ECONOMIC ASPECTS OF ENVIRONMENTAL PRODUCT DESIGN

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1. INTRODUCTION
Optimizing is the core of micro-economic analysis. The societal rationale for this behavior is that it enhances societal optimality as specified in Pareto-oriented welfare theory. In product design technical and behavioral variables usually can be related to the central value of (in the end) consumer utility or welfare. This welfare is measured practically in money terms. Marginal analysis in welfare theory specifies the individual and societal optimum conditions. Environmental damages do not fit into this framework. Being external effects with public goods characteristics no monetary measure of (negative) consumer utility or welfare is available. So environmental values are excluded from normal optimum analysis in societal and micro-economic analysis alike. Still at least some optimality conditions, like in minimum cost analysis, would apply if a general measure of environmental damage were available. This measure of effects on environmental values can be constructed for polluting effects of products, using a simplified ecological model. This model converts emissions into 'potential damage'. Addition and subtraction of different types of emissions then becomes possible. In this paper I will explain how this information enables the designer to include environmental aspects in most types of normal optimum analysis.

2. THE VALUATION OF ENVIRONMENTAL EFFECTS
Specifying all possible chains of cause and effect as induced by design decisions may be possible in principle but not in reality. Correspondingly a designer might specify the chains leading to the consumer utility of his product in principle, but not in reality. If he tries he will learn a lot about relevant factors and mechanisms, the weather, the climate, the education and love affairs of potential buyers, family structures, housing facilities, etc. To some extent this analysis is useful, especially in the creative phases of design. When optimising a product design though these factors are shoveled into a black box and utility is measured in terms of the resulting potential market demand. Of course this demand for a product is the result of all possible uses and their valuation by all potential users. Likewise a full specification and valuation of all relevant environmental effects is impracticable. What can be specified is the potential damage of pollution.

Environmental values may be grouped into three main fields; those on human health, on nature, and on the welfare from material products. Not all environmental effects emanating from products are relevant. Effects of decisions in product design normally cannot be specified spatially. So all negative environmental effects that exceptionally occur only when the product is made or used in a specific location should not be
also its environmental effects. Its net value is the only justification for negative effects on the environment.

FIGURE 1. Processes and environmental effects of the use of a product.

4. SOCIETAL RATIONALITY.
All methods of emission reduction bring costs to society. For most production-consumption-wastedisposal systems society means the world at large. Every country, firm and consumer tries to confer these costs on others. Societal rationality, be it global or (supra) national, asks for minimizing of costs more or less regardless of their distribution. No central agency can plan these minimum cost points for all production and consumption systems even when given a set of products and processes. Product design by nature cannot be planned at all, but may at best be influenced. What is possible centrally is the societal valuation of negative effects on the environment. A unified system for measuring potential damages as described in the preceding paragraphs may guide individuals, firms, private organizations, and governments alike in their search for economically sound environmental improvements. So government planning at the physical level in principle leads to excessive costs, being suboptimal and not being able to plan design. Also physical planning is difficult to implement. The regulations and procedures used cause cumulative costs, totalling to several percent points of the national income within decades.

So why is physical regulation by governments used at all in environmen-