An Introduction to EcoDesign Strategies – Why, what and how?

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The basic idea of eco-design is the reduction of environmental impacts throughout entire product life cycles by improved product design. Two initial key questions in relation to this are: Why is "the environment" a relevant topic, and, of particular interest to companies? And; what is the philosophy behind the legislative activities of, for example, the European Union? Once it is understood, why the environment is a significant and relevant topic, companies are then better able to deal pro-actively with the requirements coming not only from the legislators, but also business and private customers, the market, and other stakeholders. In addition, those companies that have a strategic and pro-active approach to eco-design are likely to open the door to creative innovation.

Why is the Electric and Electronics Sector in the Focus?

The electronics industry is a major component of the European economy and small and medium sized enterprises (SMEs) in this sector are an outstanding driver of innovation and new product ideas. However, this success story is at the same time linked to certain environmental concerns. For example, home and office appliances consume more than 25% of final electricity use, and domestic lighting is responsible for 17% of all residential energy use, with a high proportion of this energy going on wasted heat rather than light generation. In addition, the high innovation, development and availability of electronic products means that many such products are now associated with the throw-away society. When an electronic product is placed on sale it is likely that it has been made from a variety of globally sourced and manufactured parts, which perhaps have already travelled several times around the world. The complexity of electrical and electronic devices means they contain a large variety of materials, some very specific to electronics, some known as hazardous for humans and the environment. All these are reasons, why the electronics industry has an important role to play when environmental protection is on the agenda.

Let's turn the light on the "green" benefits of electronics as there are great opportunities to make electronics a pacemaker of sustainable development. Miniaturisation means less material per function, more information concentrated in less "physical" product, creation of a global village by the internet – offering education, equality of chances, and means of participation for many people on the globe –, more efficiency through smart automation of processes and machines, just to give a few examples. But, before addressing "green" products, it is important to have a common understanding of what the "environment" is...

The "Environment"

When the environment and potentials hazards to it are discussed, global warming might be the most pressing issue currently, but there are many more aspects, e.g., the depletion of raw materials and amount of water consumption. Water consumption is not a major problem in many European locations, but is a key issue in many regions where electronics component manufacturing is located: Water pollution through toxic constituents and eutrophication aggravate the problem. Exhaust emissions causing photochemical smog, acid rain and transmission of toxic substances are also issues in some regions. Further aspects include noise, odour, and radiation. All these impacts occur during a product's life cycle, maybe even several times. A company might only be involved in a specific single step within the general product's life cycle of raw materials acquisition, component production, product assembly, distribution and retail, product use, (optional) refurbishment and reuse, and final disposal (or materials recycling) at the end-of-life. However, the relationship between upstream suppliers and downstream customers, consumers, and potential recyclers means that individual companies have an (indirect) influence on – and a responsibility for – the environmental impacts throughout the entire life cycle.

EcoDesign is a Question of Business Success

Environmental consciousness is linked to creativity and innovations. Following and adhering to legislation may result in compliance, which is positive, but also a degree of bureaucracy with little added value. Discovering the business benefits associated with a green product strategy can be the first step towards developing a more pro-active strategy, and thus evolving from a passive, reactive approach.

Environmental consciousness is also about creating a positive brand image, being visible on the market. Supplier selection of major OEMs now frequently considers the environmental profile of a supplier. With some consumers, who are conscious for environmental protection and maybe even realize that green products in most cases are more efficient than others, “green sells better”. Numerous Eco-labels are in place to certify and communicate the outstanding environmental properties of products to consumers. Besides their often greater efficiency, eco-designed products also increase customer safety, are more reliable and of better quality. Frequently, environmental strategies are said to be too costly for companies, but in many cases eco-design facilitates cost savings. For example, reduction of material consumption and wastage in production and the manufacture of products with less energy consumption are direct benefits to the manufacturer, not forgetting related internal risk reduction and employee motivation. Following an eco-design strategy is also about developing innovations to keep products up-to-date and increase their efficiency. And last but not least eco-design also represents a pro-active approach towards legal compliance.

The Business Case: Better Energy Systems

The UK based company Better Energy Systems (BES) is a good example for promoting “green” in conjunction with an innovative product concept. BES claims to be a leading manufacturer of portable renewable energy products: “We are committed to using the most effective means to develop and distribute environmentally conscious products to the global economy. […] Through our work we aim to educate the consumer on the functionality and profitability of environmentally designed products.” In contradiction to the frequently heard argument “the customer does not ask for green products” BES follows an assertive strategy to educate the consumer about environmental aspects of their first product, a solar charger for mobile devices. The design of this solar charger combines aesthetic appeal with being a "green" product and was awarded the Macworld Best of Show Award 2005. Energy and toxicity assessment of the product was undertaken during the design phase to check and optimize the environmental performance.

The main messages from this business case are: Green products can be aesthetically designed products and tell your story to the world – creating a unique brand image!

Private consumers are a major driver for eco-design as global awareness of environmental problems has increased. With certain regional differences, pollution prevention is recognized as a major task. Hence, an image of being eco-friendly is appreciated by many.

There are a large number of eco-labels established in different countries, for different product groups. By the end of 2002 approximately 10,000 products bore one of the European national or regional eco-labels, or the EU-flower. In Germany in 2004 about 83% of consumers agreed that they knew the German Blue Angel label. Thereof, 49% said, that the Blue Angel is important for their purchase decision. Eco-labels are not only important to private consumers, but are also implemented in decision criteria for a large sector of public procurement, where the environmental properties of products in general also play a major role. Price, functionality, and service are at the top in purchasing decisions –however, “green” might be the one additional argument that favours a certain product. Asked if they are willing to pay more for environmentally benign products, 10% of German consumers answered “definitely yes”, another 53% are willing to pay more, according to a study by the German Federal Environmental Agency. This does not mean that eco-designed products are necessarily more expensive, indeed they could be cheaper, especially when considering life cycle costs.

An initial approach towards eco-design can start just by thinking about manufacturing costs of products. How much of your product costs are related to raw materials, auxiliaries, water and energy consumption? It’s difficult to identify these numbers throughout the whole supply chain, but for example, for printed circuit board manufacturers about 20-40% of total manufacturing costs relate to materials and energy use. Minimizing the material throughput per product unit reduces costs and makes the product "greener". Less use of process chemicals and less variety means also less internal logistics. Avoiding hazardous substances within products can reduce handling costs, smaller products mean less packaging, and using recycled materials might be cheaper. Simple, easy to assemble products will reduce assembly costs and also make disassembly for reuse, repair or recycling easier.

Industrial customers are a further important driver for eco-design; especially the global players with environmental policies can have a major impact on their suppliers. As a minimum, they request that suppliers utilize environmental management principles to a certain degree. Also, the material break-down of supplied products is frequently requested, with different levels of detail ranging from substance watch-lists to full material declarations. Therefore, being a "green supplier" can be a decisive argument to be chosen at all as a supplier.

Another business benefit of eco-design is a changed perspective on the product. Product design considering the ecological background may lead to new, highly innovative concepts. Environmental analysis of the product results in a better understanding of component composition and functions as well as supply chain relations. Good supply chain management is a prerequisite for a high product quality.

The Business Case: TWINflex®

Already several years ago Würth Elektronik, a German printed circuit board manufacturer, started to think about an innovative PCB concept to meet future recycling requirements. Würth developed a PCB in MicroVia technology using foil technology with flexible material. Flexibility in form and function makes this TWINflex® concept suitable for high density flexible, flex-rigid and three dimensional circuits. The foil circuit board is mounted on a homogenous plastic or metal substrate. The TWINflex® concept separates mechanical and electrical functions of the PCB. The use of harmful substances during PCB manufacturing can be reduced drastically through changed production processes. At the end-of-life, easy separation of the base material and the circuits, containing e.g. a higher concentration of precious metals, is possible. Keeping in mind, that in the future the manufacturer has to bear the recycling costs, such a concept helps to minimize end-of-life treatment costs and to maximize the benefit from recovered materials.

Why Focus on Design?

The traditional approach to environmental protection is pollution prevention or waste management, but these strategies only focus on avoiding or minimizing potential environmental impacts without considering the design of products. To use a medical metaphor, this traditional approach alleviates the symptoms without addressing the reasons of the illness.

Eco-Design puts the spotlight on an earlier stage within the value-added chain: the product development process. Hence, the philosophy is to "design the environmental impacts out of the product and manufacturing processes". Although design by itself is a “clean” process, it determines most of the product related environmental impacts. Once the main design has been completed and the necessary manufacturing technologies have been fixed, only minor possibilities to increase process efficiency and to minimize emissions of the production processes are left for improvement measures. Also, even the most advanced recycling technology has to cope with what has been defined during the product design.

In total, about 80% of all product-related environmental impacts are determined during the product design phase. For life cycle costs the situation is the same. Hence, it is of utmost importance to consider environmental and economic aspects right from the beginning, as integrative part of product design.

Definition: Eco-Design

Eco-Design is the integration of environmental considerations at the design phase, considering the whole product life cycle from raw materials acquisition to final disposal. The syllable "eco" refers to both economy and ecology.

The Baseline for EcoDesign – Legal Compliance

Legal compliance is a “must” and a major driver for environmental efforts. However, legislation should not be the only reason for "green" activities as this will not lead to innovative strategies.

In recent years the European Union has pushed several activities for environmental legislation forward, affecting especially the electronics and electrical industry. The most important product-related policies and legislation are

- IPP – Integrated Product Policy
- EuP – Eco-Design of Energy-using Products Directive
- WEEE – Waste Electrical and Electronic Equipment Directive
- RoHS – Restriction of the use of certain Hazardous Substances Directive

Whereas the IPP is an overall policy outlining the framework and philosophy of product-related environmental legislation on European level, the directives set out the detailed requirements which are relevant for companies. Table 1 summarizes the scope, main content, and relevance of these three directives for SMEs in the electrical & electronics sector.

Table 1 – EU legislation summary: EuP, WEEE, RoHS (part 1)

EuP	WEEE	RoHS
	Target	
Optimizing the whole product life cycle Consideration of environmental effects in the life cycle phases	Improving end-of-life management for electronics Implementing extended producer responsibility	Restrictions of hazardous substances from electrical and electronics equipment (lead, mercury, cadmium, chromium-VI, PBB, PBDE)
	Scope / Product groups	
In general: ▪ products which represent a significant volume of sales and trade, involve a significant environmental impact, and present a significant potential for improvement Product groups under discussion for implementing measures: ▪ heating and water heating equipment ▪ electric motor systems ▪ lighting in both the domestic and tertiary sectors ▪ domestic appliances ▪ office equipment ▪ consumer electronics ▪ HVAC (heating ventilating air conditioning) systems	▪ Large and small household appliances ▪ IT and telecommunications equipment ▪ Consumer equipment ▪ Lighting equipment ▪ Electrical and electronic tools (with the exception of large-scale stationary industrial tools) ▪ Toys, leisure and sports equipment ▪ Medical devices ▪ Monitoring and control instruments ▪ Automatic dispensers	▪ Large and small household appliances ▪ IT and telecommunications equipment ▪ Consumer equipment ▪ Lighting equipment ▪ Electrical and electronic tools (with the exception of large-scale stationary industrial tools) ▪ Toys, leisure and sports equipment ▪ Automatic dispensers (Currently exempted: Medical devices, Monitoring and control instruments; see WEEE)

Table 1 – EU legislation summary: EuP, WEEE, RoHS (part 2)

EuP	WEEE	RoHS
Status and deadlines		
Framework directive adopted in principle by Council and European Parliament in April 2005 For single product groups specific directives will be adopted, based on the EuP Voluntary agreements by industry may be considered as alternatives, under certain conditions	Directive 2002/96/EC of 27 January 2003 Published in Official Journal February 13, 2003 EU member states transpose WEEE by August 13, 2005 (April 2005: deadline will be missed by most EU members) Take-back logistics to be established by August, 2005 (postponed in some countries) Recycling quotas to be met by End of 2006	Directive 2002/95/EC of January 27, 2003 Commission Decision 2004/249/EC of March 11, 2004 EU member states transpose WEEE by August 13, 2005 (April 2005: deadline will be missed by most EU members) Restrictions come into effect July 1, 2006 Review of exemptions undertaken by European Commission
Requirements		
Setting up an eco-profile of the product may be required by the implementing measures Design control or appropriate environmental management system in place CE marking requires EuP conformity Generic (“improvement”) and specific (“limit values/ thresholds”) requirements to be defined in follow-up directives (implementing measures)	"Distributor" or "producer" are obliged to follow the requirements, not of direct relevancy for (component) suppliers Separate Collection ≥ 4 kg per inhabitant and year from households (per country) Specific recovery/recycling/ reuse quotas per product category Producers finance recycling Producers have to offer an appropriate take-back solution for B2B customers Producers are obliged to submit to recyclers all relevant information for proper recycling	Restrictions of RoHS-6 substances in all products within the scope put on the market after June 30, 2006 (certain exemptions applicable)
EcoDesign relevancy		
EuP implements IPP Product design has to be improved considering the whole product life cycle	Product design should not hinder dismantling, recovery, and reuse (priority on reuse and recycling of WEEE, their components and materials) Products should be designed for easy disassembly of critical components (PCBs, batteries, brominated flame retardants containing plastics, …) Producer has to pay for recycling, thus, recyclability is an economic issue	Product material content has to be known at least regarding RoHS-6 substances Supply chain communication needed regarding legal compliance Reduction/elimination of hazardous substances

Besides these three directives there are several others linked to the topic of eco-design. These are briefly summarized here:

The End-of-Life Vehicles Directive (ELV) restricts certain materials in automotives, but lead in automotive electronics is (currently) exempted. Aim of the ELV directive is to increase the rate of reuse and recovery to 85% by average weight per vehicle and year by 2006, and to 95% by 2015. This directive has been in force already for several years, preceding WEEE and RoHS. The automotive industry reacted with an extensive International Material Data System (IMDS), which became also a benchmark for the electronics and electrical sector as a whole.

There are already three product-related directives in place, which could be seen as archetypes for EuP follow-up directives:

- Directive on energy efficiency requirements for ballasts for fluorescent lighting (2000/55/EC)
- Directive on energy efficiency requirements for household electric refrigerators, freezers and combinations thereof (96/57/EC)
- Directive on efficiency requirements for new hot-water boilers fired with liquid or gaseous fuels (92/42/EEC)

A new EU regulatory framework for chemicals is currently under discussion, called REACH (Registration, Evaluation and Authorisation of CHemicals). According to the draft, enterprises that manufacture or import more than one ton of a chemical substance per year would be required to register it in a central database. The electrical and electronics industry is affected indirectly by REACH as major user of chemicals.

Cross links of Environmental Management Systems with EcoDesign

According to the European EMAS (environmental management and audit scheme) or ISO 14001, environmental management systems traditionally set the focus on cleaner production measures, however, there are also overlaps with eco-design. Hence, an environmental management system is an appropriate starting point to engage more in product related eco-design.

To make the environmental performance of an enterprise comparable over time, key figures are frequently based on some kind of "production unit". Such key figures might be energy or water consumption, specific chemicals consumption, or (hazardous) waste generation with reference to, for example:

- "m² PCB area" (an appropriate key figure for a PCB manufacturer)
- "m² silicon area" or "m² silicon area per mask layer" (semiconductor fab or ASIC design house – although a design house does not process wafers itself)
- "component" (passive components manufacturer)
- "product" (OEM, although this key figure might yet be too unspecific)

With such key figures, a product related benchmark can be established. To improve these key figures, targets can be set within an environmental management system and this is also a first step towards product improvements and eco-design, although it should be noted that such production related figures lack the life cycle perspective.

Business Case: Heidenhain-Microprint (Germany)

The PCB manufacturer Heidenhain-Microprint (HMP) initiated a project for "flow cost accounting". This tool is based on the identification of “end-of-pipe” environmental costs, analysing waste costs, related waste and waste water treatment costs, processing costs and procurement of process chemicals throughout the processes. Relating these costs, e.g., to the processes causing waste generation, helps to identify the "hot spots" within a production site, where improvements efficiently lead to remarkable environmental as well as economic benefits. Through "flow cost accounting" HMP realized significant cost savings.

Hands on – Strategies, Tools, and Methodologies for EcoDesign

The very first step in eco-design only needs a perceptive and inquiring mind. If you think about the basics of your product and have a rough, basic understanding of environmental problems related to electronics, you will be able to give an approximate guess about your product's most environmentally significant aspects on which you should focus your eco-design strategy.

Key questions to ask are:

- What is the main purpose or application of your product?
- What are the most likely usage patterns?
- What is the intended lifetime, the usual lifetime?
- Who is the user? Business-to-business or business-to-consumer?
- What is the product size?

Such questions can be answered if you have a draft product idea in mind, but what do the answers tell you? Some examples:

- Has the product a lifetime of several years, is it switched on for several hours or even 24 hours a day? If so, energy consumption and efficiency during the use phase will surely be a major issue. Higher energy efficiency will easily offset additional energy consumption during production processes (e.g., more efficient components, more "intelligence" in the components; supporting energy saving during use).
- If the product is small and intended for consumers it is likely, that the product will end up in the municipal household waste (although the WEEE regulations will be in place and prohibit this). The consequence is that valuable materials are not recovered and hazardous substances will be problematic at disposal. An appropriate eco-design strategy should focus on minimizing the content of materials with a heavy "ecological rucksack" as these are not always recycled, and of hazardous materials which cause additional expenses and efforts in treatment processes.
- If the product is large, such as white goods, or sold to business customers, there is a higher chance that the product will be reused and recycled. Hence, a design for easy repair, disassembly, and recycling makes good sense.

An exemplary Life Cycle Screening: Personal Computers

A screening of the whole life-cycle of a product, i.e., from "cradle to grave", helps to set the right priorities for design optimizations. Regarding the example of Personal Computers, the production, including raw materials acquisition and transportation, requires approximately 535 kWh of primary energy. An average figure for the lifetime of a PC might be 4 years and within this time, average use patterns lead to approx. 1,600 kWh of primary energy consumption. With state-of-the-art recycling technologies a major proportion of the materials can be recovered. Thus, replacing the need for using virgin materials and recycling can result in a calculated benefit of approx. 70 kWh. The comparison of these three figures leads to the conclusion, that improved recycling (see the current focus of the WEEE directive) is important, but even more important is an improvement of production processes. However, clearly the first priority has to be given to the use phase. That is where the energy consumption takes place. So it is important on the one hand to educate the consumer to use the product in an efficient way, and on the other hand to increase efficiency during use through hardware and software features.

Having gained a first environmental impression of a product, it is time to assign clear responsibilities. There is no single "eco-designer" in a company as eco-design requires an interdisciplinary teamwork approach. Hence, there are several entry points for eco-design in a company, here listed using typical departments:

- Procurement is responsible for supplier selection, for sourcing components which might contain less hazardous substances
- Marketing can recognise the market opportunities of "green sells better" and communicate the company's "green" efforts
- Research and development could use environmental considerations as a creative platform to develop new innovations and identify the potential for efficiency improvements
- If the "traditional" product designer or design team already works in an interdisciplinary way, environmental performance is just one more decision criterion to be incorporated in their daily work
- Environment, Health & Safety (EHS) with its expertise in environmental issues might give a direct input from the ecological side
- Quality management is about better products - and perfectly merges with eco-design!

Keep in mind:

Eco-design is an integrated task of product design and will fail as a stand-alone activity.

Is there a cookbook for eco-design? Unfortunately not, as eco-design is also about creativity and innovation. But, ISO/TR 14062:2002 gives guidelines for the integration of eco-design into a product development process. Table 2 summarises the stages of the design process and a selection of appropriate measures for eco-design (adapted from ISO/TR 14062).

Table 2 – The Product Development Process and Related EcoDesign Activities

Stage	EcoDesign activities
(1) Planning	▪ clarify: what is the product idea? ▪ what are the priorities (economical, technological, ecological) for this product? ▪ is it a totally new product or a product improvement (when planning a product improvement, the former generation might be an appropriate benchmark) ▪ what is the overall and environmental company strategy? ▪ status quo: what eco-design activities can you already base on? – use the cross links to environmental management systems ▪ consider business environment: Customer/market needs, legislation, eco-label planned, market niches, competitors' products, ...
(2) Conceptual	▪ integrate eco-design aspects when drafting the specification (hard and soft criteria) ▪ check feasibility (technological, financial) ▪ apply guidelines, checklists, etc. to refine the specification ▪ communicate with your supply chain
(3) Detailed Design	▪ apply eco-design tools and related data bases ▪ find alternatives for problematic materials ▪ develop life cycle scenarios for a better product understanding ▪ design for assembly/disassembly
(4) Testing/ Prototype	▪ benchmark with former product generation ▪ targets achieved?
(5) Market launch	▪ communicate environmental excellence of your product (customer group specific) ▪ communicate related features: quality, life cycle costs ▪ raise awareness among consumers
(6) Product review	▪ evaluate success of the product (which arguments really counted for the customer?) ▪ identify further improvements for next product generation ▪ which innovations are next (internally and on the market)? ▪ what are the competitors doing?

Basic tools for eco-design are checklists. Checklists give advice on where to focus and what to do; they help to start thinking about certain environmental aspects – and to not forget a significant one. Repeated checks can also be a guideline for improvements. An extensive list of questions with relevant background information can, e.g., be found in: J. Rodrigo, F. Castells: Electrical and Electronic Practical Eco-design Guide (2002).

Some questions within such checklists might sound simple, but they lead to the elementary basics of environmentally benign products. Such questions might be:

- Does your product have energy saving features?
- Do you motivate the customer to reduce unnecessary stand-by?
- Are your energy saving features state of the art and easy to use?

The art of eco-design behind these questions is not to answer them just with yes or no, but to start thinking on each "no" how to convert it to a "yes" next time.

Other questions, e.g., regarding the material content of your product, help to understand how much you really know about your product. Knowing more about your product is the basis for quality and research to identify and implement product improvements.

Material declarations are nowadays becoming a minimum supply chain requirement. There are different levels of material declarations ranging from negative lists, a.k.a. "black lists" or declarations of conformance, to "100%" or full declarations. All electrical and electronics companies supplying major OEMs have to, or soon will have to provide material declarations. But just maintaining databases in order to fulfil the material declaration requirements of customers does take advantage of the full potential of these resources for companies, especially SMEs. A smarter strategy uses this material data as a basis for eco-design and thus achieves some remarkable synergetic effects. Also, SMEs that are well prepared will benefit from the pro-active implementation and management of material declarations as they will be prepared to meet upcoming requirements and will have greater legal security.

A basic eco-design strategy is to set up a ranking of the Bill of Substances (BOS) (derived from the composition of the Bill of Materials (BOM)) using suitable environmental indicators. Such indicators might be primary energy consumption for raw materials acquisition, materials life cycle assessment data (e.g., "eco-indicator 99" values summarizing environmental impacts to a single score), or toxicity indicators. Depending on the eco-design improvement goals (which environmental aspect is the most relevant one for you?) the product can be optimized with respect to this indicator. Whereas the material declaration makes materials comparable only by weight, the environmental screening indicator offers the possibility to compare by potential environmental impacts. Eventually – and even more important than just finding out how to apply indicators – you will have learned how to see your product from a new point of view, and may not anymore need to apply a screening tool the next time to identify the environmental hot-spots.

However, you should never forget that single-score indicators often do not cover all environmental aspects and often cannot represent the whole product life cycle.

An Example of an EcoDesign Tool: Fraunhofer IZM EE Toxic Potential Indicator (TPI)

The idea behind the TPI is to evaluate and compare the toxicity of materials. The ranking is based on easy accessible data from Material Safety Data Sheets (MSDS) and legislation within the European Union: R-phrases, allowable workplace concentrations (German "MAK"), and water pollution classification ("WGK", according to German law). These three legislative classifications are aggregated to a single material specific index ranging from 0 (no hazardous potential) to 100 (highest hazardous potential) per mg of substance. With these material specific values and the Bill of Substances a ranking of materials and components facilitates a “hot spot” analysis, and supports the identification of components which should be improved or replaced with priority.

The TPI calculator is available for free and can be downloaded from: http://www.pb.izm.fhg.de/ee/070_services/75_toolbox/index.html .

A different approach, that maps the relations between life-cycle phases, environmental aspects, and other issues like business or customer requirements, is the MET matrix developed by H. Brezet et al. This is basically just a table with the life cycle phases production and supply of materials/components, final product manufacturing, distribution to customers, product use and end-of-life. A statement regarding the material cycle (M), energy consumption (E), and toxic emissions (T) is assigned to each of these phases. Once the environmental aspects of the product design alternatives are assessed in this way, it is important to relate this assessment to the other elementary aspects, such as business and customer benefits, societal, technical, and financial aspects.

Getting started

As an incentive for the optimization and redesign of your products, you might want to apply the 6 RE Philosophy:

The 6 RE Philosophy (Reference: UNEP Guide to LCM)

1. Re-think the product and its functions, e.g., how the product may be used more efficiently.
2. Re-duce energy and material consumption throughout the product's life cycle.
3. Re-place harmful substances with more environmentally friendly alternatives.
4. Re-cycle. Select materials that can be recycled, and build the product in a way that it can be easily disassembled for recycling.
5. Re-use. Design the product so parts can be reused.
6. Re-pair. Make the product easy to repair so that the product does not yet need to be replaced.

Your first eco-design strategy might look like this:

Getting started with Eco-Design

1. Check current status: What does the market request, what does the customer ask for, what have you done already?
2. Get to know current environmental issues: Where might your product have environmentally relevant aspects? Stay in touch with the EcoDesignARC network.
3. Set and develop your targets.
4. Involve relevant departments and the supply chain, check benchmarking opportunities. Stay in touch with the EcoDesignARC network.
5. Choose appropriate tools, checklists, guidelines; link ecological with cost arguments.
6. Analyse your product, you will easily find improvement potential; do not forget: eco-design is about better products!
7. Communicate improvements - show how "smart" you are!

For further questions, updates, and support on the implementation of eco-design, please feel free to contact the EcoDesignARC network (http://www.EcoDesignARC.info).