8 Cost-efficient solutions can speed up ecological (and social) development – A proposal

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Abstract

The view that positive ecological, economic and social development need to be combined for sustainable development (SD) is a generally accepted concept. In practice, however, the focus is on achieving ecological advantages to support SD, e.g. through IPP (integrated product policy), ecolabelling etc.

This paper shows that integration of economic advantages – by using them sensibly – can achieve huge ecological savings, compared to ecological advantages alone. By way of example, the paper discusses a case in which part or all of the economic advantage of low-cost products is invested in better thermal home insulation, thus saving heating energy. This mainly yields savings of primary energy and various emissions resulting from the burning of non-renewable resources.

The paper formulates a proposal to better support and speed up SD, by using low-cost products and investing part or all of the resulting cost advantage in ecologically sensible optimisations. In all options investigated, this would lead to much greater ecological gain than could be achieved by just purchasing the ecologically most advantageous product. The cost advantage can of course also be invested in social optimisation, such as improving medical services.

The paper concludes that there is no clear relation between ecological and environmental performance. Low-cost products can have excellent results in quantitative life cycle analysis (LCA) and vice versa.

G. Huppes and M. Ishikawa (eds.), Quantified Eco-Efficiency, 211–219.

8.1 Three-pillar model of sustainable development

The three-pillar model of sustainable development (SD) was introduced at the Rio conference and elsewhere. It stresses the importance of developing the ecological, economic and social pillars to overcome fundamental problems like energy resource exhaustion, the greenhouse effect, the increasing gap between first and third world countries or that between the poor and the rich, etc. It has been accepted by all societal groups, including citizens, politicians, NGOs (non governmental organisations), industry etc.
A source of debate between different groups is of course the relative importance of the different pillars. Environmentalists tend to attach the greatest importance to the ecological pillar, while industry might emphasise the economic pillar. This aspect is not discussed here, but results will show the great importance of the economic pillar.

Although many political programmes are based on this three-pillar model of SD, activities seem to be restricted to strengthening the ecological pillar only.

This paper focuses on the economic pillar and especially on the importance of low-cost products and the opportunities they offer to support ecological and social development. The cost advantages of these low-cost products, as derived from economic life cycle cost (LCC) are converted quantitatively into ecological gains, quantified by ecological life cycle analysis (LCA).

The paper partly answers some more general environmental questions:

1. What is the importance of low cost products for SD?
2. How can an industry based on non-renewable resources support SD?
3. Can consumption be in accordance with SD?

8.2 A proposal for supporting SD

People often have to choose between different products, all serving the same needs, all differing in ecological and economic cost, as measured e.g. by LCA and LCC. A very effective strategy to support SD would be to use low-cost products and invest part or all of their cost advantage in optimisation activities which are ecologically and/or socially beneficial.

Examples of ecologically beneficial activities include investment in better thermal home insulation to save heating energy and thus greenhouse emissions, while an example of social benefits would be investment in better medical service. This strategy is very simple, since no profound knowledge of LCA is needed and no LCA has to be applied for specific products. It avoids wasting scarce money on more expensive products and makes money available for optimisation. In many cases, like those discussed in this paper, this strategy leads to huge ecological (and social) improvements. The effectiveness of this proposal can and should of course be verified in doubtful cases.

8.3 The strategy

The following aspects of the strategy are briefly discussed:

- Are other strategies – like eco-efficiency thinking – more effective?
- What is the general importance of cost in SD?
- Does external ecological cost greatly influence LCC?
- Which ecological savings result from a quantitative conversion of economic advantages?
- How can one deal with rebound effects by using the money saved in a positive or negative way?

Role of eco-efficiency in SD

Eco-efficiency is interpreted here as a method to identify optimal ecological, economic (and social) options to satisfy human needs. Continuous improvement of the eco-efficiency of products is a clear target for industry. Some fear, however, that eco-efficiency alone will not be able to solve the ecological problems humankind is facing, and that even the most eco-efficient option can run up against ecological limits, e.g. if it is used by more and more people. Hence, eco-efficiency is a necessary but not a sufficient condition for SD. Additional methods would be needed to deal with increased consumption by growing numbers of people. One of these could be the strategy discussed here, as well as other strategies like sufficiency thinking.

Importance of cost in SD

Cost is an important, perhaps the most important economic parameter. Of course, cost is viewed here from a life cycle perspective, i.e. throughout a product's use time. Low cost is strongly and often positively interconnected with all three pillars of SD:

- Use of low-cost products or product systems saves scarce economic resources.
- Use of low-cost products supports social development, since many people are better able to afford low-cost than high-cost products.
- Use of low-cost products can also support social development, by saving money which can be used for social optimisations, like better medical service.
- Use of low-cost products can support ecological development, since using low-cost products saves money which can be used for ecological optimisations, like better thermal home insulation.

External ecological cost

Discussions of the advantages of low-cost products for SD must include the influence of external cost, since this external cost – if internalised – could cancel out the economic advantage. Only external ecological costs are discussed here, like the cost of CO_2 emissions. The literature provides cost figures for CO_2 emissions ranging from some 4 €/t up to 195 €/t.[1] This large spread in cost figures makes reliable assessment difficult. The spread results from the influence of issues such as economic development, population growth etc., which are beyond the scope of this paper.

Nevertheless, the highest cost figure can serve to evaluate the maximum influence of external CO_2 cost on product cost. The above maximum cost

[1] E.g. European Commission DGXII ExternE Project and others. Highest CO_2-cost e.g. is from Masuhr et al. (1991).

of 195 €/t for CO_2 (Masuhr et al. 1991) is a limit cost required to reduce CO_2 emissions in industrialised countries to 25% of today's emissions. This percentage derives from the target of reducing greenhouse gases by a factor of two worldwide. Industrialised countries need to achieve a greater reduction, i.e. by a factor of four (reduction to 25% of today's emissions) so that greater emission rights can be granted to third-world countries to stimulate their industrial development. In addition, reduction activities will of course become increasingly expensive if the most efficient measures are implemented first. In this sense, 195 €/t is a limit cost for CO_2 to achieve the final and most costly reductions down to 25% of today's CO_2 emissions.

Internalisation of this maximum limit cost for CO_2 of 195 €/t does not greatly influence LCC. By way of an example, let us consider the production of a piping system for drinking water and waste water: the external cost of producing such a system, supplying some 21 houses,[2] would increase the LCC only by some 6.5%, from € 82,163 to € 87,506 (see Table 8.1). If CO_2 emissions are internalised, i.e. converted into monetary value, their LCA result has to be reduced from 27.4 to 0 t (see Table 8.1) to avoid double counting. And since this cost is avoidance cost, the energy demand would also be reduced to around zero. A cost increase of some 6.5% would not be regarded as prohibitive, since competing offers for the work involved would usually differ by much more than 10%.

Other examples, involving windows (Spindler 1999) architectural foils etc, show even smaller increases in LCC. Thus, internalisation of ecological external cost will in many cases not have a great impact on LCC. It should be considered that this internalisation reduces not only CO_2 emissions but also the demand for primary energy (mainly from non-renewable resources) and the emissions of carbon monoxide (CO), nitric, sulfurous acids (NOx, SOx), polycyclic aromatic hydrocarbons (PAH), mercury (Hg), etc.

Table 8.1 shows some LCC and LCA results for the piping system. The results have been averaged over different material options for this system, like PVC (Polyvinylchloride), PE (Polyethylene), cast iron and cement pipes. Cost in Euro (€) and ecological impacts as energy demand in Gigajoules (GJ) and greenhouse gas emissions are shown as negative figures.

[2] See Reuter (1998); parallel to this LCA a LCC study was realised.

The table compares the ‘normal’ piping system with an ‘internalised’ piping system, in which CO_2 is internalised at a maximum CO_2 cost of 195 €/t.

Table 8.1 Some LCC and LCA results for a water piping system

Average piping system	**LCC results**	**LCA results**	
	Cost [€]	**Energy demand [GJ]**	**Greenhouse gas emissions [t CO_2]**
‘Normal’ piping system	- 82,163	- 569.3	- 27.4
‘Internalised’ piping system (195€/t CO_2)	- 87,506	≈ 0	0

Conversion of economic advantage into ecological gain

One efficient energy saving option would be to invest money in better thermal insulation of the walls of the houses. The LCC results presented here derive from an actual sanitation project at a housing estate in Ludwigshafen, Germany.[3] LCA results for thermal insulation were calculated with the help of well-known formulas for heat savings, based on a very efficient heating system. The results of this calculation are shown in Table 8.2, which presents cost and two LCA results for primary energy saved and greenhouse gas emissions saved by investing money in better thermal insulation. The fourth row represents the same situation as row 3, but was calculated for an investment of 1 € instead of investing in 1 m^2 of thermal insulation. LCA results are positive, since they are savings.

The example corresponds to an avoidance cost for CO_2 of 65 €/t, which can be compared with the cost figures dscussed in Section ‘External Ecological Cost’. It is clear that the avoidance cost for CO_2 will increase to some 200 €/t in the future, if the CO_2 emissions are to be reduced to 25% of today’s emissions.

[3] The sanitation project is described in a BASF eco-efficiency study on thermal insulation of houses: www.sustainability.basf.com/de/sustainability/oekoeffizienz/

Table 8.2 Cost and two LCA results for thermal insulation systems

Thermal insulation	LCC result Cost [€]	LCA results Energy saved [GJ]	Greenhouse gas emissions saved [kg CO_2]
1 m^2	- 44.5	+ 11.9	+ 680
0.022 m^2	- 1.0	+ 0.267	+ 15.3

This example can be used to convert the economic advantages of low-cost products into ecological savings. The ecological gain from investing money in better thermal insulation is compared here with the economic and ecological impacts of an average drinking water and wastewater piping system (see Table 8.3). The results show that cost increases of only 2.2% and 2.6% can compensate 100% of, respectively, the greenhouse gas emissions and energy demands associated with the production of an average piping system. Neutralising energy demand (row 'energy neutral pipes') in this case is slightly more expensive than neutralising greenhouse gas emissions only (row 'climate neutral pipes') and more than neutralises the greenhouse gas emissions. In this sense, small economic advantages allow huge ecological optimisations.

Table 8.3 LCC and some LCA results for an average piping system

Average piping system plus thermal insulation		LCC result	LCA results	
Piping system	Plus thermal insulation[m^2]	Cost [€]	Energy demand [GJ]	Greenhouse gas emissions [t CO_2]
'normal pipes'	0	- 82,163	- 569.3	- 27.4
'climate-neutral pipes'	40	- 83,956	- 90	0
'energy-neutral pipes'	48	- 84,292	0	+ 5.1

Positive and negative rebound effects

The cost advantage of low-cost products can be converted into huge ecological optimisations, as shown above. I regard this as a positive rebound effect. Some fear, however, that the money saved could also be used to finance ecologically negative rebound effects.

A positive rebound effect could be the implementation of the optimisation measures shown in Table 8.3, using money to reduce the energy demand or the greenhouse gas emissions required to produce the product.

A negative rebound effect could be to spend the same amount of money to buy gasoline and just burn it for fun. A quantitative comparison shows that one person investing in the positive rebound effect would save as much primary energy and greenhouse gas emissions as eight to ten people would waste investing the same amount of money in the negative rebound effect. Hence, it is more efficient to invest in a positive than in a negative rebound effect.

Optimisation potential and 'climate-neutral products'

It is clear that investing money in ecological optimisation is only an option. Nobody can be forced to do so. In the following, private and public procurement of goods are distinguished, since they differ in their accountability for the money spent.

Public procurement is accountable to the public for the way money is used, and the public also influences and controls it. In addition, public procurement offers many opportunities to invest money for ecologically useful optimisations, e.g. better thermal insulation for houses owned by a public institution.

Various strategies can be used to prevent private consumers from investing in negative activities and to stimulate them to invest in positive activities. One option would be to make balancing activities available to people who do not have the opportunity to implement special optimisation potentials in their personal environment. This could be achieved by means of a concept like 'energy-neutral products' or 'climate-neutral products' (see Table 8.3) or 'carbon-neutral products'.[4] This would be similar to concepts

[4] For more information please contact the author.

like 'climate-neutral flights', where a surcharge is paid on a flight ticket by people who wish to balance the ecologically negative CO_2 impact of their flight,[5] or similar to systems in which a higher price for products imported from the third world is used to balance social injustice ('fair trade'). In many cases, the price increase for 'energy/climate/carbon-neutral products' would only be some 1 to 3% of the normal product price.

References

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[5] For more information: www.myclimate.org