Factor 10 for 10 domestic appliances? Is it reachable quickly? An ecodesign case studies experience at University

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Abstract After having carried out different lca's [1] of commercialized domestic appliances (barbecue set, bread maker, coffee machine, fragrance diffuser, hair drier, iron, light, toaster, raclette grill, range hood), students of the University of Cergy-Pontoise (France) tried by groups to re-concept each of them, in order to improve their eco-efficiency [2] by a factor 10. This work has been an opportunity to suggest some creative and innovative tracks to lessen environmental impacts of domestic devices, without giving up their functionality, or even if possible to improve them.

1 Introduction

According to a recent study led by the University of Cergy-Pontoise (France) and Ecoeff [3], only two thirds of domestic appliances claiming to be environmentally friendly are actually low energy consumers. And a very short number of them sticks up a real gap from conventional appliances. Nevertheless, the United Nation Environment Programme called for a tenfold reduction in resources and energy consumed by industrial countries [4]. Can this purpose be reasonably reached for domestic appliances? To reply to this question, a complete methodology has been worked out [5] to lead groups of students in ecodesign of the University of Cergy-Pontoise (France) to rethink, in an ecological way, the conception of common appliances (barbecue set, fragrance diffuser, iron, toaster, range hood, light, hair drier, raclette grill, coffee machine and bread maker).

The aim was to improve their eco-efficiency by a factor 10. The eco-efficiency is defined by the ratio of the ecological indicator of a product on the service it does the user. This way, the loss (or gain) of functionality of an ecological goods would be taken into consideration in comparison with the conventional goods (see Figure 1).

For simplification reasons, the ecological indicator considered is the emission of greenhouse gases (GHG, expressed in kg eq. CO_2), although 7 to 10 indicators were used (especially with CML 2001 [6]).

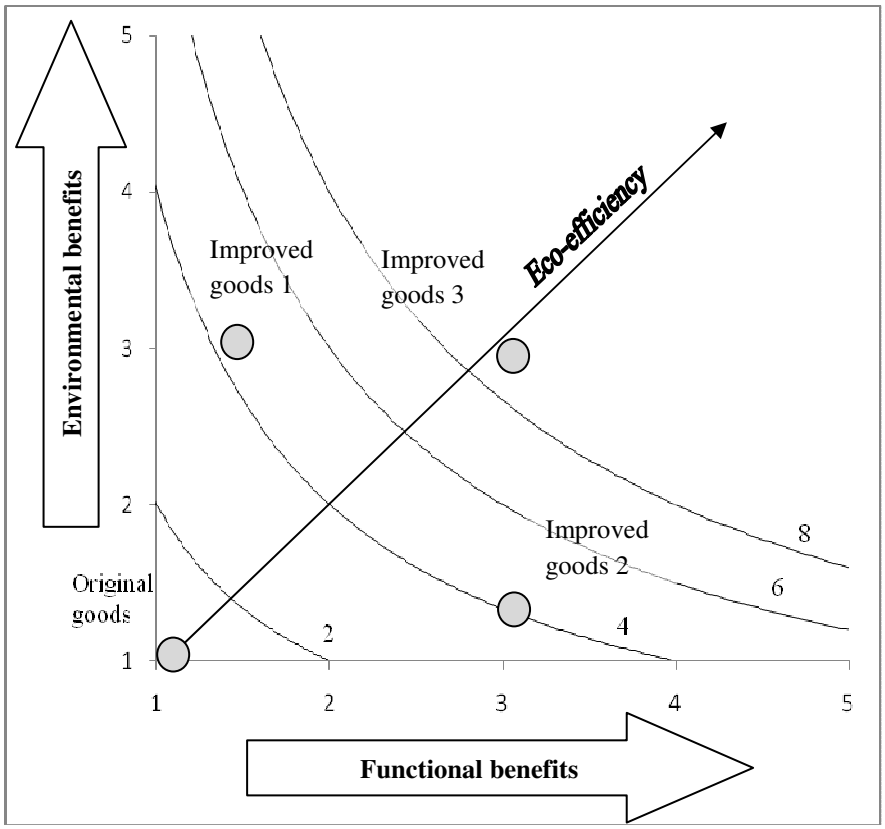

Fig. 1: Example of eco-efficiency representation

As we can see in the example above, the eco-efficiency of the original goods is worth 1 by default. For the improved goods 1, the stress has been layed on environmental benefits and on functional benefits for the improved goods 2. The improved goods 3 take up the benefits of the two others and so obtains a better eco-efficiency score (wich is here worth about 8).

2 Methodology

The first step of their work was to the students to realize the functional analysis [7] of the appliance they had chosen. With the help of tools like environment diagrams and the software TDC Need [8] the functions of the product and its functional unit has been able to be listed. A study has been led as well on economical and market data. Some user surveys were also conducted.

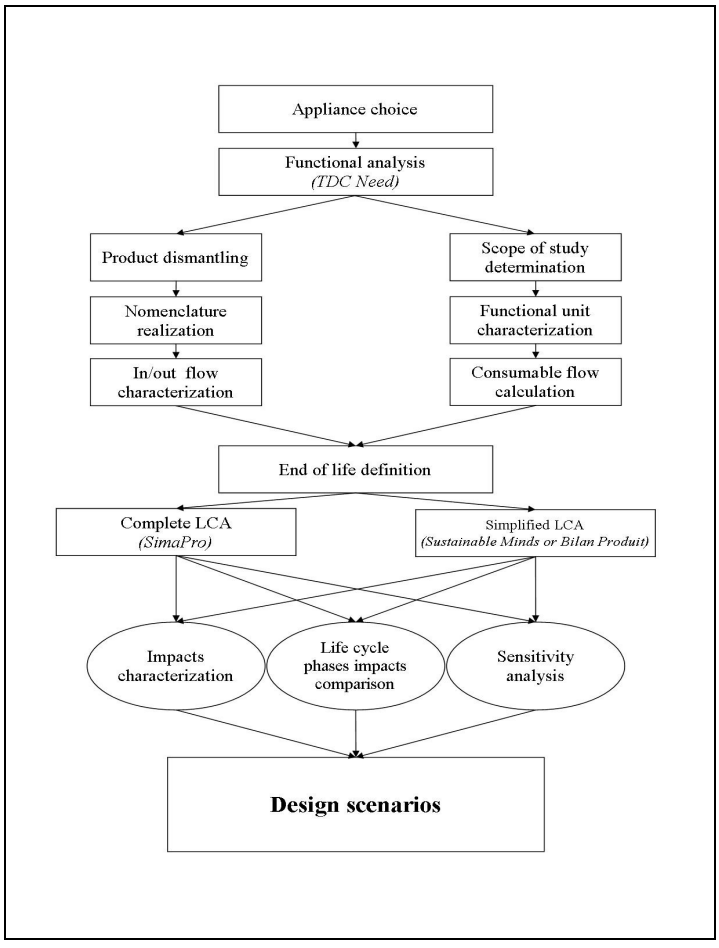

Fig. 2: Methodology diagram

Then, a model of each appliance has been purchased from a store and been dismantled to make the assessment of its components and materials. Some technical tests had also been carried out in order to check use characteristics (such as temperatures – see Table 1 –, time of use, insulation…).

Tab. 1: Example of characteristic test - temperature measurement (barbecue set)

Distance from the grill	Time since turning on	Temperature
0.1 m	5 minutes	70°C
0.1 m	10 minutes	83°C
0.1 m	15 minutes	90°C
0.05 m	15 minutes	130°C

After this, the life cycle assessment of each object has been carried out by using both SimaPro (7.2 education version) [9] and a simplified LCA software (Bilan Produit 2008 [10] or Sustainable Minds [11]). Using two different programs allowing checking and confirmation of the results, the calculation were validated if the GHG emissions were similar between the two programs. No information having been available directly from the makers about type of materials, distances and logistics, or industrial processes, students had to make estimation based on literature for most of these data.

In addition of this LCA, sensitivity analysis were conducted on some parameters (lifetime, materials, energy consumption, waste scenario ...) in order to determinate the most impacting life cycle phases and the benefits leeway they could obtain by improving them.

These works done, the groups started the design phase of their project, following creativity methodologies [12]. The goal to reach was to imagine a new model of the appliance with its environmental impacts reduced and functionality bettered (or, at least, not lessened) compared to the reference model.

The functionality value was determinated by a functionalities table to which every function of the product is transferred. A coefficient (comprised between 1 and 4) is attributed to each function depending on its importance (see Table 2).

Tab. 2: Extract from the range hood function coefficients

Function	Coefficient
Filtering ambient air	4
Optimizing odor elimination	4
Recycling air	4
Being easily cleaned	2
Allowing fan-speed regulation	2
Being removable	2
Informing the user	1
Being aesthetic	1

Otherwise, a score (on a hundred possible points) was given to each function, for both the basic product and the redesigned product, depending on the extent they answer the function (see Table 3).

Tab. 3: Extract from the range hood function scores

Function	Basic product Score	Redesigned product Score
Filtering ambient air	60/100	80/100
Optimizing odor elimination	60/100	80/100
Recycling air	0/100	90/100
Being easily cleaned	40/100	70/100
Allowing fan-speed regulation	60/100	60/100
Being removable	0/100	80/100
Informing the user	60/100	70/100
Being aesthetic	40/100	70/100

Then, the weighted average of each product has been calculated, giving their functional value. The ratio between the both functional values was the functional benefits of the redesigned product.

In the example showed in Table 2 and Table 3, the functional value of the basic product and the redesigned product are respectively 39 and 78, that is to say a functional improvement factor of 2 (note: the final range hood functional improvement factor showed below is higher because other functions have been taken into account).

3 Results

The functional and environmental scores of the reference and ecological appliances have been combined to get an eco-efficiency score, as described in the introduction, in order to size up the progress accomplished. The main innovations of each appliance are reported in Table 4 and the eco-efficiency scores are pooled in Figure 3.

Tab. 4: Main innovations developed for each appliance

Appliance	Main innovations
Light	LED bulb, innovative materials
Coffee machine	Use of ceramics
Fragrance diffuser	Fragrance diffusion by warm sheet
Hair drier	Solar energy, innovative battery
Toaster	Horizontal closed toaster
Range hood	Mobil range hood, washable filter
Bread maker	Innovative materials
Barbecue set	*Confidential*
Raclette grill	Individual burners, renewable energy
Iron	Ironing between two blades

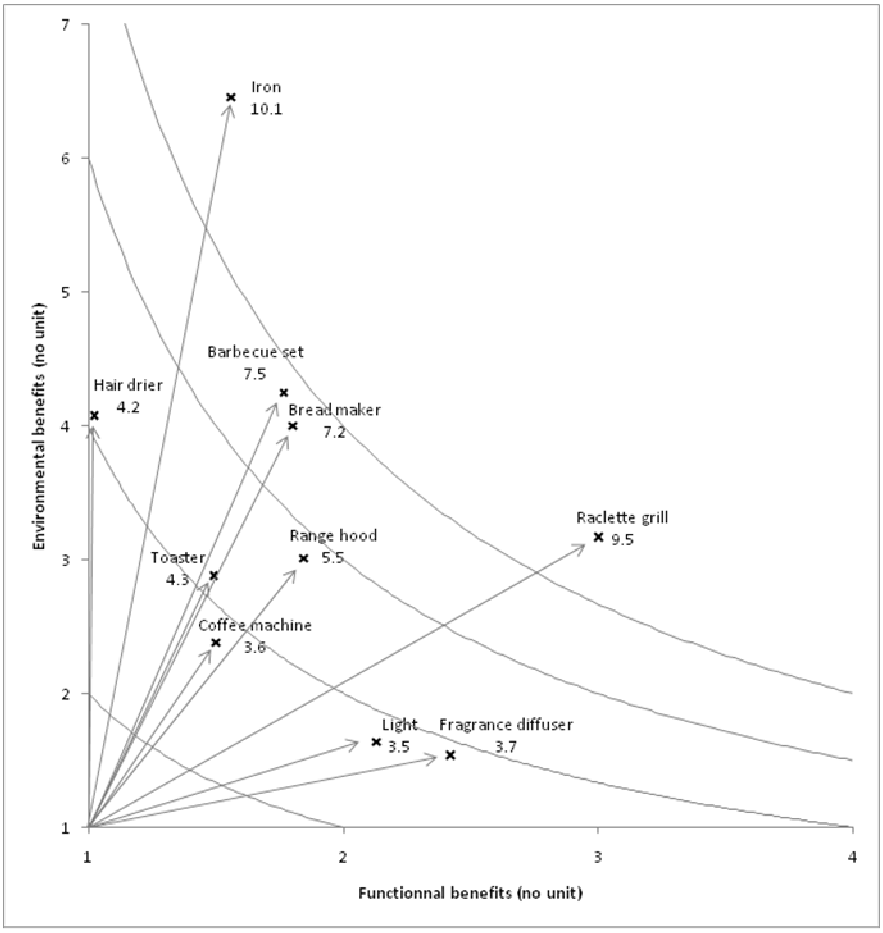

Fig. 3: Eco-efficiency analysis of each appliance, distribution between environmental and functional benefits

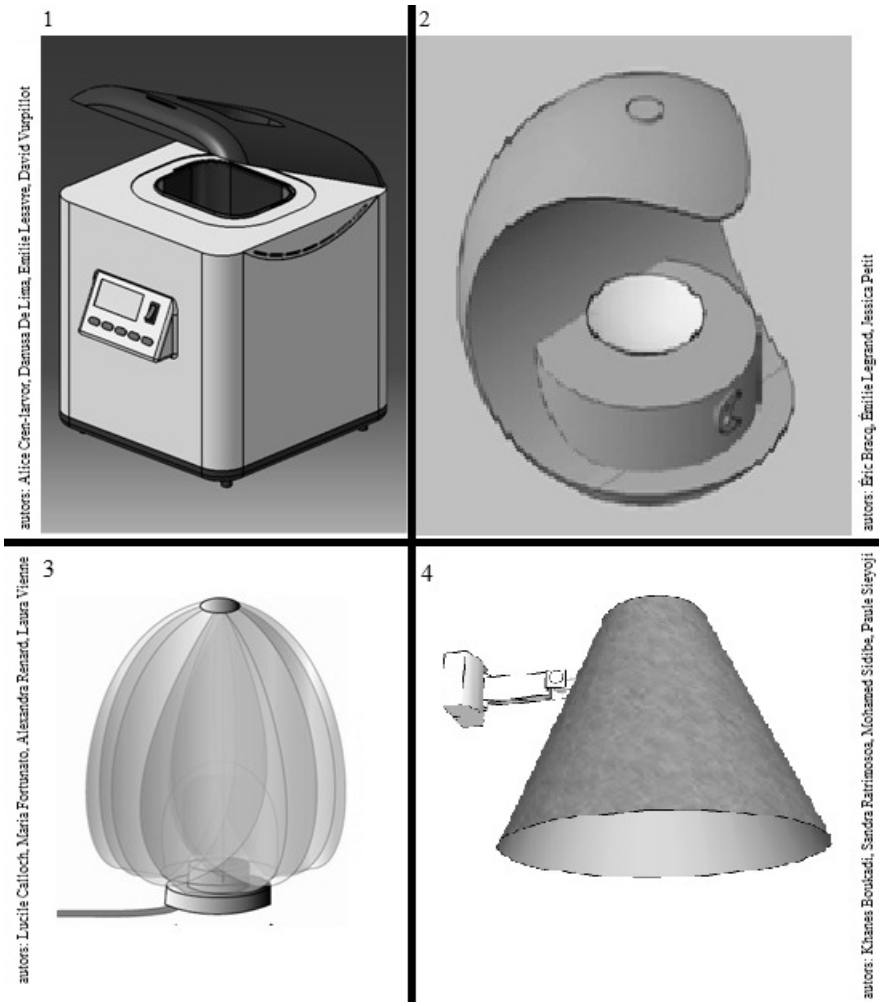

Fig. 4: Examples of innovative products (1: bread maker; 2: fragrance diffuser; 3: light; 4: range hood)

4 Conclusion

In a short time (four months), ten domestic appliances have been redesigned in new innovative concepts. If the goal of a 10 factor in eco-efficiency has been reached in one case (iron), the remaining results are comprised between 3.5 and 9.5 factor, which is however decent in our opinion.
Of course, the feasibility of the new concepts should be audited to confirm the results obtained but the underlying objective was principally to work out a methodology of LCA and ecodesign adapted to students.

5 Acknowledgment

We would like to acknowledge companies directly or indirectly involved in the data collection.

6 References

[1] ISO 14040 and ISO 14044
[2] World Business Council for Sustainable Development, “Eco-Efficiency: Creating more value with less impact”, 2000
[3] Valentin Auffret, Florent Chalot, Philippe Schiesser, Virginie Robert, Adrien Tissot, « Du green dans nos machines », University of Cergy-Pontoise, Ecoeff, 2011
[4] UNEP, Global Environmental Outlook 2000, 1999
[5] Philippe Schiesser, « Éco-conception, indicateurs, méthodes, réglementation » Dunod, 2011
[6] http://www.leiden.edu
[7] Knowlence, Analyse fonctionnelle et maitrise des risques, Congress AFAV, 1999
[8] http://www.tdc.fr/en/
[9] http://www.pre.nl/

[10] University of Cergy-Pontoise and ADEME, http://www.ademe.fr/internet/bilan_produit
[11] http://www.sustainableminds.com/
[12] Edward de Bono, Lateral Thinking: Creativity Step by Step, Harper Colophon, 1973, 304p.