MACROECONOMICAL LEVEL

Cristian Teodorescu[1], Carol Lehr[2], Margareta Nicolau[2],
Constantin Mandricelu[3]

[1] CERTINDECO SRL – Bucharest, Romania

[2] National Research and Development Institute for Industrial Ecology – ECOIND, Panduri 90-92 Street, sector 5, Bucharest, Romania, ecoind@incdecoind.ro

[3] National Institute of Statistics, Bucharest, Romania

Abstract

Having as background the lasting global economical crisis, efforts towards the use of new, environmental friendly materials, design of new products and technologies that could be labeled "eco", finding alternative, renewable, dependable energy sources, efforts that should not impede the economy of the country neither the deterioration of the environment become more numerous and more intense. Evaluating such efforts at the enterprise level is done, with more and more success, by applying the Life Cycle Assessment (LCA) Method, usually in its two, more elaborated approaches: *cradle-to-grave* or, more recently and having an increased impact, *cradle-to-cradle*. The present paper illustrates an LCA methodology that generates LCA scores, aggregating impact of a given product or material upon the environment or humans, during the entire life of that product or material, from multiple environmental and health and safety points of view. The paper approaches the industrial sectors (metallurgy, chemistry, energy, transport, waste treatment) having a major impact upon the environment and analyses the structure of this impact, vs the structure of the contribution of these sectors to GDP and the dynamics of this impact, in time.

The objective of the work is to generate new, modern instruments for the objective building of new sustainable strategies at a macroeconomical level and help devising new policies that substantiate these strategies.

Keywords: Life Cycle Analysis, eco-efficiency, macroeconomical analysis

Introduction

The LCA approach is a powerful technique to assess the technological, environmental and health & safety impacts and performances of a given product or service, at the company level. Mangers can carry out such analyses for all their product portfolio, in order to detect which of their products are more environmentally friendly and where to take action to improve the environmental and health & safety record of their products. A scheme of how to set up a Life Cycle Analysis of a given product or service, at a company level is given in the following flowchart.

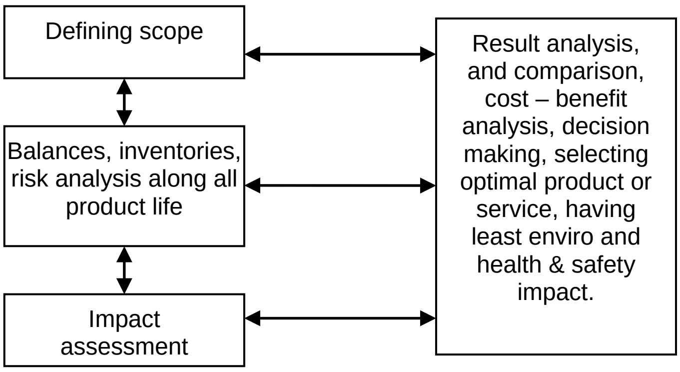

Figure 1. Flowchart for conducting an LCA at the company level.

Currently, national and EU statistics, though extremely complex and including indicators and metrics at all levels (e.g., GDP and its derivatives, but also very specific indicators such as unemployment at regional or country levels) are subject to critics. It becomes clearer and clearer that the economic indicators do not tell the entire story and using only such indicators in devising sustainable strategies will be misleading. In the search of new indicators that could quantify the economic aspects but also the environmental and health & safety performance of various industrial branches, the LCA approach seem the tool at hand.

But in devising a new metrics, one must keep in mind that such a new metrics havs to be compatible with the existing metrics, with the current set of indicators.

The following paragraphs will try to explain how LCA evgaluates and quantifies, at macroeconomical level, all kind of environmental and health and safety impacts, along all the life cycle of industrial products, from their production to their final disposal. (*cradle to grave*). Such an LCA indicator would constitute an eco-indicator trying to include as much as possible of the phisical exchanges with the environment (inputs: resource extraction and exploitation, land use, power generationrilor; outputs: emissions in the 3 media, air, water, soil). The most recent approach is presented in the following figure (EC, JRC, IES, 2011a).

The methodology used in the present work is based on the Dutch methodology devised to derive LCA indicators at company level (Eco-Indicator 99). The Dutch approach is transposed at macroeconomical level. The general set-up of teh Dutch methodology is described below.

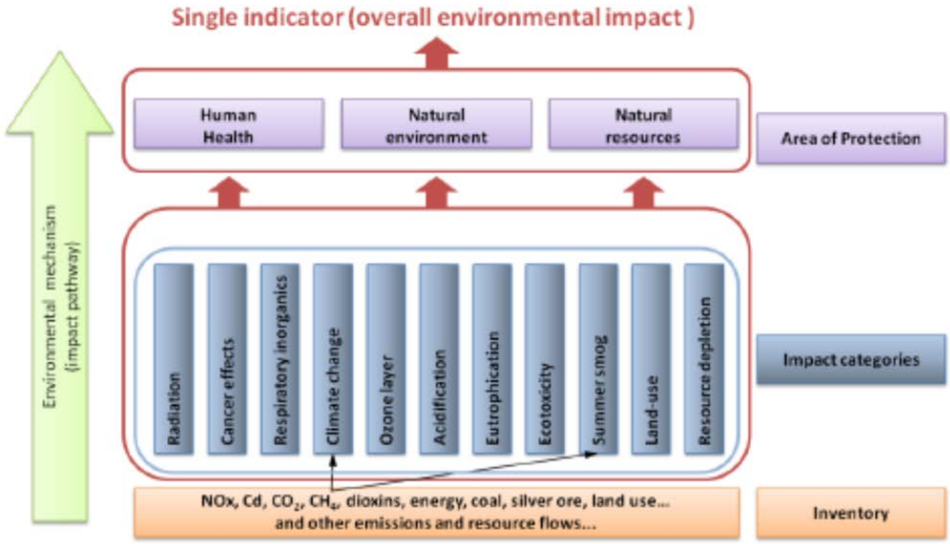

Figure 2. General structure of teh LCA methodology for devising a new eco-indicator.

Any flux in the industrial environment is a source of environmental or health & safety concern. The most important, retained for the methodology are NOx, SOx, CO_2, NH_3, pesticides, heavy metals and their compounds, VOC, fluorochlorohydrocarbons, radioactive materials, PAH. They are viewed as triggering factors, leading to First Order Effects like, natural habitat modification, water quality, area occupied by humans, GHG accumulation, ozone layer reduction, new radioactive sources, VOC plumes, depreciation of teh quality of air, water, agricultural products.

As a cascading consequence, these First Order Effects generate Second Order Effects like, reducing the energy source availability for future generations, regional effects upon vegetation (deforestation, desertification), disparition of some specia, acidification and eutrophication of waters, accumulation of toxic materials in the environment, changes due to climate evolution, increased incidence in skin, eye, lung and radioactive induced diseases, cancer. Finally all these effects are aggregated in 3 categories: the affection of teh resource invetory available for future generations, alteration of ecosystems and modifications of people's health. The result is a scale of impacts for each material, for each energy source, for each industrial operation, devised by calculating a LCA score for each such item. Such scores are connected with the production of each industrial output of the entire economy. Contribution of each such outputs are readily available by multiplyuing the production of a given item by its LCA score based upon the described methodology. Some examples are given in the Table below.

Table 3. Examples of LCA scores and product contribution

Industrial products	2003 Production, Thou tons	LCA score Thou points /1000 tons	LCA Ecoindicator Thou points
(1)	**(2)**	**(3)**	**(4)=(2)x(3)**
Wood processing, pulp and paper industry			
Paper, cardboard and pasteboard	489	247.18	120873
Paper	457	97.26	44449
Newsprint	43	97.26	4182
Chemistry and synthetic and man made fibres			
Hydrochloric acid	160	39	6240

Results

The LCA scores accompany the production levels for each industrial branch. They add the environmental and health and safety impact of the given product to its contribution to the economic added value. The following figure illustrates the contribution of the metallurgy sector to the physical production and to the environmental and health and safety impact.

The following figures illustrate large discrepancies between the contribution of various metallurgical products to the physical production of the branch and to the LCA impact. At the country level, policies should therefore be directed to reduce the production of pig iron that has a much larger negative effect on the environment and on health and safety than other metallurgical products.

Calculations were carried out for a multitude of industrial products manufactured in Romania. Similar conclusions can be inferred form the analysisi of any other indutrial range of products in the Romanian economy.

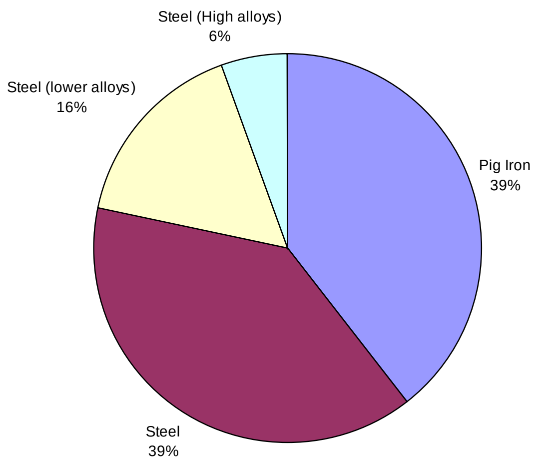

Fig 3a. Contribution of various ferrous products to the metallurgy physical production

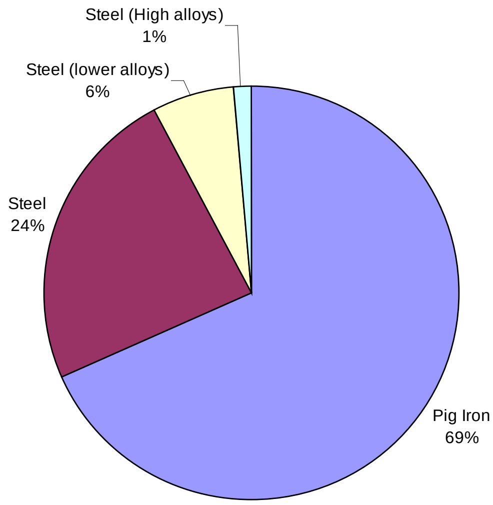

Fig 3b. Contribution of various ferrous products to the LCA impact

An interesting outcome of the LCA analysis is the dynamics of a given LCA score. As can be seen from the figure below, in the case of the Aluminum industry, the LCA analysis shows that due to the increase of recycled metal used in production, the LCA score significantly decreased in the last years, indicating a very good progress of this industry towards sustainability.

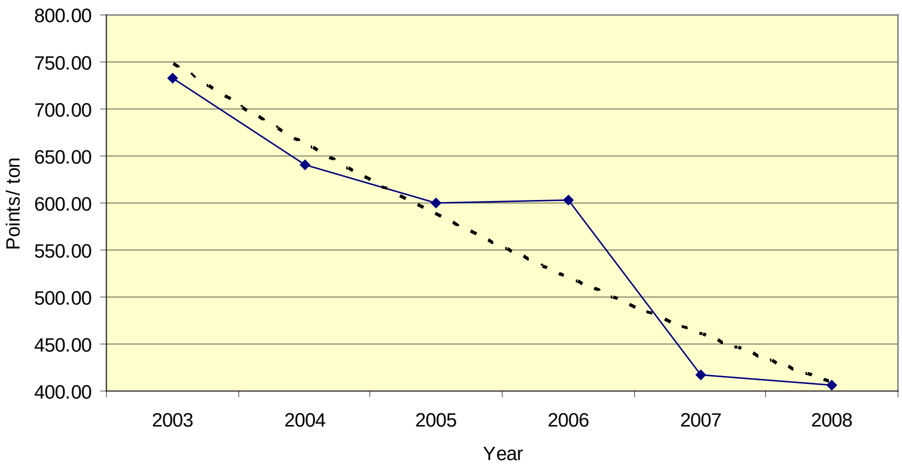

Figure 3. Evolution of an LCA score (Aluminum industry)

The power of the LCA procedure is illustrated also by the possibility of devising a synthetic eco-efficiency index at the macroeconomic level, using the formula

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$$\text{Eco-efficiency}=\frac{\text{GDP variation,\%}}{\text{LCA Score variation,\%}}$$

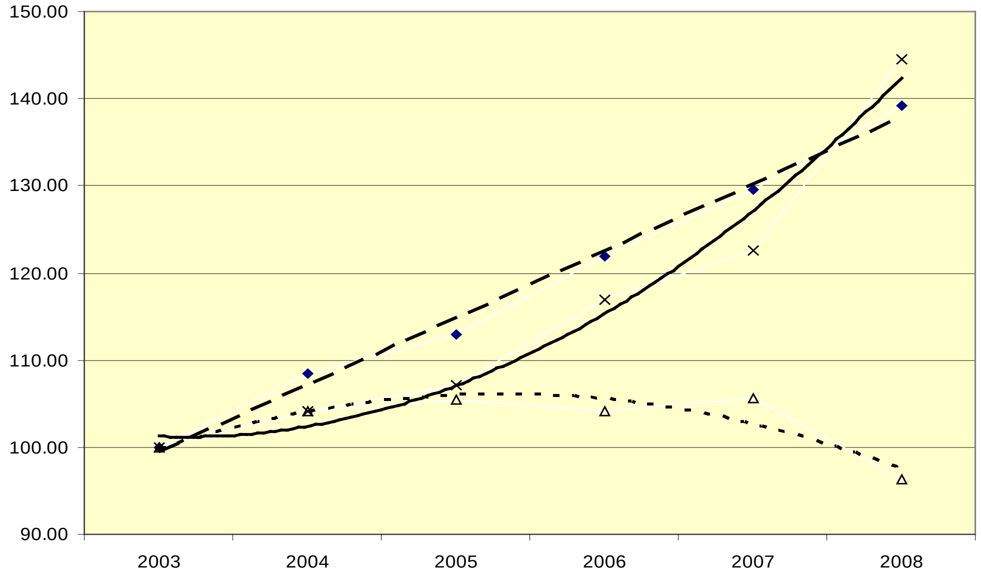

Figure 4. Dynamics of GDP (dotted line with positive slope), macroeconomic LCA score (the concave dotted curve) and eco-efficiency (solid curve).

The above figure shows that though the GDP grows, the aggregated LCA score exhibits a concave dynamics and decreases after 2006, illustrating a reduced environmental impact of the industry and a decoupling between the development and the environmental impact. The eco-efficiency index shows a marked increase, a positive trend illustrating the progress of the Romanian economy towards sustainability.

References

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