of such tools and the uses to which they can be put during the process. The more complex the tools, the higher they appear in the diagram; the simpler ones are located on the lower end.[34]

Figure 6: Helpful tools for Ecodesign, Source: Tischner et al. 2000



[33] Cf. DIN-Fachbericht ISO/TR 14062:2003: Umweltmanagement – Integration von Umweltaspekten in Produktdesign und -entwicklung; deutsche und englische Fassung ISO/TR 14062:2002 *[DIN technical report ISO/TR 14062:2003: Environmental management – Integrating environmental aspects into product design and development; German and English versions ISO/TR 14062:2002].*

[34] Cf. Tischner et al. (2000): Was ist Ecodesign, Birkhäuser, Basel, Boston.

Environmental design tools are generally found in the following four areas:

- Analysing ecological strengths and weaknesses
- Setting priorities, selecting the major potentials for improvement
- Implementation: support with design, identification of ideas, detailing of ideas
- Comparing against other important criteria: cost-benefit estimate, performance auditing prior to market launch

Many tools can be used in various phases of the Ecodesign process. For example, ecological strengths and weaknesses can be analysed equally for the initial situation in Phase 1, for alternative draft concepts in Phase 2, for prototypes in Phase 4, and for the completed product after market launch in Phase 6.

The following sections describe a normal Ecodesign procedure in combination with useful tools.

5.2.1 ECOLOGICAL ANALYSIS OF PRODUCTS AND SYSTEMS (PHASE 1)

This phase is concerned with identifying, quantifying and weighting environmentally harmful factors associated with a product, a product system, a service or a concept. This is carried out in more or less greater detail, depending on the availability of time, staff or budgets. In all cases, however, the whole life cycle of a product should be investigated, even if it is not always possible to carry out a full LCA with comprehensive quantitative surveys of all environmental impacts.

Life cycle assessments according to ISO 14040 and ISO 14044 comprise the following phases:

(1) Goal and scope definition

(2) Inventory analysis

(3) Impact assessment

(4) Interpretation.[35]

During the goal and scope definition phase, the first step is to define the purpose for which the life cycle assessment is to be used and which elements of the product system are to be analysed or where the limits of the system are to be set. A functional unit is then defined as the measure for environmental impacts, for example a use, one hour of use, one passenger kilometre or the like. Many of the results of the life cycle assessment will depend on these definitions, since, for example, differences in the limits drawn for a system can fade environmental impacts either in or out. If already existing life cycle assessments are to be compared with one another, the selected scope and the analysed environmental impacts will show whether the environmental impacts are really comparable. One pragmatic way for companies to deal with this is to concentrate mainly on the factors which can be influenced by the company and to fade out those which are outside the company's sphere of influence or are in any case the same for all product systems. A coffee machine manufacturer, for instance, could ignore the production of the coffee powder.

In the inventory analysis phase all inputs and outputs of the defined system are recorded. A survey is made of resource consumption (including water and energy use), emissions and waste. These are then set against the useful output (the product and its functional units).

The impact assessment finally assigns the inputs and outputs to various impact categories, for example contributions to the greenhouse effect or the ozone hole, the acidification of the soil, and human or environmental toxicity. The impact assessment results in a quantitative statement on the harmful environmental effects of the product in question. These are then ordered into a set of impact categories, which can be conclusively assessed in the interpretation phase and which indicate where action is most urgently needed for the analysed product system.[36]

[35] DIN EN ISO 14040:2009-11: Umweltmanagement – Ökobilanz – Grundsätze und Rahmenbedingungen (ISO 14040:2006); deutsche und englische Fassung EN ISO 14040:2006 *[Environmental management – Life cycle assessment - Principles and framework (ISO 14040:2006); German and English versions EN ISO 14040:2006]* / DIN EN ISO 14044:2006-10: Umweltmanagement Ökobilanz – Anforderungen und Anleitungen (ISO 14044:2006); Deutsche und englische Fassung EN ISO 14044:2006 *[Environmental management – Life cycle assessment - Requirements and guide-lines (ISO 14044:2006); German and English versions EN ISO 14044:2006].*

[36] Cf. also the life cycle assessment database of the Umweltbundesamt [The UBA] for LCAs which have already been drawn up: www.probas.umweltbundesamt.de/php/index.php and the following list of available software tools: http://eplca.jrc.ec.europa.eu/ResourceDirectory/faces/tools/toolList.xhtml

Other environmental analysis tools such as Material Input per Service Unit (MIPS)[37], Cumulative Energy Demand (CED)[38] or the carbon footprint[39] combine analysis and assessment in a single working step. In this case the assessment of the environmental impact is based directly on the assessment of individual environmentally relevant factors such as material or energy input, or carbon emissions.

Comparative analyses of different products must always be based on the same set of conditions. There is no point, for example, in comparing packages with different capacities, and evaluations of energy consumption must make allowance for the type of energy used: whether electricity or heat is obtained from renewable energy sources or from fossil fuels.

Analyses of a more qualitative nature can be carried out with Ecodesign checklists. These address the basic Ecodesign strategies and query ecologically relevant aspects over the entire product life cycle. An Ecodesign checklist of a rather general nature is shown below in Table 5 – more specific checklists can be used for particular industries or product types. Checklists can also be drawn up for particular aspects of Ecodesign, such as design for easy recycling.

EXAMPLE:
Focus on the use phase

The Kärcher scrubber-drier for industrial cleaning services causes the greatest environmental impact during the use phase by its consumption of energy and cleaning agents. For this reason it was designed in such a way as to offer the ecoefficiency mode as a default user interface.

The defined default setting automatically ensures that efficient use is made of resources and energy during operation. A system of nozzles enables the dirt container to be cleaned without excessive use of water. In addition, the number of parts was reduced by intelligent designing of the individual components, and fewer different types of material were used to make repair and recycling easier.

www.kaercher.de

Table 5: Ecodesign checklist. Source: Ursula Tischner

Raw material sourcing, raw material selection (suppliers)	**+ Good**	**o Medium**	**- Poor**
Origin of material:			
→ Raw material sourcing sustainable (certified/label)?			
→ Raw material sustainable (fulfils all the following criteria)?			
Semi-finished product manufacturing sustainable:			
→ Raw material sourcing sustainable (certified/label)?			
→ Chemical surface treatment sustainable, low-pollutant and durable?			
→ High proportion of recycled material?			
Manufacturing (own production)			
Product manufacturing:			
→ Material input minimised?			
→ Energy input minimised?			
→ Pollutant input avoided and safety precautions observed?			

[37] Cf. Wuppertal Institut, http://wupperinst.org/de/projekte/themen-online/mips/

[38] Cf. Öko-Institut e.V. *[Institute for Applied Ecology]*, www.oeko.de/service/kea/

[39] Cf. for example Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit *[Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety]* (BMU), Umweltbundesamt [The UBA], Öko-Institut e.V. *[Institute for Applied Ecology]* – Memorandum Product Carbon Footprint, www.bmu.de, 4 March 2011, and www.carbonfootprint.com/cfpstandard.html

➜ Emissions avoided and safety precautions observed?			
➜ Not readily separable material mixtures or coatings avoided?			
➜ Chemical surface treatment sustainable?			
➜ Preference given to nearby suppliers and upstream suppliers?			
Delivery/installation:			
➜ Amount of packaging minimised?			
➜ Transport distances optimised?			
Use/benefit (customer)			
➜ Design tailored to the target group?			
➜ Service offers prepared?			
➜ In the case of potentially durable goods, all of the following criteria:			
› Robustness, reliability, not susceptible to wear?			
› Repairability, maintainability?			
› Combinability, adaptability?			
› Variability, multifunctionality?			
› Multiple and shared use possible?			

➜ For consumables such as hygienic paper, disposable cutlery especially:			
› Recyclability/biodegradability?			
› Take-back obligation?			
› Pollutant-free?			
› Environmentally compatible disposal?			
➜ Product readily understandable for users?			
➜ Dirt-repellent, easy to clean?			
➜ Minimal material and energy input: during use, care and maintenance?			
➜ Low pollutant input/emission during use?			
Re-use/recycling (own facilities/recycling company)			
➜ Is there a product take-back guarantee?			
➜ Is there a recycling strategy?			
➜ Can the product be disassembled?			
➜ Can different materials be separated?			
➜ Low number of different materials?			
➜ Low material and energy consumption for re-use/recycling?			
Disposal in own facilities or by disposal company?			
➜ Compostability, fermentability (closing of natural cycles)?			
➜ Incineration characteristics (harmless surface treatment)?			
➜ Environmental impact as a result of disposal?			

Product analysis should also include disassembly studies to determine the time and cost expenditure for the disassembly and recycling of a product. It is often useful to set up a benchmarking programme in which a company's product can be systematically compared with competitor products from the ecological, functional and economic viewpoints.

Analyses of a more strategic nature can be carried out by the so-called SWOT analysis, which is concerned with the Strengths and Weaknesses of the existing (product) system or market and with the future Opportunities and Threats. The SWOT analysis, originally developed at Harvard University, was extended to include a number of dimensions for ecologically and socially relevant analyses, as shown in Figure 7.

The aim of the ecological analysis is to provide an informed overview of the ecological strengths and weaknesses of a company and its products and to identify the most urgent need for action, together with the most interesting opportunities for the new product development. This analysis serves as a basis for establishing targets, concrete criteria and requirements. It is rarely possible to cope with all environmental problems at once, and priorities have to be set. For this purpose, account must be taken of the most serious environmental impacts. It is also important to know what possibilities for change lie within the company's own sphere of influence, and during the course of further planning it will finally have to be asked where the greatest market potentials lie. The information obtained in this way will be included in the briefing or in the product requirements/functional specifications for the new product design.

EXAMPLE: Benchmarking LED lamps

During the course of development of its new LED lamps, Carus carried out a disassembly study in which normal LED lamps were taken apart and analysed in order to identify weaknesses and avoid them in the new design (see also p. 19).

www.carus-world.de

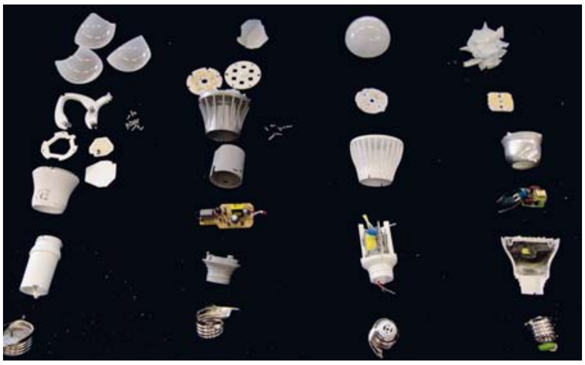


Figure 7: SWOT analysis for sustainability. Source: Ursula Tischner

SWOT	Current situation		Current situation	
	Strengths	Weaknesses	Opportunities	Threats
Environmental aspects				
Social/ethical aspects				
Economic aspects › for the company				
› for the customer				
Technological aspects				
Legislative aspects and the political framework				

EXAMPLE: Know-how transfer – packaging meets LED lamp

After analysing the status quo of commercially available LED lamps (mostly from the Asian region) Carus recognised a potential opportunity for the development of its new LED lamp by drawing on the know-how of its parent company in the area of cosmetics packaging and using it to design a radically improved LED lamp which could be produced at competitive costs in Germany.

www.carus-world.de

5.2.2 IDENTIFICATION AND DETAILING OF IDEAS, DESIGN (PHASES 2 AND 3)

Based on the analysis and requirements from Phase 1, ideas and concepts are developed in Phase 2 and followed up by much more detailed proposals for solutions in Phase 3. A variety of different paths are pursued here, depending on the complexity of the task: is the project concerned with a technical product involving a great deal of engineering, or with a relatively uncomplicated product calling for a great deal of design work?

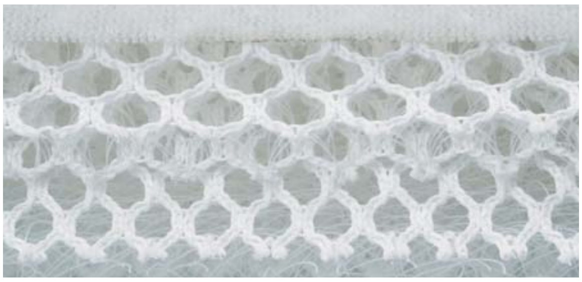
Tools for promoting creativity are useful, such as brainstorming or role play, which help to ensure that the viewpoints of various parties involved, for example customers, find their way into the design.

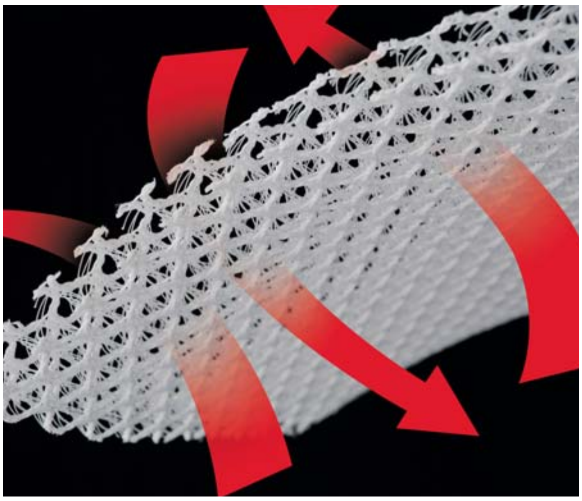
The biomimetic method is of particular interest for Ecodesign. It analyses the solutions developed by nature and transfers their underlying principles to technical or design-related problems. This is a way of devising extremely effective and ecologically intelligent solutions.[40]

EXAMPLE: Breathable fabric modelled on nature

Köhl GmbH has incorporated biomimetic discoveries in the development of the breathable mesh backrest AMR® for its Aureo swivel chair programme (see also p. 23). A three-dimensional fabric modelled on the respiration and moisture regulation of leaves was used instead of the conventional foam material. This results in a microclimate inside the backrest that has a temperature balancing effect. The material transports moisture and heat outwards and serves as a shield against outside cold.

www.koehl.com

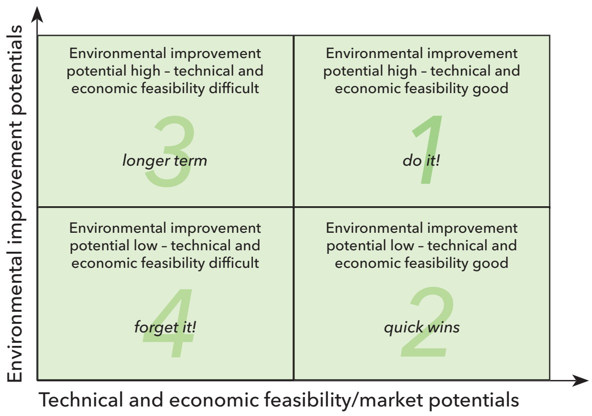




[40] Cf. for example www.bionik-hessen.de; www.asknature.org; Bionics Competence Network www.biokon.de; Nachtigall, Werner, Blüchel, Kurt G.: Das große Buch der Bionik. Neue Technologien nach dem Vorbild der Natur. DVA, Stuttgart and Munich 2000; Bionik im Betrieb – Vol. 20 in the Publication Series Hessen-Nanotech (www.hessen-nanotech.de)

If a whole series of promising ideas have been generated, it will be necessary to select the best. A useful aid here is the Ecodesign Portfolio chart. On two axes it categorises the environmental relief resulting from the new solution and also the anticipated market potential. All solutions are positioned in the portfolio according to whether environmental relief and market potential are high or low. Only the solutions placed in the top right quadrant should be followed up further.

Figure 8: Ecodesign Portfolio – portfolio chart for categorising and selecting ideas and solutions



Detailing of solutions can be done with Ecodesign checklists. These are quick and easy to use and provide a pragmatic basis for action. Here again the Ecodesign strategies in Chapter 4 play a key role. For example, aspects of energy and material consumption are to be taken into consideration, absence of pollutants targeted, and material and product cycles closed. At this point in the process, the criteria in the checklist serve as reminders not to forget important aspects during product development.

5.2.3 REVIEW OF THE NEW SOLUTIONS (PHASES 4 AND 6)

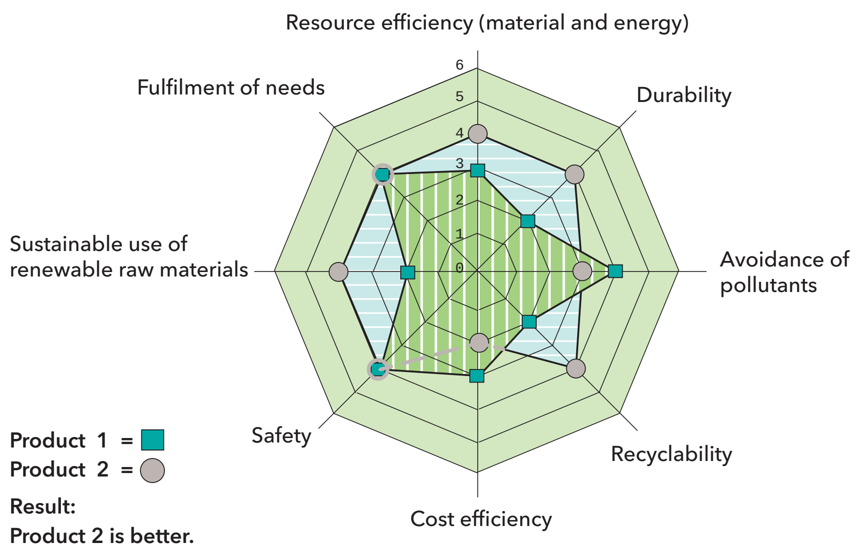
The new solutions have to be evaluated at various stages of the Ecodesign process, not only from the environmental angle but also with an eye to the other quality criteria, such as functionality, cost effectiveness, marketability and technical feasibility. Suitable tools here include environmental accounting, benefit analysis, House of Environmental Quality, evaluation matrices and portfolios.[41]

A highly practicable tool is the Ecodesign spider chart, which brings up to eight overarching evaluation criteria together in a single tool. The spider chart enables several solutions to be evaluated in comparison both with one another and with a reference situation, for example the situation at the start or the market average. Points are allotted under each individual criterion, ranging from 0 (poor) to 6 (good), and the scores on all axes are connected. The result is a quality profile of the solution under consideration. The solution with a profile reaching out furthest from the centre will be the best. The spider chart can be linked with the Ecodesign checklist by using the most important aspects in the checklist as evaluation criteria on the spider chart. Here an example of a stand-ard set of Ecodesign evaluation criteria for the spider chart:

(1) Cost effectiveness, (2) sensible use, (3) health and safety, (4) durability aspects, (5) material efficiency, (6) energy efficiency, (7) avoidance of pollutants, (8) avoidance of waste/recycling.

An example of this is given in the figure below.

Figure 9:
Ecodesign spiderweb diagram for two products.
Source: Ursula Tischner



41 Tischner et al. (2000): Was ist Ecodesign, Birkhäuser, Basel, Boston.

In the same way as with conventional product developments, the selected new solutions should be constructed as prototypes and presented to potential customers and relevant business units for testing. These tests should cover all relevant environmental aspects. Environmental departments, sales and in particular marketing should be involved at the earliest possible stage. At the end of this phase a thorough documentation of the new solution will have been drawn up for submission to the decisionmakers in the company. It is important here always to present the environmental advantages together with the economic and marketing potentials.

5.2.4 MARKET LAUNCH AND COMMUNICATION (PHASE 5)

After the development process has been successfully completed, planning can start for launching the new solution. Aspects of price policy, production planning, choice of suitable suppliers and in particular careful selection of distribution channels and communication strategies play a major role in this context. In Germany the environmental awareness among the general public has been fairly high for quite some time, but here, too, there are target groups and lifestyle groups which have greater interest in sustainable goods than others. Different target groups can have completely different reasons for choosing ecological or socially beneficial products, and often decide on different product categories. One target group of interest for Ecodesign is known as LOHAS.[42] This is a growing group of educated individuals with high purchasing power, often highly self-determined and creative, who consistently cultivate a “lifestyle of health and sustainability”. They would prefer to invest their often above-average income in things which make life more agreeable, more enjoyable and healthier and which are at the same time good for the social and natural environment. German market researchers have estimated that there are 12 million consumers in Germany and 49 million consumers in Europe as a whole who can be described as LOHAS.[43]

EXAMPLE – NEW CUSTOMER GROUPS
The Fairphone

The Fairphone started out as a project of the Waag Society, ActionAid and Schrijf-Schrijf in the Netherlands and is an example of a new approach to the development of sustainable products: a particular customer group is not simply addressed but motivated to participate actively – to become “doers”. In 2013, the project developed into the social enterprise Fairphone, the primary aim of which was to inspire the industry to tackle social and environmental issues in the supply chain. For the development of the smartphone and as part of a sustainable design, the supply chain in particular was organised and audited with a view to environmental and social criteria to avoid conflict materials. As a preliminary step, two out of more than 30 minerals were traced back to the mining stage, and more materials are due to follow. The development was financed by crowdfunding and advance orders from customers, in other words, the product was manufactured “on demand”. Repairability and recyclability were also important features in the Fairphone design.

www.fairphone.com

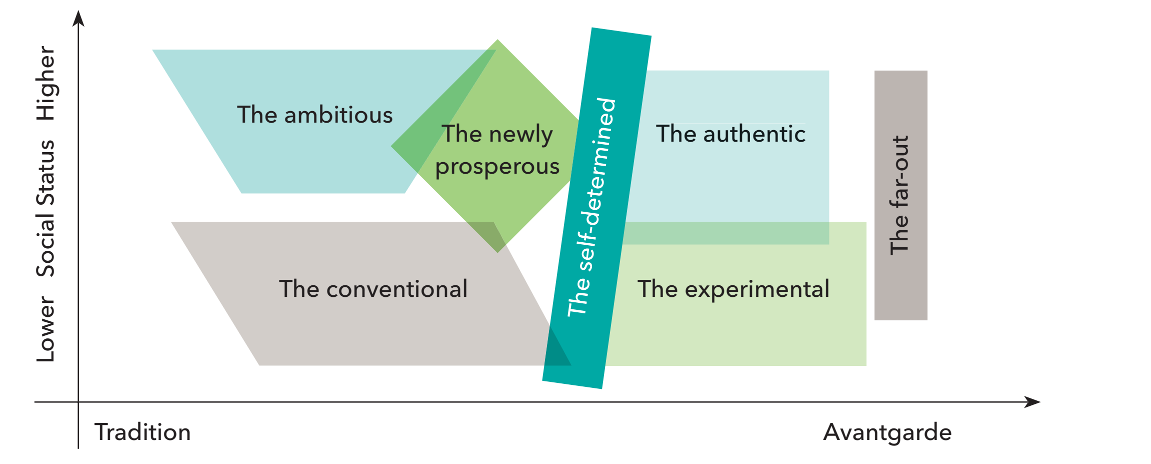
Another interesting target group is the so-called Millennials, who no longer learn to drive a car, go without TV, want to find enjoyment in their work and have a preference for vegan food.[44] Clichés of this kind help to define target groups more accurately and to devise suitable marketing strategies accordingly.

[42] Lifestyle of Health and Sustainability, cf. www.lohas.de or www.lohas.com

[43] Wenzel, Eike; Kirig, Anja; Rauch, Christian (2007): Zielgruppe LOHAS: Wie der grüne Lifestyle die Märkte erobert, Zukunftsinstitut. Cf. also the more critical study from stratum GmbH: Häusler, Richard; Kerns, Claudia (November 2008): LOHAS – Mythos und Wirklichkeit, stratum GmbH.

[44] Cf. for example Hurrelmann, Klaus; Albrecht, Erik: Die heimlichen Revolutionäre – Wie die Generation Y unsere Welt verändert. Verlag Beltz, Weinheim 2014.

Figure 10: Ecologically interested target groups in Germany by social status and personal value systems.
Source: ecobiente Project



Looked at in this light, the idea prevalent in the seventies and eighties that Ecodesign is all about "jute instead of plastic" and "isn't nature beautiful" is completely outdated. Nowadays, ecologically and socially sustainable goods are also "sexy, beautiful and cool" – and they do the job. Even today, however, scarcely any consumers are prepared to buy a product only because it is ecological. A good mix of attractive product features including an acceptable price, together with ecological and social features to provide extra benefit and to set them apart from the competition – these are the ingredients of successful Ecodesign.[45]

Sustainable product range design, choice of target group, communication and marketing concept – if these three elements are properly harmonised, sustainable goods can be highly successful on the market. And not only among LOHAS customers – they can also appeal to broader sections of the population, provided the particular qualities of sustainable products can be brought across in terms of customer advantage, such as energy saving (hence cost saving), health aspects and prestige, or wellness and personal fulfilment.

EXAMPLE: Baufritz widens its target group with the ecobiente project

Baufritz, a company in Erkheim (Allgäu region), extended its range of rather traditional-style wooden houses to include more modern versions, while maintaining the company's high ecological quality. The new house design and communication policies resulted in increased sales and a larger target group.

A typical Baufritz house before the project started, and a modern Baufritz house design which was consistently pursued afterwards.

www.baufritz.com

The wrong way – no greenwashing

Unfortunately, the increasing demand for ecologically and socially sensible products has led also to a great deal of "greenwashing" in communication campaigns. Companies build up a green image for themselves and their products which has little to do with reality. This, in turn, erodes the trustworthiness not only of these ill-advised companies but also of the sustainability movement as a whole. It is always better for companies, designers and the communication and marketing experts to "do good" first and talk about it afterwards.

TIP

[45] Tischner, Ursula et. al: ecobiente – Nachhaltige Güter erfolgreicher gestalten.

6. Conclusion – Green means Go!

Political requirements in the form of product take-back regulations or chemicals acts and customer requirements in the form of increased demand for ecological, healthy and fair products, taken together with global crises, all indicate that Ecodesign and design for sustainability are more profitable and successful than conventional product design and that, in the long term, this is the only kind of product design that has a future.

The examples and strategies shown above bring out clearly that there is no "right way" or "wrong way", but only a very great variety of ways to develop and manufacture ecologically intelligent products which are successful in the market – whether in the niche and mass markets, or in the field of investment goods.

To identify the ecological and economic levers or critical issues and come up with better solutions, it is essential always to keep an eye on the entire product life cycle. For some products it is the materials which are important, for others it would be advisable to give more thought to the use phase or to an intelligent product cycle concept. In this context, the current market situation and limiting factors such as the availability of resources, the infrastructure and the type of energy supply have a fundamental part to play. Ecodesign always means, among other things, good and functional design and calls for suitable communication and marketing strategies.

Success stories in various sectors, from renewable energy technologies, food, home technology and green technology to cosmetics and eco fashion, show that Ecodesign pays off. Particularly product lines which affect consumers personally, or which thanks to their efficiency can help to save costs, or which turn out to be interesting prestige items, have already become successful Ecodesign markets.

Media, policymakers, environmental and consumer associations contribute to this success by providing consumer information and trustworthy quality marks (ecolabels), by granting subsidies or by removing obstacles for suppliers of ecological products, and also by instituting ecologically oriented public procurement.

In the Service Section below are lists with many helpful information sources and organisations which can be of use for all those keen to make a start on Ecodesign or to develop it further.

7. Service section

The Service Section contains further information on matters concerned with Ecodesign, including legal texts, environmental awards, networks, software and research facilities.

Brief overview:

Opportunities to learn more about Ecodesign are offered by a large number of private companies, chambers of commerce, testing institutes and research facilities, some of which are listed below. Since the offers are subject to considerable variation, it is advisable to obtain information about current events directly from the listed networks and the institutions.

7.1 ECODESIGN STRATEGY MATRIX

ECODESIGN STRATEGIES IN THE VARIOUS PHASES OF A PRODUCT LIFE CYCLE					
Phases / Criteria	**Raw material sourcing, product manufacturing**	**Use**	**Upcycling, re-use, recycling**	**Disposal**	**Distribution in all phases**
Optimise material input, including avoidance of waste **Quantitative: amount of material/ Qualitative: type of material**	Reduce material input: lightweight construction, increase material efficiency in the production chain, reduce rejection rate, avoid production wastes, choose low-waste production methods and materials, bring production wastes back into production or return them for direct recycling, raw materials from nearby sources, renewable raw materials, readily and sufficiently available materials, secondary materials, correct sorting by type of production wastes, identify materials, standardise materials, avoid packaging.	Reduce material input for operation and maintenance, cut down material losses, minimise waste from use and from maintenance/repair. Choose renewable operating materials, use operating materials which are available in sufficient quantities, use secondary materials, design products which are as durable as possible and as suitable for re-use and further use as possible, avoid packaging.	Make provision for efficient material recycling, reduce material input in the recycling process, eliminate residual waste, opt for efficient upcycling, re-use and recycling rather than for disposal. Use recyclable materials, identify materials, keep materials correctly sorted by type, check material compatibility of multimaterial systems, standardise materials, make provision for high-quality material recycling, design products to be completely recyclable.	Preferably design zero-waste concepts so as to ensure that neither product nor components or materials need to be disposed of. Use readily disposable materials, reduce material input for disposal. Choose pollutant-free, compostable or combustible materials, identify materials, standardise materials.	Choose material-efficient means of transportation, avoid packaging, reduce pack sizes and adapt to means of transportation, optimise packaging design (the corresponding strategies for the other phases continue to apply). Choose a low-waste type of transportation, avoid packaging, use re-usable packaging systems, avoid transportation damage.
Optimise energy input **Quantitative: amount of energy/ Qualitative: type of energy**	Choose product variants requiring less energy for manufacture, increase the energy efficiency of the production chain, use low-energy materials. Improve energy management, choose efficient energy generation (e.g. cogeneration), recover energy, choose renewable energies.	Increase energy efficiency during use, reduce energy input for operation and maintenance, use low-energy operating resources. Choose renewable energies, recover energy.	Increase the energy efficiency of the recycling process, choose an energy-saving recycling process. In the product: keep the energy content of the product at as high a level as possible, give priority to direct re-use and further use. In the recycling process: use renewable energies, recover energy.	Increase the energy efficiency of the disposal process, choose an energy-saving or energy-generating disposal process. In the product: use materials which are suitable for energy generation, use the energy content of the product at as high a level as possible (biogas generation, waste to energy). In the disposal process: use renewable energies, recover energy.	Reduce transportation volume, increase transportation efficiency: reduce product weight, reduce product volume. Choose energy-efficient means of transportation, reduce pack sizes and adapt to means of transportation. Optimise packaging (the corresponding strategies of the first four phases continue to apply), optimise the logistics system, renewable fuels, energy recovery.
Minimise land use **Quantitative: size of surface area/ Qualitative: type of land use change**	Keep size of surface area needed for production plants and material sourcing as small as possible, optimise warehousing. Reduce degree of land sealing, cultivate land sustainably (agriculture, forestry), avoid depletion and overfertilisation of soils, avoid erosion and deforestation.	Keep size of surface area needed for use and maintenance as small as possible. Reduce degree of land sealing and soil erosion resulting from use. Avoid emissions of harmful substances into soils.	Keep size of surface area needed for recycling plants (collection, sorting, storage, recycling) as small as possible. Optimise storage of components and materials, reduce degree of land sealing. Avoid emissions of harmful substances into soils.	Keep size of surface area needed for disposal plants (collection, storage, disposal) as small as possible. Optimise storage, reduce degree of land sealing, avoid emissions of harmful substances into soils.	Reduce transportation volume, increase transportation efficiency. Avoid land-consuming types of transportation, avoid emissions of harmful substances into soils resulting from transportation.

Ecodesign Strategy Matrix, Ursula Tischner, econcept

ECODESIGN STRATEGIES IN THE VARIOUS PHASES OF A PRODUCT LIFE CYCLE

Phases / Criteria	Raw material sourcing, product manufacturing	Use	Upcycling, re-use, recycling	Disposal	Distribution in all phases
Minimise harmful substances and risks	Use low-pollutant materials, avoid harmful auxiliary materials, give priority to low-pollutant production processes, avoid harmful emissions during production. Prevent odour nuisance, reduce noise level, reduce electromagnetic radiation, prevent radioactive radiation. Ensure safety of plants and processes, minimise accident risks, pay attention to safe and healthy working conditions. Provide EHS training for employees.	Use low-pollutant materials during use and maintenance, avoid harmful operating materials, avoid harmful emissions. Prevent odour nuisance, reduce noise level, reduce electromagnetic radiation, prevent radioactive radiation. Ensure product safety, design products so as to be self-explanatory, provide product information.	Use low-pollutant materials in the product and the recycling process, and avoid harmful operating materials. Make depollution easier: identify harmful components and design them for easy separation. Choose low-emission recycling processes, use materials suitable for low-emission recycling. Reduce emissions, prevent odour nuisance, reduce noise level, prevent radioactive radiation. Ensure safety of plants and processes in recycling, minimise accident risks. Design products so as to be self-explanatory for recyclers, provide product information on safe recycling. Pay attention to safe and healthy working conditions.	Keep residual wastes as free of harmful substances as possible, make depollution easier, ensure separability of polluted material, e.g. siphoning engine oil. Choose low-emission disposal processes, use materials which can be composted, fermented, incinerated or landfilled with a minimum of emissions. Ensure safety of plants and processes during disposal, minimise accident risks, provide information on safe disposal. Pay attention to safe and healthy working conditions.	Choose means of transportation with low emissions and few harmful substances, reduce transportation volume, design packaging so as to be free of harmful substances. Choose safe means of transportation, design packaging to fit the specifications.
Maximise benefit	Design product for efficient use: increase product service life, take account of user requirements, ensure good functionality, create a timeless formal idiom and high quality, improve product robustness, design product so as to be easily maintained, design product so as to be easily repaired, construct product on a modular basis, allow for technical and formal upgrading, reduce amount of cleaning necessary, increase corrosion resistance.	Increase the product service life: analyse market and user behaviour, provide multifunctional product design, ensure functional flexibility, integrate self-regulation and self-optimisation, integrate error tolerance. Enhance service quality: analyse market and opportunities for service concepts, give priority to leasing, pooling and sharing concepts, etc., rather than to selling.	Recycle product at the highest possible level, plan cascade use, develop concepts for further use (mustard jar to drinking glass) or re-use (replacement engine), ensure product return (take-back systems), consider possibilities for changed use, construct product on a modular basis, design product so as to be easily repaired or dismantled, identify components, provide a guide to dismantling, establish a second-hand market, develop concepts for recycling (e.g. use of scrap glass), reclamation (e.g. crude oil from waste plastics), concentrate recyclables in the products, design product so as to be easily disassembled, identify materials, make easy material sorting possible, reduce number of different materials used, establish a secondary material market.	Allow for pollutant-free compostability, fermentability in biogas plants, incineration with energy recovery.	Build up a redistribution logistics system: combine delivery and collection of goods (new and old products).

7.2 FURTHER READING

Abele, E. et al. (eds.): EcoDesign – Von der Theorie in die Praxis *[EcoDesign - From Theory to Practice]*, Springer Verlag, Berlin 2007

Braungart, W./McDonough, M.: Die nächste industrielle Revolution: Die Cradle to Cradle-Community *[The Next Industrial Revolution: the Cradle to Cradle Community]*, Cep Europäische Verlagsanstalt, Hamburg, 2011

Brezet, H./van Hemel, C. (eds.): Ecodesign. A promising approach to sustainable production and consumption, UNEP, Paris 1997

Datschefski, E.: The Total Beauty of Sustainable Products, RotoVision, Crans-Pres-Celigny 2001

ecobiente consumer booklet and final report, downloadable at www.econcept.org/index.php?option=com_content&task=view&id=61&Itemid=44

Fuad-Luke, A.: Ecodesign – The Sourcebook, Chronicle Books, San Francisco 2010

Geerken, T./Borup, M. (eds.): System Innovation for Sustainability 2: Case Studies in Sustainable Consumption and Production – Mobility, Greenleaf Publishing, Sheffield 2008

Peters, S.: Materialrevolution and Materialrevolution 2 – (Neue) Nachhaltige und multifunktionale Materialien für Design und Architektur *[Material Revolution and Material Revolution 2 - (New) Sustainable and Multifunctional Materials for Design and Architecture]*, Birkhäuser Verlag, Basel 2011 and 2013

Schmidt-Bleek, F.: Wieviel Umwelt braucht der Mensch? – MIPS – Das Maß für ökologisches Wirtschaften, *[How much environment does Man need? - MIPS - the measure for ecological economic activity]* Birkhäuser Verlag, Basel 1994

Tischner, U. et al.: Was ist Ecodesign? Ein Handbuch für ökologische und ökonomische Gestaltung *[What is EcoDesign? A Manual for Ecological and Economic Design]*, Birkhäuser Verlag, Basel 2000 (new edition available from the UBA, autumn 2015)

Tukker A. et al. (eds.): System Innovation for Sustainability 1. Perspectives on Radical Changes to Sustainable Consumption and Production, Greenleaf Publishing, Sheffield 2008

Tukker, A./Tischner, U. (eds.): New Business for Old Europe. Product-Service Development, Competitiveness and Sustainability. Greenleaf, Sheffield 2006

Wimmer, W./Züst, R.: ECODESIGN Pilot: Produkt-Innovations-, Lern- und Optimierungs-Tool für umweltgerechte Produktgestaltung *[ECODESIGN Pilot: Product Innovation, Learning and Optimization Tool for Environmentally Sound Product Development]*, Verlag industrielle Organisation Zürich, 2001

7.3 INFORMATION ON REGULATIONS AND STANDARDS

Current environmental regulations can be found on the topic pages of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, also on the service pages of the Federal Ministry for Economic Affairs and Energy, and the pages of the UBA. See also under **7.10. Public authorities, p. 55**.

The EuP Network makes available all information on current developments, accompanying studies and legislative texts on issues related to the ErP Directive for all product groups. Newsletter providing regular information on the latest legislative amendments, important dates and new directives.
www.eup-network.de

REACH Helpdesk (REACH-CLP-Biozid Helpdesk). National information centre for producers, importers and users of chemical substances and biocides.
www.reach-clp-biozid-helpdesk.de

WEEE/RoHS and other information on EU regulations and policies (including sustainable procurement, environmental management, wastes) can be found on the environment pages of the EU Commission.
http://ec.europa.eu/environment/index_en.htm

ISO Standards
(International Organisation for Standardisation).
www.iso.org

VDI [Association of German Engineers] Standards
www.vdi.eu/engineering/vdi-standards

7.4 ECOLABELS

There are a large number of labels and quality marks, a selection of which is given below. Further information can be found, for example at www.globalecolabelling.net and www.label-online.de, also directly from the testing institutes themselves.

Other certifications for environmentally friendly products and production methods (selection)	
	Global Ecolabelling Network (GEN) – The Global Ecolabelling Network (GEN) is a non-profit association of third-party, environmental performance recognition, certification and labelling organisations founded in 1994 to improve, promote, and develop the eco-labelling of products and services. Only environmentally friendly products and services proven to have lower environmental impact may carry a GEN member ecolabel.
	Der Blaue Engel – The Blue Angel is the ecolabel of the Federal Government for protection of human beings and the environment. It is independent, and is awarded for products which possess special environmental advantages. For each product group there is a set of Basic Award Criteria stating the relevant requirements and compliance verifications (ISO Type 1 label) **www.blauer-engel.de/en**
	EU Ecolabel – The EU Ecolabel is recognised in all member states of the European Union, and also in Norway, Liechtenstein and Iceland. This voluntary label, which was introduced in 1992 in an EU Regulation (Regulation ECC 880/92), has increasingly become a reference for consumers who are interested in purchasing products that protect the environment. **www.ecolabel.eu**
	Nordic Ecolabel – The Nordic Ecolabel is the official label of the Nordic countries, established by the Nordic Council of Ministers with the purpose of providing an ecolabel scheme that would contribute to sustainable consumption. It is a voluntary environmental label for products and services (ISO Type 1 label). **www.nordic-ecolabel.org/about/**
	PEFC Certification – PEFC is a certification system which is recognised throughout the world and which provides complete certification of compliance with ISO standards. The PEFC quality mark stands for sustainable, careful and responsible forest management and guarantees the independence of the certification bodies. **www.pefc.org**
	FSC – The FSC logo signifies that a product complies with environmental and social standards and the requirements of sustainable forest management. It was the first international, globally recognised certificate for sustainable wood products (ISO Type 1 label). **www.ic.fsc.org**
	natureplus – The natureplus seal of quality is awarded to sustainable building materials which have been tested for health and environmental friendliness. **www.natureplus.org**
	Cradle to Cradle – The Cradle to Cradle concept is based on the closing of technical and biological cycles. The certification comprises an evaluation of all constituent materials, taking into account also production processes and development. Certification is awarded in gold, silver and bronze by independent third party organisations. **www.epea.com**

	TÜV SÜD awards several certification marks for Ecodesign, including certification of product life cycles to ISO 14040, a product carbon footprint (PCF) and the corporate carbon footprint for company-wide greenhouse gas emissions (CCF). **www.tuv-sud.com**
	TÜV Rheinland awards the Green Product Mark for consumer products. The test catalogue is based on known regulations relating to the environment and energy efficiency; its contents include requirements for recycling, carbon balance, use of recycled materials and responsible handling of chemical substances. Life cycle assessments, carbon footprints and water footprints are compiled and certified. **www.tuv.com**
Compiled quality marks and labels (selection)	
	HTV-Life® is a test mark for obsolescence which is granted by HTV GmbH. The mark of excellence is awarded for products which show no evidence of planned obsolescence. Products are carefully tested for electronic and mechanical breaking points; software, service, documentation and availability of spare parts are also evaluated. **www.htv-life.com**
	OFFI Label is a quality mark for environmentally compatible production of office products. The label is granted with a view to compliance not only with the legal requirements but also with the usual ISO Type 1 label criteria, including Blue Angel, EU Ecolabel, Green Seal, Nordic Ecolabel, FSC and certifications such as Cradle to Cradle. **www.offilabel.org/doku.php**
	The **Energy Star** (EU Energy Star since 2002) is a quality mark developed by the US EPA and awarded to electronic products complying with defined energy consumption criteria in use and during stand-by. **www.energystar.gov**
	Bluesign is a label which takes account of the ecological footprint in the value chain of textile products and shoes. **www.bluesign.com**

7.5 ASSOCIATIONS AND NETWORKS

Design	
Internationales Design Zentrum Berlin e. V. (IDZ) – The International Design Centre Berlin is an association for the promotion of design, and thus committed to the furthering of design quality and potentialities. It awards the Federal Ecodesign Award jointly with the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety and the UBA, and organises the Sustainable Design Forum (workshops, speakers), the project series BerliNordik **(www.berlinordik.com)** and Ecodesign exhibitions (including German Shades of Green). **www.idz.de/de/en**	**Hessendesign e. V.** offers advisory service on design, including sustainable design strategies. **www.hessendesign.de**
enec – european network of ecodesign centres – An alliance of European governmental or public institutions for the purpose of promoting Ecodesign activities in industry and politics. **www.ecodesign-centres.org**	**O2 globales Netzwerk** – International network for designers engaged in sustainable design. **www.o2.org**

DESIS Network – Design for Social Innovation and Sustainability – a network of design laboratories, design schools and design-oriented universities for the promotion and support of sustainable development. **www.desis-network.org**	**LeNs – the Learning Network on Sustainability** – A project for the development of teaching contents and teaching materials on "Design for Sustainability" focusing on product-service system innovation. **www.lens.polimi.it**
Sustainable Design Center e. V. (SDC) – SDC is an independent competence centre for all matters concerned with sustainable and ecologically intelligent design. **www.sustainable-design-center.de/en**	**Enterprise Europe Network Ecodesign network** – A network of five European projects to provide legal, strategic and practical Ecodesign support for small and mediumsized enterprises. **www.ecodesign-een.eu**
Designers Accord – International Network for Design – The network was created in 2007 to mainstream sustainability in the global creative community. **www.designersaccord.org**	**innonatives** – Open innovation and design platform for sustainable projects and projects with crowdfunding and online shop. **www.innonatives.com**
Ecocrowd – Crowdfunding platform for sustainable projects. **www.ecocrowd.de**	**Bionik-Netzwerk Hessen** – A network of companies, institutions and individuals for promoting applications, knowledge sharing and research in the field of biomimetics. An initiative of Hessen-Nanotech, Hessian Ministry of Economics. **www.bionik-hessen.de**

Sustainable product development, production and company management	
PIUS Internet Portal – The portal offers a comprehensive overview of the opportunities for cleaner production in various sectors, lists the relevant documents for these sectors, and provides links to expert networks. **www.pius-info.de**	**Bundesdeutscher Arbeitskreis für Umweltbewusstes Management e. V. (B.A.U.M. e. V.)** – Since 1984, economic, ecological and social issues have been dealt with by businesses for businesses. With well over 500 members, B.A.U.M. is today the largest company network for sustainable management in Europe. **www.baumev.de**
Collaborating Centre on Sustainable Consumption and Production (cscp) – The Centre provides scientific support with sustainable consumption and production for customers in the private and public sectors. **www.scp-centre.org**	**Umweltallianz Hessen** – The Hessen Environmental Alliance is a project of the government of Hessen to maintain Hessen's high environmental standard and also to improve the framework conditions for environmentally friendly economic development in Hessen. **www.umweltallianz.de**
VDMA Blue Competence – Blue Competence is a sustainability initiative of the German mechanical engineering industry with the aim of providing know-how and solutions. **www.bluecompetence.net/en**	**VDI Zentrum für Ressourceneffizienz** (ZRE) – The VDI Centre for Resource Efficiency is a cooperative project of the Federal Ministry for the Environment for the provision of expert advice, research, publications and training programmes on resource efficiency in companies and production processes. **www.ressource-deutschland.de**

7.6 RESEARCH AND TRAINING FACILITIES

Research	
Institut für Zukunftsstudien und Technologiebewertung (IZT) – The Institute for Future Studies and Technology Assessment is a non-profit research facility which runs projects including inter- and transdisciplinary future studies, sustainability design, technology assessment and early identification of opportunities and risks. **www.izt.de/en**	**ECOLOG Institut für sozial-ökologische Forschung und Bildung** – The Institute for Social-Ecological Research and Education was founded in 1991. Its activities are centred on Technology & Environment, Future & Development, and Communication & Education. **www.ecolog-institut.de**
Institut für Energie- und Umweltforschung Heidelberg (ifeu) – A non-profit environmental research institute, focussing primarily on life cycle assessments and sustainability research. **www.ifeu.de/english**	**Institut für ökologische Wirtschaftsforschung (IÖW)** – The Institute for Ecological Economy Research is a scientific institute in the field of practice-oriented sustainability research. It devises strategies and approaches for viable, long-term economic activity. **www.ioew.de/en**
Product-Life Institute – The institute concentrates primarily on practical strategies and approaches for creating greater real prosperity, economic growth and more qualified jobs with substantially reduced consumption of resources. **www.product-life.org**	**Institut für sozial-ökologische Forschung (ISOE)** – – The independent Institute for Social-Ecological Research focuses on sustainability research. Its research fields include mobility, consumer research and water infrastructure. **www.isoe.de/en**
Fraunhofer-Projektgruppe IWKS – The Fraunhofer Project Group for Materials Recycling and Resource Strategies offers projects and research in recycling and re-usable materials cycles, substitution and resource strategies across the entire value chain. **www.iwks.fraunhofer.de/en**	**Öko-Institut e. V.** – The Institute for Applied Ecology is an independent research and consultancy institute. Founded in 1977, it develops principles and strategies not only for systems but also at product level, based, for example, on life cycle assessments and sustainability ratings. **www.oeko.de/en**
Wuppertal Institut für Klima, Umwelt und Energie – Since its foundation in 1991, the Wuppertal Institute for Environment, Climate and Energy has developed strategies, models and tools for sustainable development, including the measurement method MIPS Material Input per Service Unit. **www.wupperinst.org/en**	**The Centre for Sustainable Design (CfSD)** – The CfSD is a competence centre for the sustainable design of products and systems. Its activities comprise research, events, education, training, networks and information. **www.cfsd.org.uk**
Environmental Protection Encouragement Agency (EPEA) – As a scientific research and consultancy institute, EPEA optimises the quality and use value of materials, products and services with the aid of the ecologically effective "cradle to cradle" design concept. **www.epea.com**	**Fraunhofer UMSICHT** – The Institute for Environmental, Safety and Energy Technology specialises among other things in the development of bio-based plastics, sustainable technical processes and innovative products. **www.umsicht.fraunhofer.de/en**
Fraunhofer-Institut für Produktionstechnik und Automatisierung (IPA) – The Institute for Manufacturing Engineering and Automation is active in the field of sustainable production and quality. It offers seminars on Design for Environment and on environmentally friendly product and process development. **www.ipa.fraunhofer.de/en**	**Fraunhofer-Institut für System- und Innovationsforschung (ISI)** – The research activities of the Institute for Systems and Innovation Research are carried out partly in various Competence Centres under the headings Emerging Technologies, Sustainability and Infrastructure Systems, and Energy Technology and Energy Systems. **www.isi.fraunhofer.de/en**
Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration (IZM) – The Fraunhofer Institute for Reliability and Microintegration specialises in industry-oriented applied research. Its Department of Environmental & Reliability Engineering also focuses on the Ecodesigning of electronic products. **www.izm.fraunhofer.de/en**	

Training	
ecosign/Akademie für Gestaltung – Private academy for design in Cologne focusing mainly on sustainable design. **www.ecosign.net**	**TU Berlin – Institut für Technischen Umweltschutz** – The Department of Environmental Technology offers courses in environmental technology and sustainable engineering. **www.itu.tu-berlin.de**
Köln International School of Design (KISD) – The KISD in Cologne offers courses in ecology and design. **www.kisd.de/en**	**Friedrich Alexander University Erlangen-Nürnberg – Institute of Polymer Technology** – The main areas of research comprise additive manufacturing (3D printing), construction and joining technology, forming and polymers in mechatronics, recycling-oriented development and design. **www.lkt.techfak.uni-erlangen.org**

7.7 FUNDING OPPORTUNITIES

HESSEN

HA Hessen Agentur GmbH und Hessen Trade & Invest GmbH – HA Hessen Agentur GmbH and its subsidiary Hessen Trade & Invest GmbH act as Hessen's business developers. They implement projects, campaigns and funding activities, and provide advice and networking for stakeholders in business and science.
www.hessen-agentur.de, www.htai.de

Hessen ModellProjekte – is a programme for the funding of applied research and development projects, intended for small or medium-sized enterprises, research facilities and universities in Hessen. Sustainable innovations are funded within the framework of LOEWE (Hessen's programme for the development of scientific and economic excellence) and the SME model and pilot projects.
www.innovationsfoerderung-hessen.de

Geschäftsstelle Kultur- und Kreativwirtschaft Hessen – is an information and contact office set up by Hessen Agentur for Hessen's creative industry. The platform provides networking and funding opportunities with the aim of promoting Hessen's creative sector and exploiting synergies in the development of innovations.
www.kulturwirtschaft-hessen.de

WIBank Hessen – The bank for economic and infrastructure development provides funding programmes in particular for small and medium-sized enterprises, for activities such as research, development, innovation and knowledge and technology transfer.
https://www.wibank.de/wibank/gruender-unternehmen/foerderprogramme

GERMANY

Förderdatenbank – The Federal Government uses the national funding database to provide a comprehensive, up-to-date overview of the relevant funding programmes of the Federal Authorities, the Federal States and the European Union.
www.foerderdatenbank.de

Forschung für nachhaltige Entwicklungen (FONA) – With its Research for Sustainable Development programme, the Federal Government supports the financing of ground-breaking research at international level in the fields of climate, energy and resources.
www.fona.de/en

Deutsche Bundesstiftung Umwelt (DBU) – The German Federal Environmental Foundation funds exemplary innovative projects for environmental protection in the areas of environmental technology, environmental research and environmental communication.
www.dbu.de/2535.html

KfW Group – environmental programmes – Sustainability is a priority business objective of the KfW Group. With its motto "Responsible Banking", it promotes environmental and climate protection worldwide. Investments in sustainable measures are supported by various funding products in the areas of energy, environment and innovations, for example the ERP innovation programme for the development of new products and processes. www.kfw.de/kfw.de-2.html

Fachagentur Nachwachsende Rohstoffe e. V. FNR – The Specialist Agency for Renewable Resources provides information and funding for various issues concerning renewable raw materials. Funding focuses mainly on technologies and applications for renewable materials and the use of bio-based materials in products. www.international.fnr.de

KMU-innovativ – SME funding initiative of the Federal Ministry of Education and Research (BMBF) for the technology fields of resource and energy efficiency, etc. www.bmbf.de/de/kmu-innovativ-561.html

PIUS (Produktionsintegrierter Umweltschutz) initiative on cleaner production – PIUS gives a broad overview of funds available from the Federal authorities, the Federal States and the EU.
www.pius-info.de/de/aktuelles/foerdermoeglichkeiten/index.html

ZIM (Central Innovation Programme for SMEs) – is a funding programme open to all branches and technological sectors throughout Germany; in 2015 the guidelines for project calls were redefined to include small and medium-sized enterprises. Funding is possible equally for individual R&D projects and for co-operative projects with other companies or with research facilities.
www.zim-bmwi.de/zim-overview

UBA – Environmental Research Plan – Every year the UBA announces calls for research projects on environmental topics, including efficient and sustainable product development. www.umweltbundesamt.de

Rentenbank – With its "Sustainability" funding programme, the Rentenbank promotes innovative ideas and products for agribusiness.
www.rentenbank.de/cms/beitrag/10012823/289983

EU FUNDING PROGRAMMES

Enterprise Europe Network Hessen – In Hessen, the Enterprise Europe Network Hessen offers assistance for companies with questions concerning all aspects of EU funding programmes. It informs about current project calls, arranges joint research collaborations and provides support with application procedures. www.een-hessen.de/english.html

LIFE Programme – LIFE is the funding instrument of the European Union for nature, climate and environment protection projects throughout the EU.
http://ec.europa.eu/environment/life

Horizon 2020 – Horizon 2020 is the EU Framework Programme for Research and Innovation. Ideas for Ecodesign research can be submitted on specific thematic areas (e.g. transport, water, etc.) in response to various project calls.
http://ec.europa.eu/programmes/horizon2020/en

COSME – COSME is the EU programme for the competitiveness of small and medium-sized enterprises (SMEs).
http://ec.europa.eu/growth/smes/cosme

7.8 ENVIRONMENTAL AND ECODESIGN AWARDS

Deutscher Nachhaltigkeitspreis – The German Sustainability Award is presented for pioneering ideas and exemplary initiatives and is intended for companies, researchers, builders and architects.
www.nachhaltigkeitspreis.de

Bundespreis EcoDesign – The German Federal Ecodesign Award is granted by the Federal Ministry for the Environment and the UBA. It is awarded for products, services and concepts with convincing quality in terms of ecology and design.
www.bundespreis-ecodesign.de/en

GreenTec Awards – The GreenTec Awards were initiated in 2008. Some of the nominations are made on the basis of online voting. The awards are granted for environmental technologies in various areas, research projects, innovations and ecological commitment. www.greentec-awards.com/en/greentec-awards.html

Deutscher Verpackungspreis – The German Packaging Award under the auspices of the Federal Ministry for Economic Affairs and Energy is the most renowned packaging prize in Europe. It is presented publicly once a year for the best and most innovative developments in packaging. An independent jury made up of experts from research institutes, universities, industry and the trade press select the winners in five categories. The jury looks for solutions across all materials and sectors which help to improve packaging. www.packagingaward.de

Kyocera Environmental Award – This awards has been granted since 2011 to companies in Germany and Austria developing green technologies and products. Award categories include working environment and offices, climate, energy, mobility and transport. www.kyocera-umweltpreis.de

nawi Award – The nawi Award was established in 2012 and is a mark of distinction intended primarily for the furtherance of medium-sized or family-owned companies engaged in sustainable business activities. The winners are selected by an independent jury under various categories such as SMEs, products, projects, ideas and start-ups.
www.nawi.muveo.de

iF Design Award – The iF Design Award was established in 1953 and is awarded for special achievements in creation and design. The award goes to products in many areas (consumer goods, medical engineering, industrial products). The evaluation criteria include environmental compatibility.
www.ifworlddesignguide.com

Red Dot Design Award – The Red Dot Design Award is granted to products from 31 different product categories. Award criteria include durability, environmental compatibility and product periphery.
http://en.red-dot.org

Rat für Formgebung – German Design Council – Awards will go to products and projects from product and communication design, to outstanding designers and newcomers, all of whom are pioneering in the German and international design landscape. The evaluation criteria include operability, ergonomics and innovation. Products should also possess high environmental compatibility and quality.
www.german-design-council.de/en/design-awards.html

B.A.U.M.-Umweltpreis – The environmental prize of the German Environmental Management Association (B.A.U.M.) is awarded to dedicated citizens and to entrepreneurs who have committed themselves in their company activities to environmental concerns.
www.baumev.de/Auszeichnung.html

7.9 PRACTICAL AIDS

LCA SOFTWARE AND ECODESIGN TOOLS

SimaPro – SimaPro is an LCA software developed by the Dutch company Pré. In addition to the SimaPro software Pré produces other tools for supporting Ecodesign (e.g. Ecoit). There is also an international partner network of LCA experts who serve as local contacts. Since 2008, Green-Delta has been the partner company for Germany and undertakes consultancy, sales, support and training for customers in Germany.
www.simapro.de

GaBi – GaBi, developed and distributed by Thinkstep, offers a great variety of LCA tools (software and databases) for determining product carbon footprints, EPDs, energy and resource efficiency, product environmental footprints and water footprints. Thinkstep also offers support to companies in their Ecodesign processes.
www.gabi-software.com/international/index/

Umberto – Umberto is a program developed and distributed by ifu hamburg for generating company and product specific LCAs and material flow analyses. Umberto offers a variety of products, e.g. for calculating carbon footprints, or focussing on resource efficiency.
www.umberto.de/en/

Sustainable Minds – Sustainable Minds is a software for Ecodesign and LCA (in English) based on ISO 14040. In addition to the LCA software, Sustainable Minds offers companies support in the Ecodesign process together with so-called Transparency Reports (compare with EPDs).
www.sustainableminds.com

Open LCA – is an open-source LCA which was developed within the framework of a research project and which can be used with the usual LCA databases such as ecoinvent and the European Life Cycle Database.
www.openlca.org

European Platform on Life Cycle Assessment – Data and handbooks on the preparation of LCAs.
http://eplca.jrc.ec.europa.eu

Jump-Tool – Guidance tool from the Effizienz-Agentur in North Rhine-Westphalia for optimising the product development process in terms of environmental friendliness and Ecodesign.
www.ressourceneffizienz.de

Ecolizer 2.0 – Various Ecodesign tools: OVAM SIS toolkit, Ecolizer – choice of materials with Eco-Indicator 99 scores (Ecolizer 2.0), OVAM (Public Waste Agency of Flanders).
www.ecodesignlink.be/en

MATERIALS DATABASES

Materio – Information Centre for Materials and Innovative Products in Paris (since 2001).
www.materio.com

raumPROBE – Materials agency with materials database (incl. cost-free materials database).
www.raumprobe.de

Materia – Knowledge centre for materials, cost-free materials database, innovative materials for design and architecture.
www.materia.nl

MaterialConnexion – Consultancy, database and library for innovative and sustainable materials (incl. Cradle to Cradle).
www.materialconnexion.com

Stylepark – Information platform for architecture and design, with materials database.
www.stylepark.com

Materialarchiv – Swiss materials database for materials used in architecture, art and design (together with a material archive).
www.materialarchiv.ch

Biowerkstoffe – Information portal of the Specialist Agency for Renewable Resources on bio-based products, plastics and composites.
www.biowerkstoffe.fnr.de

Materialsgate – Database and information portal for innovative and sustainable materials, surfaces and production methods.
www.materialsgate.de/en

7.10 PUBLIC AUTHORITIES

Hessisches Ministerium für Umwelt, Klimaschutz, Landwirtschaft und Verbraucherschutz
[Hessian Ministry of the Environment, Climate Protection, Agriculture and Consumer Protection]
www.umweltministerium.hessen.de

Hessisches Ministerium für Wirtschaft, Energie, Verkehr und Landesentwicklung
[Ministry of Economics, Energy, Transport and Regional Development, State of Hessen]
www.wirtschaft.hessen.de

Hessisches Landesamt für Umwelt und Geologie (HLUG)
[Hessian Agency for the Environment and Geology]
www.hlug.de

Umweltbundesamt (UBA)
[The UBA]
www.umweltbundesamt.de/en

Bundesamt für Umwelt, Naturschutz, Bau und Reaktorsicherheit (BMUB)
[Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety]
www.bmub.bund.de/en

Bundesministerium für Wirtschaft und Energie (BMWi)
[Federal Ministry for Economic Affairs and Energy]
www.bmwi.de/en

Bundesministerium für Bildung und Forschung (BMBF)
[Federal Ministry of Education and Research]
www.bmbf.de/en

7.11 HESSEN-UMWELTTECH AND HESSEN-PIUS

Hessen-Umwelttech (Environmental Technologies) is the central platform set up by Hessen Trade & Invest GmbH for the environmental technology sector. It strengthens the competitiveness and innovative power of Hessian producers and service providers in the field of environmental technology and acts as an interface to the users of environmental technology – particularly with a view to resource efficiency and cleaner production ("production-integrated environmental protection", known as PIUS).

Hessen-Umwelttech provides information, communication options and cooperation opportunities for providers and users of environmental technology, for example in the areas of waste technology, water and waste water technology and energy technology. It serves in an advisory capacity for companies, promotes technology transfer, and makes Hessen's competences in environmental technology better known.

The following services are available to companies from Hessen-Umwelttech:

- **Up to date** industry sector information in the hard copy newsletter Hessen-Umwelttech NEWS and in the e-mail NEWS Hessen-Umwelttech
- **Information brochures and guidelines** on specific topics
- **Congresses and workshops** for exchanging information and establishing contacts
- **Participation at exhibition** stands organised by Hessen-Umwelttech
- **Hessen-PIUS:** Arranging for information sharing and publicly sponsored advisory services on cleaner production in Hessen
- **Support with foreign trade activities** for environmental technology companies in collaboration with national export initiatives
- **Central contact agency** offering „piloting" services for all matters connected with environmental technology

Hessen Trade & Invest (HTAI) GmbH is the economic development company of the State of Hessen and is responsible for implementing Hessen Umwelttech. HTAI aims to further develop Hessen sustainably as an economic and technology location and to consolidate and strengthen its competitiveness. The project is funded by the Ministry of Economics, Energy, Transport and Regional Development, State of Hessen, and co-financed by the European Union.
Hessen-Umwelttech is the central contact agency for all matters connected with environmental technology and in its "piloting" function cooperates closely with various facilities including

- Hessen ModellProjekte
- Förderberatung Hessen (Funding Consulting)
- Contact point in Hessen for the "Enterprise Europe Network"
- Transfer agency for climate protection and emissions trading in Hessen
- Hydrogen and Fuel Cell Initiative Hessen
- National export initiatives in the area of environmental technologies

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Hessen-PIUS: Protect the environment – cut the costs

It is becoming increasingly important for companies to make economical use of their resources. Cleaner Production or, to use the German terminology, “Produktionsintegrierter Umweltschutz” (PIUS) is an effective tool for this purpose and opens up interesting opportunities for both suppliers and users of environmental technology. For this reason, a PIUS consultancy programme for small and medium-sized enterprises in Hessen has been started by the Federal Ministry of Economics. The aim is to achieve efficient handling of resources such as energy, water and air, raw materials, auxiliary and operating materials by optimising in-house processes, subsequently saving costs. The PIUS consultancy programme is implemented by RKW Hessen GmbH.

Hessen-Umwelttech coordinates all further activities in connection with Hessen-PIUS. Since 2008 it has been one of the partners of the PIUS portal www.pius-info.de, with 25,000 individual accesses per month the most frequently visited PIUS portal in Germany. The PIUS portal is operated and funded jointly with the Effizienz-Agentur NRW (EFA) in Duisburg, the Sonderabfall-Management-Gesellschaft Rheinland-Pfalz mbH (SAM) in Mainz and the VDI Zentrum Ressourceneffizienz (ZRE).

Consultancy funding:

Financial assistance made available by the Hessian Ministry of Economics and the European Regional Development Fund for a PIUS consultancy can amount to 8,000 € per SME (9,000 € in ERDF priority areas) over a period of 3 years. The programme does not only cover the improvement of production processes but also points out opportunities for environmentally friendly and efficient organisation of service and commercial enterprises.

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Bau-Fritz GmbH & Co. KG
www.baufritz.com

Biowert Industrie GmbH
www.biowert.de

CAPAROL
Farben Lacke Bautenschutz GmbH
www.caparol.de

Carus GmbH & Co. KG
www.carus-world.de

EDAG Engineering AG
www.edag.de/edag.html

ESE GmbH
www.ese.com

e³ computing GmbH
www.e3c.eu

Fairphone
www.fairphone.com

Alfred Kärcher Vertriebs-GmbH
www.kaercher.com

Köhl GmbH
www.koehl.com

Lässig GmbH
www.laessig-fashion.de

MEWA Textil-Service
AG & Co. Management OHG
www.mewa.de

Swiss Innovation Products GmbH
www.mycoffeestar.com

myVALE
c/o Schott Orthopädie
– Schuhtechnik GmbH & Co. KG
www.my-vale-shop.de

PUBLICATION SERIES

of Hessen-Umwelttech
Ministry of Economics, Energy, Transport and Regional Development, State of Hessen

Vol. 1 (in German and English)
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Uses of Nanotechnology in Environmental Technology in Hessen // Innovation Potentials for Companies

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Kompetenzatlas Erneuerbare Energien in Hessen
Competence Atlas Renewable Energies in Hessen

Information/Downloads/Orders: www.hessen-umwelttech.de

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