FACING GLOBAL-WARMING, MANUFACTURERS ARE INVITED TO THINK TO ECO-DESIGN. ENVIRONMENTAL PRODUCT DECLARATION ALSO CONCERNS FUSES

Jean-Louis GELET[(1)], Joël GAUCHON[(2)]

(1) FERRAZ-SHAWMUT, Rue Vaucanson, 69720-St-Bonnet de Mure. France.
Tel. 33 (0)4 72 22 66 30. jean.louis.gelet@fr.ferrazshawmut.com
(2) FERRAZ-SHAWMUT, Rue Vaucanson, 69720-St-Bonnet de Mure. France.
Tel. 33 (0)4 72 22 69 92. joel.gauchon@fr.ferrazshawmut.com

Abstract :

Global-warming doesn't suffer any doubt today. Nevertheless important are the debates concerning its amplitude, effects and causes. In front of this problem, International Authorities make efforts for a global legislation. In 1992, conclusion of the Summit of Rio on behalf of United Nations was a Declaration on Environment and Development. Later, in 1998, the Kyoto-Protocol to United Nations Framework Convention on Climate Change was adopted by most of industrials countries. In despite of this, some stay as opponents. Anybody knows who they are.

As a follow up of Kyoto-protocol, European Community stated three orientations for electrical products. First is WEEE, which specifies conditions for the end of live of electrical products. Second is RoHS, which gives rules for restriction of hazardous substances. And third concerns directives for eco-design.

EC-economical experts estimated that 80% of global environmental impacts of products are deterred as soon as design-phase. Then, it has been proposed to define a method for carrying out this estimation at the level of each single product. This should take the concrete form of an Environmental Product Declaration (EPD), based upon several criteria such as use of renewable or non-renewable resources, electricity consumption, emission related impacts and waste.

For the time being eco-design is not subjected to legal obligations. But manufacturers could have great interest to follow this way. FERRAZ-SHAWMUT uses the help of a so called software "EIME", from CODDE-company for the determination of Environmental-Profiles of his products. The purpose of this paper is to come back to the environmental considerations from legislation-point of view and to compare the Environmental Profiles of two fuse-ranges.

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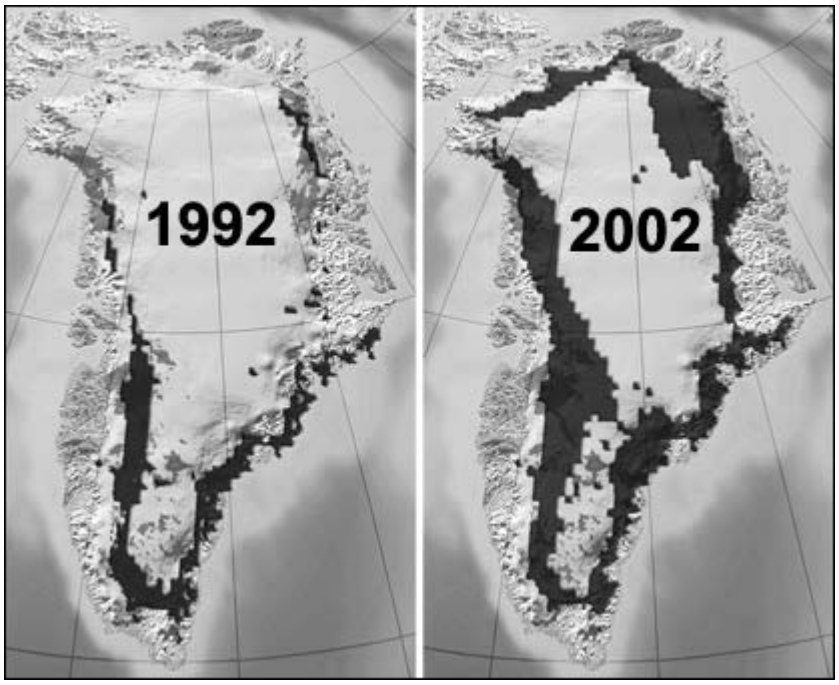
1. ECO-CONCEPTION AS A PART OF A GLOBAL ANSWER TO EARTH-WARMING :

An Unquestionable Statement

Numerous figures may illustrate how much today's human activities impact the Earth. For example, man today burns within one single day, resources that nature took 10 000 days for building up. In France, statistics demonstrate that each inhabitant thoughts out 1 kg of waste per day, which is twice what he did 40 years ago, and equivalent figures are available for all industrial countries. As a consequence, our planet is under the menace of a global heating. Estimations have been carried out, announcing that during the 20th century, the mean-temperature of the earth increased of about 0.6°C. For the 21st century, the less alarmist forecasts concern temperature-increase of 2°C, with dramatic effects on the polar ice-pack and mountain-glaciers leading to an elevation of the see-levels.



First comes to the mind the fuel-consumption during the life of the product. But this is not the only impact over the environment. Indeed raw material-consumption, water-consumption, through out in water, through out in air, various kinds of wastes, also modification of natural environment and life-conditions are very significant impacts. And they will occur at any stage of the life-cycle of the product, from manufacturing to disassembling.

Earth-Summit of Rio –1992

From 3rd to 14th June 1992 took place at Rio de Janeiro, in Brazil, the United Nations Conference on Environment and Development (UNCED), commonly known as Earth-Summit of Rio. More than 2,400 senior officials from 179 governments attended to the meeting. They were joined by hundreds of officials from United Nations organizations, municipal governments, business, scientific, non-government and other groups. Nearby, the `92 Global Forum held a series of meetings, lectures, seminars and exhibits on environment and development issues for the public. This drew 18,000 participants from 166 countries, as well as 400,000 visitors. There were 8,000 journalists covering the Rio meetings, and the results were seen, heard and read about around the world.

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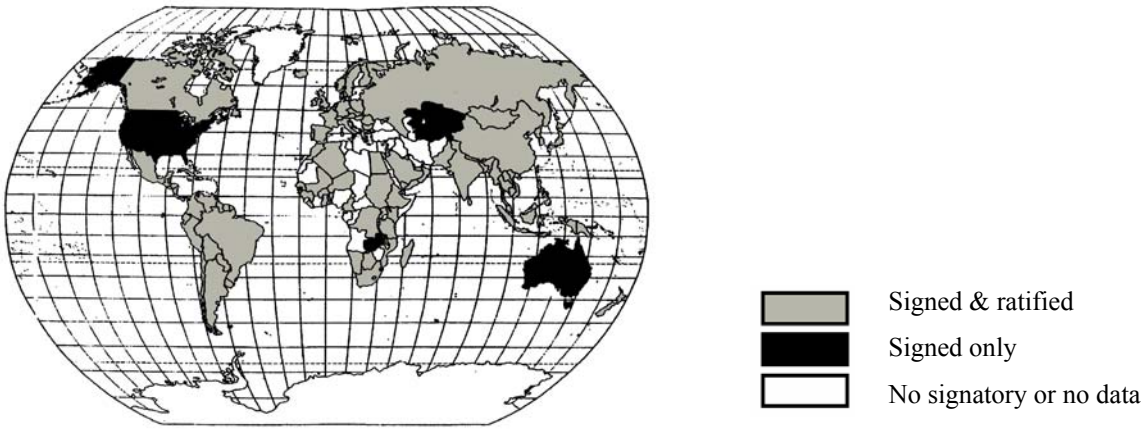
This Conference has been concluded by the adoption of 27 principles, called "Rio Declaration on Environment and Development" which introduced the idea of sustainable development, i.e. *development that meets the needs of the present without compromising the ability of future generations to meet their own needs*. Moreover the Conference gave the opportunity to adopt an actions-plan for the 21st century, called "Action 21" or "Agenda 21", which enumerate some 2500 recommendations for the concrete setting of the principles of the declaration.

Kyoto Protocol – 1998

Five years later, from December 1 through 11, 1997, more than 160 nations met in Kyoto, Japan, to negotiate binding limitations on greenhouse gases for the developed nations, pursuant to the objectives of the Framework Convention on Climate Change of 1992. The outcome of the meeting was the Kyoto Protocol, in which the developed nations agreed to limit their greenhouse gas emissions, relative to the levels emitted in 1990. Only Parties to the Convention that have also become Parties to the Protocol (i.e. by ratifying, accepting, approving, or acceding to it) will be bound by the Protocol's commitments. 171 Parties have ratified the Protocol to date. Of these, 35 countries and the EEC are required to reduce greenhouse gas emissions below levels specified for each of them in the treaty. The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal membership, with 189 countries having ratified, even if a polemic is still running with USA and Australia denying to ratify the protocol.



European Community Directives :

Respect of commitments taken through the Kyoto Protocol is one of European Economic Community prerogatives. EEC rules establish that directives are edited by the Community and then turned to laws by each of the twenty-five members. Then, EEC stated three orientations for electrical products. First is WEEE (Waste of Electrical and Electronic Equipments), which specifies conditions for the end of live of electrical products. Second is RoHS (Restriction of use of Hazardous Substances), which gives rules for restriction of six hazardous substances. And third concerns directives for eco-design of energy-using-products (EUP). Last directive will set the base for reduction of the environmental impact of products, for restriction of energy-consumption, and for information of consumers.

2. THE INS AND OUTS OF ECO-CONCEPTION :

Regulations and Economical Interests

At first, regulations could be considered as very compelling for industrials. This is true as long as they just look at the prohibition aspects of regulations. But, if they could admit that regulations bring a new cards-dealing,

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especially within the over-concurrential globalisation-world, large opportunities for developments will be offered to them. Respect of regulations and economical interests are not inconsistent.

Global Impact

Studies carried out during last 10 years concluded that the most significant environmental aspect of electrical and electronic products obviously concerns their energy-consumption when in use. It has been calculated that energy-consumption may reach 80% of global environmental impacts. This ratio increases with high life-duration of the product. But other environmental impacts are not allowed to be neglected. Any product interacts with its environment because of its design. The choices of the materials, the manufacturing-processes and even the technological principals highly deter effects on environment. Also during manufacturing, because of energy-consumption, raw materials and wastes and during conditioning and transportation, effects are realities. And finally, when the product is at the end of its life-cycle, it has to be eliminated. Once again, it has effects on environment by the wastes, the rejected substances, the energy spent for treatment and eventually the place needed for storing hazardous or unreusable materials.

Then, it becomes very important to manage the problem from a global point of view, otherwise pollution should be transferred from one step of the life-cycle to another one. Systemic approach must be preferred in order to minimize the total impact of the product.

A New Syntagm : Eco-Conception

The syntagm "Eco-Conception" or "Eco-Design" has been introduced for underlining that from now, Conception or Design absolutely needs to involve Ecological considerations. Thanks to multicriteria approach of the "Eco-Conception", manufacturers will investigate new progress-axles, according to available and up-to-date technologies.

A strong idea is that Ecological considerations have not to come after the Conception. But they are fully involved, as well as costs and quality.

Three main classes of impacts

As early as design-step, decisions have to be taken, keeping in mind what will be the impacts on environment all over the life-duration. Three main classes of impacts have to be considered:

- natural resources-consumption : both raw materials and energy have to be preserved,
- water- and air-pollution : emissions of greenhouses gas and ozone layer depletion are the most known of the all alterations of natural phenomena because of industrial activities,
- waste-production : manufacturing-wastes, conditioning-wares and end-of-life goods must be valued and upgraded for reducing disposal-volumes and resources withdrawals.

Ferraz-Shawmut's Environmental Policy

The Ferraz-Shawmut's management set internal policy for environmental saving. This policy consists of five axles, which are the frame for reaching and checking the environmental imperatives :

- to act as early as designing new products and processes for environment and personal safety,
- to deliver to customers quality and low environmental impact products,
- to fulfil regular, legal and all other environmental requirements, and contribute to develop them,
- to control and to reduce wastes and uses of toxic materials and to involve recycling-technologies,

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- to permanently investigate for solutions which will reduce water-, energy -, raw-materials-consumption and conditioning-wares.

3. THE EIME-METHOD :

The Needs for a Simple and Complete Tool

The syntagm "Eco-Conception" involves the word "Conception". It means that basically it is a "Conception", but for being credited as "Eco", it needs to be seriously fed by"Eco" considerations. The problem is that the specialist who owns the knowledge of "Conception", whatever is the product, is not a specialist about environmental questions.

Hence, it has been necessary to think to a tool which can help people in charge of the development of products to also be able to take into account environmental aspects. The bill of requirements of such a tool should be briefly expressed as :

- to be usable by non-specialists of environment,
- to be compatible with any existing conception procedures,
- to cover a large range of products,
- at the same time, to be easy and simple to use, and to warrant a complete and exact approach.

Principles of EIME-Method

The EIME (for Environmental Information and Management Explorer or Evaluations des IMpacts Environnementaux)) is a simple and pragmatic tool to model any product. It is a compilation of three modules :

- a database of most representative electrical and electronic industry materials, components, processes which helps you to **model** any product.
- once the product architecture is built, routines which **calculate** the environmental contributions by impact and/or by sub-assembly.
- post-treatments using **graphs** which help to make the best eco-strategic choices.

Database

User will find within EIME a database which will help him to describe the product with numerous elementary bricks. These bricks may be :

- components or sub-assemblies, which offer any specific function such as diodes, bearings,…
- materials, such as metals, plastics, papers, filling materials,…
- additional chemical substances used for the manufacturing, but in small amounts, such as glues, lubricants,…
- transformation-processes, such as injection of plastics, machining, welding, plating,…
- connections or bonds, such as clippings, clampings,… without adding any material, these bricks contribute to the final architecture of the product.

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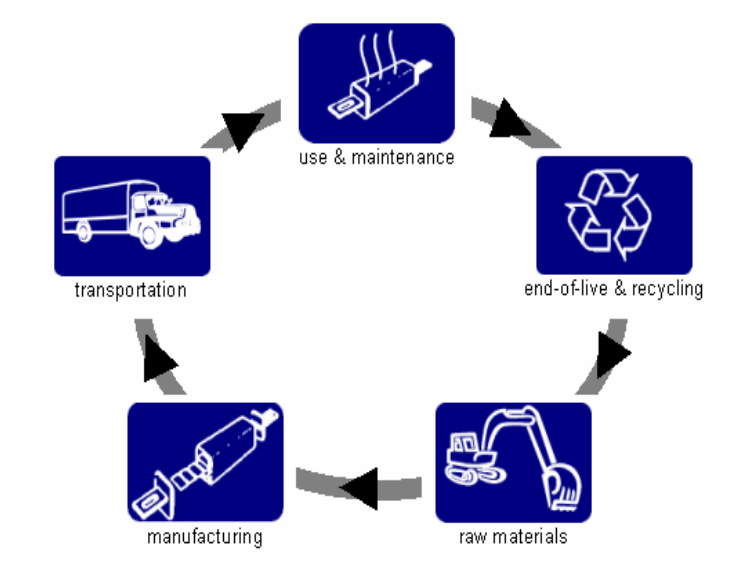
For each one of these bricks, the environmental impacts have been evaluated : for example, impacts related to the manufacturing of a kilogram of copper or to the manufacturing of a diode or to the transportation of one ton of filler for one kilometre. By addition of all the impacts of all the bricks of the concerned product, it is possible to reach the potential impacts of the product. About 250 bricks are today available in the EIME-database.

Environmental Contributions

Nevertheless, environmental impacts of a product are not only the mere summation of the impacts of its components. Indeed, after manufacturing, the product will be transported, used, sometimes maintained, and finally eliminated. During each of these stages, there are consumption of material and energy and wastes. This has to be taken in consideration within impacts-evaluation.



- transportation : distance and way of transportation (rail, road, air, sea,…) and also conditioning-wares have to be precise.
- using : we have seen here-above that in general word, energy-consumption represents 80 % of the global impacts.
- end-of-live : the elimination-scenario has to be scheduled by the designer. For instance, some rules concerning the identification of the plastic-parts must be respected. One problem with electrical components such as fuses is that their life-duration is about 10 to 30 years, and it is not possible to know today what will be the recycling technologies at that time.

Environmental Indicators

The IEME-method will explicit the impacts of the products according 11 indicators, such as Raw Material Depletion and Energy Depletion. Afterwards, these impacts are drawn out on a spider-graph and can be compared to a target or to a previous version of the product.

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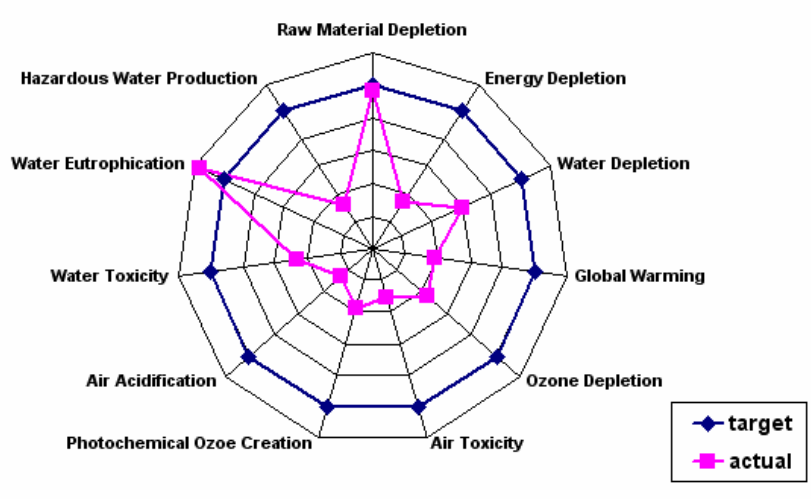
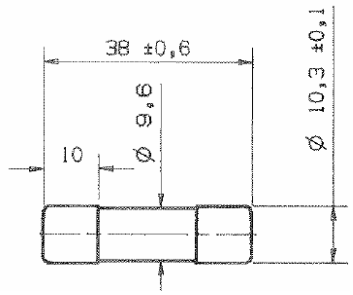


4. ENVIRONMENTAL PROFILES FOR FUSES :

The results of the EIME-method are difficult to analyze from an absolute point of view, specially for people who are not experts in environmental-science. Despite of that, it is possible and even easy to make comparisons between different solutions for a same level of functionalities and characteristics.

Cases of Cylindrical Fuses :

Here-after we will compare for two kinds of fuses, i.e. general purpose low-voltage fuses (gG) and general purpose ultra-fast fuses (gRB), two technologies of manufacturing, mainly regarding the way of connecting the fuse-element on the cup, i.e. soldering and spot-welding.



externally, the problem concerns same-size-fuses :

- diameter of ceramic body : 9.6 mm
- diameter of terminals : 10.3 ± 0.1 mm
- length : 38.0 ± 0.6 mm

Comparison of Watt-Losses :

Fuses and Technologies	**Watt-Losses at 0.5In**
10x38 gG spot-welded	0,6 W
10x38 gG soldered	0,54 W
10x38 gRB spot-welded	1,12 W
10x38 gRB soldered	1,0 W

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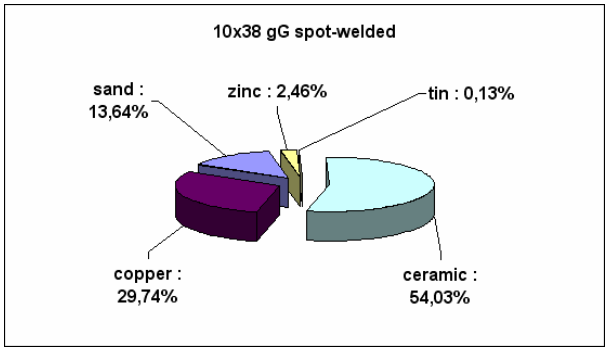
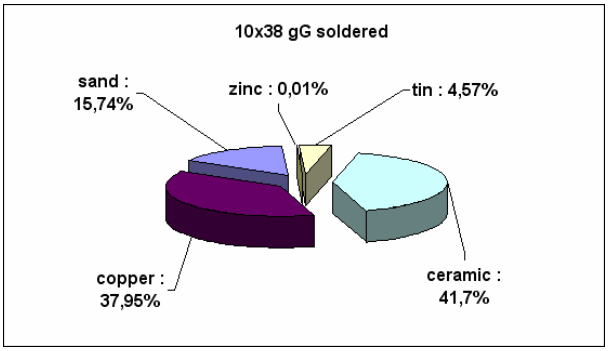
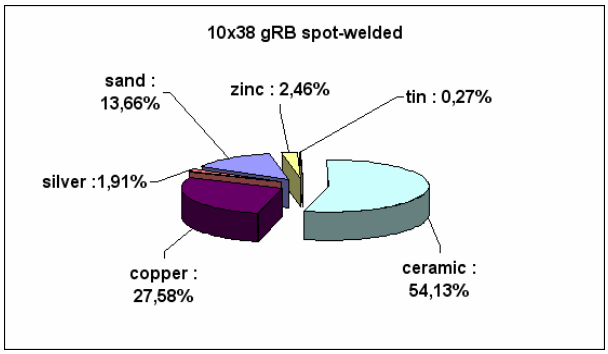
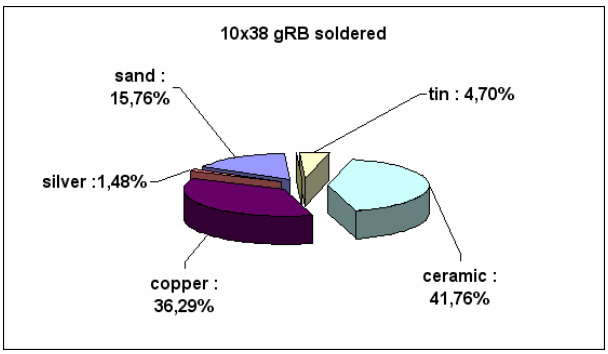
Comparison of quantities of materials :



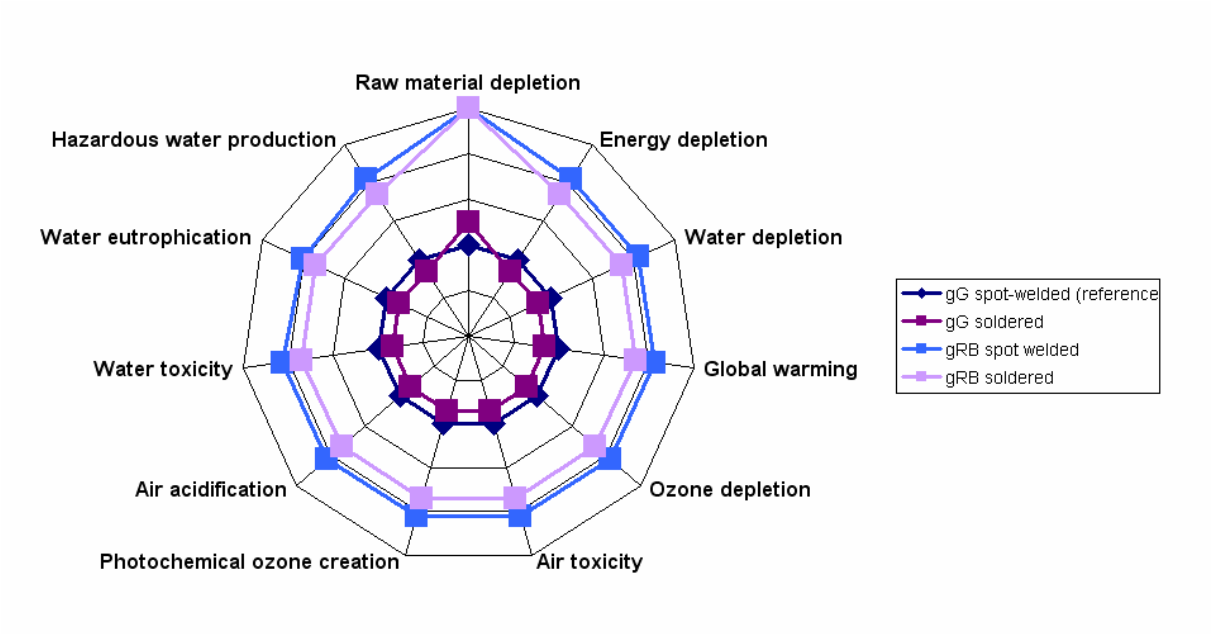






Environmental Impacts Spider-Graphs :

Afterwards, EIME-method allows to draw out the environmental-impacts under spider-graphs.



It is clear that for gG-fuses, the soldered solution gives better results for all the points, except for raw material depletion, mainly explained by a higher quantity of copper for the studied solution.

gRB-fuses have bigger impacts. Once more the soldered solution gives better results except for raw material depletion.

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5. CONCLUSIONS

The here-above example is very simple and it is clear that it can open large discussions, comparing fuse-solutions - here between low-voltage and ultra-fast fuses – and products offering the same functions, offered by different suppliers. Also interesting should be to compare protection-technologies, for example fuses and breakers.

Unfortunately, for the time being, industrials and especially industrials of electrical and electronic domains, have not achieved the publication of all the environmental profiles of their products. Maybe one reason for that is that they are not aware enough with the EIME-Method. However, this is a very positive way, for a continuous progress, taking an opposite view of compelling aspects of political regulations.

The database is promised to become a universal reference. In France, the GIMELEC (Groupement des Industries de l'Equipement Electrique) is promoting the EIME-Method. GIMELEC created and became the main financial partner of CODDE-company. CODDE is dedicated to be an expert structure for Eco-Conception. Its first aim is to distribute the EIME-software and also to make industrials sensitive to environment and to train them in this way. Through CODDE, companies can get a technical support for a better understanding and a better answer to regulations such as ROHS and WEEE-directives.

CODDE is engaged in an evolutive way, based on all his partners' experiments. Mutual sharing of these experiments will be profitable for any one of the partners, whatever will be his size, from the more little company to the largest group. And any one will be able to evaluate his environmental progresses through the same referential.

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