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ANALYSIS

The need for combining IEA and IE tools: The potential effects of a global ban on PVC on climate change

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ABSTRACT

Over the last decades the concepts of Integrated Environmental Assessment (IEA) and Industrial Ecology (IE), both claiming to provide analyses and solutions for sustainability issues, have been developed separately as they emerged in response to questions from different policy-fields. In both fields, specific tools are used to support national and international environmental policy. The focus of IEA and IE tools, however, is different. IEA tools focus on one or a limited number of specific environmental issues. They often model the chain environmental processes with high spatial (and temporal) resolution, but have a low resolution for the material structure of the economy and only partly take into account indirect effects that occur *via* physical and socio-economic linkages. IE tools take into account all environmental issues related to a specific substance or product. They have a high resolution for the material structure of the economy and take into account indirect effects that occur *via* physical linkages, however, their environmental modelling is very limited. Both IE and IEA tools have proven to be very useful and neither is superior to the other. However, a combination of both can provide additional information that can be used for more effective policy making. We use the case of a hypothetical world-wide ban on PVC to show that a measure that is not directly related to climate change could still have significant climate effects. This indirect effect is a result of the linkages of material flows in society. We show that IEA tools are not well suited to include these types of effects and that IE tools can fill this gap partially. What is really needed is a broader systems perspective that takes into account the full range of possible side-effects of environmental policy measures.

1. Introduction

Integrated Environmental Assessment (IEA) and Industrial Ecology (IE) are important concepts in the realm of sustainability and environmental sciences. Both concepts use a systems perspective to analyse similar environmental and sustainability issues. Therefore both concepts are quite comprehensive if one looks at the definitions that are used by their advocates (for Integrated Environmental Assessment see *e.g.*: Hettelingh et al., in press; Van der Sluijs, 2002; Rotmans and Dowlatabadi, 1997; for Industrial Ecology: Lifset and Graedel, 2002; Allenby, 1999). Although the definitions of the concepts are overlapping to a large extent, the tools that practitioners in the fields use are distinct both in their structure as well as in the questions they answer. To our knowledge this is the first attempt to illustrate the differences between these two concepts when applied to a specific case and to highlight the possibilities for combing them in a more comprehensive analysis.

Integrated Environmental Assessment tools are often used for scenario analysis, to calculate future trends in emissions

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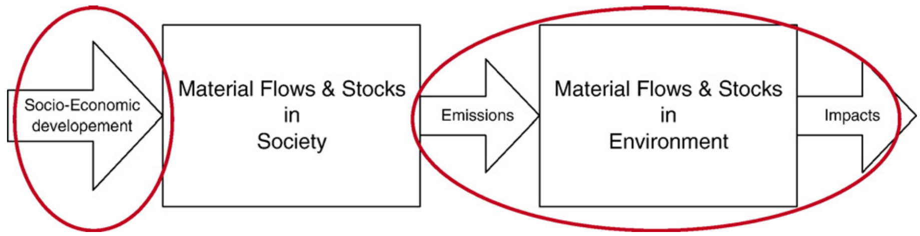

Fig. 1 – The main focus of Integrated Environmental Assessment tools.

and related environmental issues. These calculations are made on the basis of socio-economic indicators at the macro-level, such as developments in GDP and population. Current IEA tools are built around specific, large-scale environmental issues such as climate change and acidification. Although existing Integrated Environmental Assessment tools contain complex dynamic models of the economy, the resolution in terms of material flows in society is rather low (Fig. 1). The emissions are calculated on the basis of the dynamic development of a few highly aggregated economic sectors. Interconnections between material flows within society are not systematically accounted for. However policy measures aimed at reducing environmental issues mostly have a number of widely different impacts, often also outside the realm of the environmental issue they address (Raadschelders et al., 2003). Examples are: economic accumulation, relocation of pollution, substitution of one emission by another, dilution of emissions and co-recycling of contaminants (Raadschelders et al., 2003). Studies in the emerging field of Industrial Ecology have clearly shown that side-effects of environmental policy measures are often caused by changes in the closely interconnected material flows in society (*e.g.* Ayres and Simonis, 1994; Ayres and Ayres, 1996; Baccini and Bader, 1996; van der Voet et al., 2000; Bourg and Erkman, 2003). Because of this interconnection, problem shifting from one substance to another, from one environmental problem to another, or shifts in time and space often occurs as a result of policy measures. Co-benefits and co-damages of policy measures that occur *via* the interconnections of material flows in society can easily be overlooked by IEA tools.

The aims of Industrial Ecology are, as indicated above, quite similar to those of IEA. In contrast, the tools connected with this concept are quite different. Industrial Ecology tools are mainly used to analyse and assess the environmental effects of changes in material flows in society. Material Flow Analysis (MFA) and Substance Flow Analysis (SFA) are used to analyse the flows of materials or specific substances in society and their interconnections.

The resolution of IE tools is high in terms of material flows in society and their interconnections, for example linked to product life cycles, and in how these material flows result in emissions (Fig. 2). In the environment, on the other hand, the resolution is low: environmental impacts are modelled roughly or not at all like in MFA/SFA, or in terms of potential impacts with low spatial resolution like in LCA. Furthermore, the link with macro-economic drivers is weak. The result of most LCAs is only valid if the differences that are described are marginal from a macro-economic point of view. MFAs and SFAs describe also non-marginal changes but they are not systematically linked to socio-economic developments.

Our hypothesis is that the systems perspective on material flows in society that is provided by Industrial Ecology tools can be used in addition to Integrated Environmental Assessment tools, (1) to detect and therefore prevent different forms of problem shifting, or in other words to identify co-benefits and co-damages of environmental policy measures, techniques, transitions *etc*., and (2) to identify potential environmental impacts of policy measures aimed not at specific environmental issues, but at materials and products in society.

In this article we will show that tools related to Industrial Ecology analysing material flows in society can provide important additional information compared with IEA tools. In order to illustrate this we will use the example of a hypothetical world-wide ban on the production of PVC. This example is chosen for several reasons. First of all, it refers to a long-standing and still ongoing environmental debate. For that reason, PVC has been subject to policies both on the national (VROM, 1997) and on the European level (Commission of The European Communities, 2000; European Parliament, 2001). Secondly, phasing out PVC implies a large-scale change which cause far reaching changes in industrial sectors and thus possibly also in the environmental flows, both directly and indirectly. In the third place, it aims at changes in material flows in society and therefore is suitable as a case to illustrate the value of using Industrial Ecology tools in addition to an Integrated Environmental Assessment approach. In Section 2,

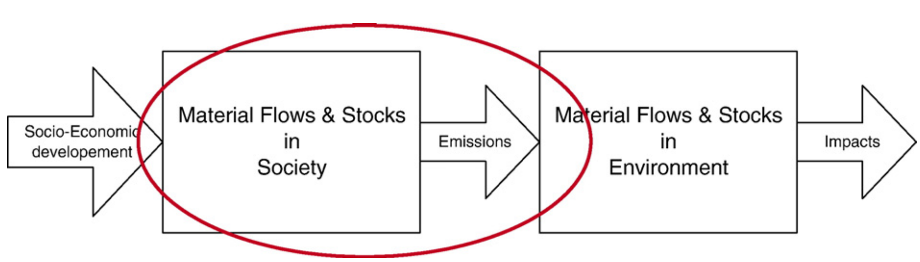

Fig. 2 – The main focus of Industrial Ecology tools.