

*Eco-design Strategies is the fourth in a seven part series from the G.EN.ESI Education Centre. The other titles in this series include Life Cycle Thinking, Introduction to Eco-design, Eco-design and Business, Life Cycle Assessment, Legislation and Regulation and Eco-design Case Studies. To read or download any of the titles in this series please visit [www.genesi-fp7.eu/education-centre](http://www.genesi-fp7.eu/education-centre).*

## Introduction

The lifecycle phase which you decide to focus on when addressing the environmental impact of your product may result from the completion of a lifecycle assessment, a response to legislative pressures or a strategic decision based on business drivers (see relevant Education Centre titles for more information). Regardless of the justification it is common for businesses to focus on specific lifecycle phases.

So once the lifecycle phase has been selected, what next? How do you actually reduce the impacts? In this document we will detail some key design strategies aimed at dealing with each lifecycle phase. Some strategies may require adaptation before being applicable within your business, while others may not be relevant. The idea is to highlight the options and stimulate innovative ideas within your business context.

## Eco-Design Strategies

Within the environmental design sector some common design strategies have been developed to address the various lifecycle phases of products, some of which are shown in Figure 1. Within this document we will provide a quick overview of what strategies for eco-design can be. The G.EN.ESI project focusses on the design and development of mechatronic products, and whilst the following sections are directly relevant to this sector, the content will often be transferable into many other industries so please do read on if you work in other areas.

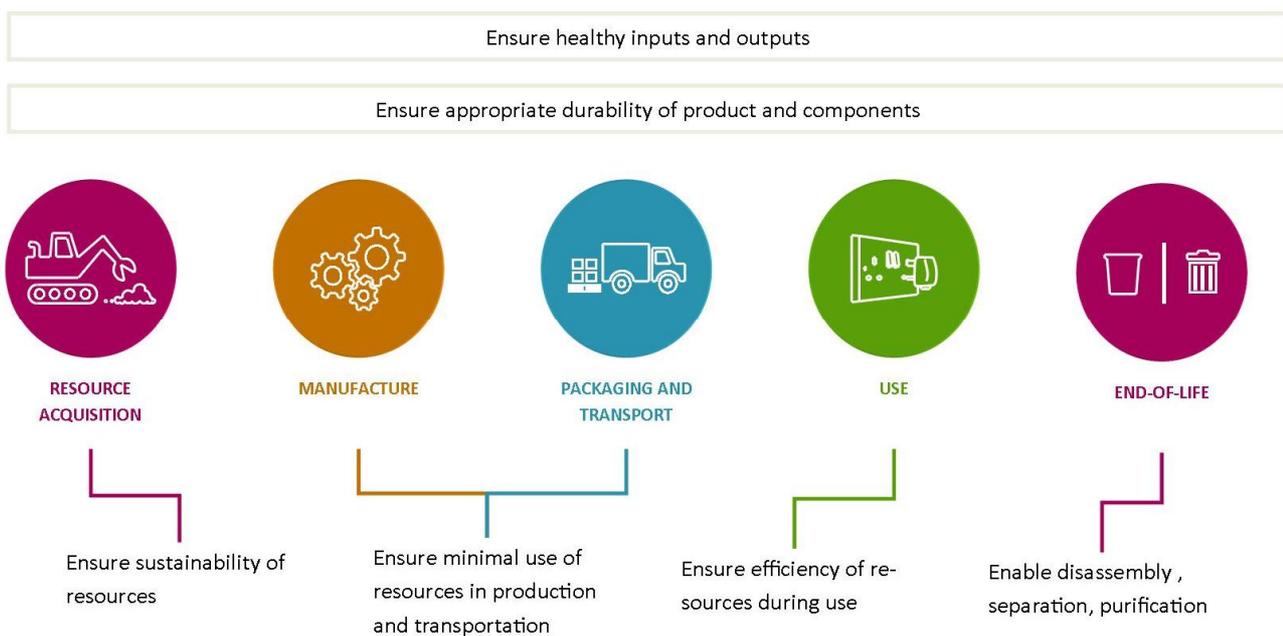


Figure 1: Generic eco-design strategies, for the entire lifecycle or for a specific phase. [Adapted from [1]]

### The golden rules: be efficient and harmless to the environment

As illustrated in Figure 1, most of eco-design strategies target an appropriate use of resources, in term of materials and energy conservation, and the selection of the least harmful option to realise a function (healthy inputs and outputs).

If you follow these two simple concepts, you are eco-designing. The next paragraph details how eco-design is undertaken within each phase of the product lifecycle.

### Generic guidelines on specific lifecycle phase – based on ecodesign pilot.

#### *Eco-Design Strategies for a raw material intensive product*

The extraction industry has a significant impact on the environment, both locally and globally. The refinement of the extracted ores generates large amounts of toxic substances that are combined with the useful part of these ores. The scarcity of all resources is also a challenge for some categories of material and ultimately for all materials if exploitation is not managed carefully.

Some of the strategies that can be used are:

- Selecting the right materials in term of functional requirements,
- Reducing material input,
- Increasing the durability of the product,
- Reusing the product, or material constituents

A well-known example of improvement for a material intensive product is the substitution of copper by aluminium in wires and especially in motor winding. Aluminium has two advantages over copper: it is less scarce and the manufacturing process is slightly more energy efficient.

#### *Eco-Design Strategies for reducing transportation impact*

Transportation tends to be relatively significant for a product with a short lifetime, such as food or packaging. Weight and size of the product to be transported, as well as distance and means of transportation are the main parameters to consider in order to improve the environmental impact of this phase.

Some strategies for reduced impact in transportation are:

- Reduce the size of the packaging to the minimum necessary to protect the product,
- Choose an environmentally acceptable means of transportation.
- When possible, limit the transportation distance

An example of reducing the impact of transportation is the redesign of the MacBook Pro packaging. By optimising the shape of the packaging, providing the same protection to the computer, the impact of transportation was reduced by 25% due to better stacking.

#### *Eco-Design Strategies for reducing production impact*

The impact of production was the main focus for environmental improvements a few decades ago. Exhaust fumes coming out of a factory is the common image used to illustrate the environmental impact of manufactured goods. Continuous improvements are necessary to decrease the environmental impact of products with no consumption in use, but with long lifetimes. The furniture industry and the shoes industry are good examples of high environmental impact during manufacturing.

Strategies to reduce the impact of this part of product lifecycle are:

- Optimising the type and amount of process materials,
- Eco-friendly procurement of external components,
- Use of the product, or part of the product, for a longer period of time,
- Reducing/eliminating toxic chemicals

An example of an improvement that will reduce the impact of production is the Herman Miller Aeron chair. The different modules of the chair were designed so that they can be separated, and broken modules can be replaced and reassembled. This modular design removes the need to construct an entirely new chair by being able to replace a part of the product.

#### *Eco-Design Strategies for tackling use phase impacts*

For the majority of mechatronic products, the use phase has the most impact due to energy consumption over the product lifetime. This problem has been acknowledged by legislators with the introduction of the energy related product directive that aims at reducing the environmental impact of product through reducing energy consumption.



Strategies in this domain have been mainly targeted at improving the energy efficiency of the product, but additional tactics can be found in design for sustainable behaviour literature. Here is a short list of some strategies:

- Improving product maintenance,
- Decreasing intensity of energy consumption,
- Automatic switching to low power mode (stand-by or off),
- Providing feedback to the user on current energy consumption of the device.

An extensive list of strategies for design for energy efficiency in use phase can be found in the Synergico tool which provides a list of 50 guidelines to better manage energy during product use.

The application of the Synergico methodology was used in the eco-design process for a postage-meter in Neopost technologies. Further information can be found here: <http://www.neopost.com/en/about-neopost/corporate-social-responsabilites/our-planet/eco-design>

### *Eco-Design Strategies for improving end-of-life*

The increasing number of electr(on)ic products is a primary source of current and future hazardous waste. WEEE – waste of electric and electronic equipment - is responsible for heavy metal emissions to soil and water, but is also a potential source of rare materials, such as copper, gold or silver. This is why the European Commission has set targets for recycling and energy recovery in the WEEE directive 2002/96/EC.

Several eco-design strategies can be used to improve the end of life phase:

- Improving disassembly by connecting parts with reversible connections (such as clips),
- Extending product lifetime by remanufacturing or refurbishing,
- Using recycled materials, in order to keep the recycling network economically viable.

Some Hewlett Packard copiers include snap-in assemblies in order to reduce the time for disassembly. This motivates recyclers to actually disassemble the product, by reducing the cost of disassembly.

### **Selecting and adapting generic strategies to your product development context**

To select the most appropriate strategies, on the following factors should be considered:

- The targeted life cycle phase(s) for improvement. For example a way to reduce the impact of transportation is to design lighter packaging.
- The environmental aspect you wish to improve. For example, a way to reduce climate change effects is to reduce energy consumption, since a lot of greenhouse gas is emitted to produce energy.
- Which guidelines are best suited to the current stage of the design process? Some guidelines must be considered early in the design process in order to be integrated in product design.

You can also set your own selection criteria based on previous experience with implementation of the strategy or its relevance for the type of product you are designing. With this restricted list of strategies, you can customise them by adding an internal reference to projects that have implemented such guidelines or add an efficiency factor for your specific product range...

## Conclusion

There are many resources available to provide you with strategies to environmentally improve your product design. These range from generic rules of thumb that will help you make a first step towards eco-design, through to detailed strategies specific to a product category, a life cycle phase or a specific environmental impact...

Life cycle thinking, engineering design inputs<sup>1</sup>, maturity analysis<sup>2</sup> can help you in the selection of the most adequate set of strategies (whether rules of thumb or specific guidelines). Adapting these strategies to your specific industrial context will allow you to incorporate eco-design into your product design activities.

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<sup>1</sup> Pahl, Gerhard, Wolfgang Beitz, Ken Wallace, Jörg Feldhusen, and Lucienne Blessing. Engineering Design. Springer, 2007.

<sup>2</sup> Pigozzo, Daniela C. A., and Henrique Rozenfeld. 'Proposal of an Ecodesign Maturity Model: Supporting Companies to Improve Environmental Sustainability'. In Globalized Solutions for Sustainability in Manufacturing, edited by Jürgen



## Further Reading

There is a wealth of information on eco-design strategies available. Here is a non-exhaustive list of the resources available:

- Ecodesign Pilot: <http://www.ecodesign.at/pilot/ONLINE/ENGLISH/>  
A website to guide you in the implementation of design strategies adapted to your product environmental profile.
- D4S: <http://d4s-de.org/manual/d4stotalmanual.pdf>  
A manual dedicated to developing economies but where strategies are converted into practical solutions.
- Information/inspiration: <http://www.informationinspiration.org.uk/>  
Strategies and examples of their implementation in product from different sectors.
- The eco-design strategies wheel: <https://app.sustainableminds.com/learning-center/ecodesign-strategies/strategy-wheel>
- A simplify guide to eco-design implementation: <http://www.grantadesign.com/eco/ecodesign.htm>
- IEC 62430: Environmentally conscious design for electric and electronic products
- ECMA 341 Environmental design considerations for electronic products  
Two standards that provide a framework for environmental assessment but also guidelines to improve product design.
- Manual on Eco-Design and End-of-Life management of Electronics Products :  
[http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=IPP\\_TEL\\_Manual.pdf](http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=IPP_TEL_Manual.pdf)

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