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Material Flow Analysis, Discourse Analysis  
and the Rhetorics of (Ecological) Economics

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Mit dem vorliegenden ersten Working Paper aus dem Forschungsprojekt „Nachhaltige Entwicklung zwischen Durchsatz und Symbolik“ (NEDS) versuchen wir, „Durchsatz“ und „Symbolik“ aufeinander zu beziehen. Wir greifen dabei auf eigene Vorarbeiten zurück, z.B. zur Methode der Materialflussanalyse und zur wirtschaftswissenschaftlichen Rhetorik-Debatte. Dieser erste Versuch, den Bereich „zwischen“ materiellen und symbolischen Aspekten nachhaltiger Entwicklung zusammen zu denken, steht am Anfang einer ausführlichen Auseinandersetzung mit diesem Forschungsfeld, bei der NEDS verschiedene methodische Ansätze zusammen bringen wird. Der vorliegende Text basiert auf einem Vortrag der Autoren auf der „Frontiers 2“-Konferenz der European Society for Ecological Economics, die im Februar 2003 in Puerto de la Cruz (Teneriffa) stattfand. Wir haben bei der Arbeit an der vorliegenden Fassung sehr von den Diskussionen im Rahmen dieser Konferenz profitiert.

Hamburg, im März 2003

In the following first working paper of the research project “Sustainable Development between Throughput and Symbolism” (NEDS), we attempt to relate throughput and symbolism to each other. We rely on our previous work, for example on the method of material flow analysis and on the debate on economic rhetoric. This first attempt to relate to each other material and symbolic aspects is the beginning of a detailed analysis of this field of research, in which NEDS will combine different methodological approaches. The text is based on a presentation at the “Frontiers 2” conference of the European Society for Ecological Economics, which took place in Puerto de la Cruz (Tenerife) in February 2003. The present version of the paper has gained a lot from the discussions during that conference.

Hamburg, March 2003

Fred Luks

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## **Zusammenfassung**

Wissenschaftliche Analysen von Prozessen, die zu (nicht-)nachhaltigen Entwicklungen führen, konzentrieren sich häufig entweder auf materielle Aspekte (Umweltverträglichkeitsprüfung, Materialflussanalyse [MFA]) oder – sehr viel seltener – auf symbolische Aspekte. Das Diskurskonzept bietet die Möglichkeit, beiden Dimensionen sozio-ökonomischer Entwicklung gleichermaßen Aufmerksamkeit zu schenken. Während materielle Ansätze wie die MFA in der Ökologischen Ökonomik bereits anerkannt sind, gilt dies nicht für Analyseformen, die sich auf das Diskursive und die soziale Konstruktion wissenschaftlicher und politischer Fakten konzentrieren. Eine Kombination dieser Methoden verspricht ein besseres Verständnis der Einbettung von Entscheidungsprozessen in einem Feld, das materielle Aspekte aufweist, oft aber durch symbolische Strukturen und Prozesse bestimmt wird. Wir zeigen, wie die Verbindung zwischen MFA und Diskursanalyse zu einer methodologischen Kritik an der MFA und einem besseren Verständnis regionaler Nachhaltigkeitsdiskurse beitragen kann.

## **Summary**

Scientific analysis of processes leading to (un-)sustainability often focus on *either* the material aspects (environmental impact assessment, material flow analysis) *or* – far less often – on the symbolic aspects of the issue. The concept of discourse offers the chance to pay attention to both material and symbolic dimensions of socio-economic development. While "material" approaches such as material flow analysis are established within the community of ecological economists, this is not true for analytical frameworks that concentrate on the discursiveness and social construction of scientific and political facts. Combining these tools promises a better understanding of how decision processes are embedded in a field that has material aspects, but is often dominated by symbolic structures and processes. In focussing on the link between material flow analysis and discourse analysis, we show how this combination can contribute to a methodological critique of MFA and a better understanding of regional discourses on sustainable development.



## **1. Introduction**

The goal of sustainable development is a core issue of ecological economics. We are in a situation where science becomes ever more necessary, but at the same time ever less sufficient for the societal relevant definition of truth. At the same time, the stakes in scientific work and political decisions are very high. This new situation is dominated by global ecological problems as well as the call for a development course which is sustainable in ecological, but also in social and economic terms. Post-normal science (PNS) is a reaction to this new situation. PNS wants to help solving problems of the (post?) modern age. PNS has obvious connections to the combination of material flow analysis (MFA) and discourse analysis (DA) that we will present in the following. MFA and dematerialization are linked to PNS in their acknowledgement of knowledge problems and the need to accept ignorance as something that will not get away but is here to stay (Luks 1996). Discourse analytic approaches are relevant for PNS because of their implications for decisions processes (Luks 1999). The author of the most influential study on the discourse on environmental policy, Maarten Hajer (1995, 282f.), argues for “reflexive ecological modernization”, which has connections to PNS, since it “would seek a strengthening of public, inter-discursive forms of debate in order to *contextualize expert opinion* and in order to make environmental politics a matter of deliberate and negotiated choice for certain scenarios of societal modernization. (...) (T)he old pair of the ignorant 'layman' and the omniscient 'expert' no longer encompass reality.” (our emphasis) We have argued at other places that this feature relates PNS with approaches interested in the discursive dimensions of (ecological) economics (Luks 1998). This paper is an attempt to broaden this perspective by applying DA to MFA. This application is part of a broader attempt to bring together both approaches in the context of an interdisciplinary project.

## **2. Considering material and symbolic aspects of sustainability: the NEDS-project**

The program “socio-ecological research” of the German Federal Ministry for Education and Research supports transdisciplinary social-scientific research with the explicit vision of contributing to changes toward sustainability in society and economy. Albeit the program is not focussing on economic aspects of sustainable development, its implications for ecological economic research are obvious. Since the direction of the program is partly explicitly following a social constructivist and discourse analytic direction, the projects under this program could contribute to a better understanding of the symbolic aspects of ecological-

economic change. Bringing together post-normal aspects of ecological economics (high stakes, uncertain scientific inputs, role of extended peer communities, problem orientation), environmental accounting (such as MFA) and discourse analysis and constructivist approaches offers a chance to explicitly take into account the complex relationship between science and policy. A research project in the socio-ecological program mentioned above is trying to achieve exactly this on the regional level. “Sustainable development between throughput and symbolism” (Nachhaltige Entwicklung zwischen Durchsatz und Symbolik, NEDS) analyzes “natural”, economic, discursive, and spatial aspects of sustainable development as discourse. Since the project mentioned only started in mid 2002, we will present methodological facets with an emphasis on the method of MFA and how discourse analytic approaches can be applied in connection with this method of accounting physical flows of the economy. Further information can be found at [www.neds-project.de](http://www.neds-project.de) or [www.seri.at](http://www.seri.at).

Among other things, NEDS will analyze the “economic construction of ecological reality” (Luks 2000). In our effort to understand the realm between throughput and symbolism, we will focus on two things that did not gain sufficient attention so far: the importance of certain terms and concepts in the discourse on sustainable development, and, secondly, the spatial dimension of the issue. Sustainable development is mostly seen as concept emphasizing temporal topics such as development and intergenerational justice. That everything concerning sustainable development has a fundamental spatial dimension as well is often overlooked. In this paper, however, we focus on two main approaches used in NEDS: MFA and DA. The project in general and this paper in particular are partly based on our work on “the rhetorics of ecological economics” (Luks 1998).

In a very general sense, we are concerned here with a quite fundamental problem: how do we get from ideas and concepts to policy and, finally, to material effects on the environment? We are sure that in order to understand the links here involved, it makes much sense to combine two methods that focus, respectively, on material and symbolic dimensions. To put it very simple: we think that MFA is a very helpful instrument to analyze the material dimensions of the economic process of a country, a region or a firm. We consider physical sustainability indicators such as MFA as a proper tool to measure the ecological impacts of socioeconomic developments and to provide important facts for decision processes, since “you can’t manage

what you can't measure". We believe, however, that it can and should be strengthened by reflecting on its methodological and political dimensions. We think that this can be done by combining it with discourse analysis (DA). DA, in turn, can benefit by linking it to a method that focusses on the material dimension of society. This paper intends to elaborate these theses.

### **3. Material Flow Analysis**

#### **3.1 The importance of material flows**

Material Flow Analysis is based on the concept of industrial/societal metabolism. Within the concept of industrial or societal metabolism sustainability problems are viewed as problems of the material and energetic relationships between society and nature (Fischer-Kowalski/Haberl 1997, 3). An analogy is drawn between biological organisms and industrial activities. Both need inputs of energy and materials for the maintenance of their functions. These inputs are transformed and leave the system (the organism or the industry) as products or wastes. Therefore industrial metabolism can be defined as "the whole integrated collection of physical processes that convert raw materials and energy, plus labor, into finished products and wastes" (Ayres 1994, 3). A history of the concept of metabolism in social sciences (social theory, anthropology, geography) for the years 1860 to 1970 has been presented by Fischer-Kowalski (1998). Ayres and Kneese (1969) have introduced this concept into economic theory and thus laid the foundations for economy-wide material flow analyses. The history of material flow analysis for the years 1970 to 1998 has been documented by Fischer-Kowalski and Hüttler (1999).

According to the OECD (2000) two broad categories of MFA are distinguished. One deals with environmental problems related to certain impacts of substances (for example, lead or mercury), materials (for example, wood or energy carriers) or products (which is the focus of a Life Cycle Analyses). The second group of MFA deals with problems related to the overall throughput of firms, sectors or regions. In this paper two basic intentions of MFA are pointed out: detoxification and dematerialization. In this classification the impact and substance-based approach follows more the concern of detoxification (for a collection of case studies see Ayres/Simonis 1994; for example, a case study on heavy metal pollution in central Europe is provided by Anderberg *et al.* 2000). Economy-wide MFA, like this study, is following the target of dematerialization, examines the total throughput of economies.

### 3.2 The method

The basic methodological concept is depicted in Figure 1 which shows the input and output flows of an economy that constitute its metabolism. Depending on the research interest and the questions to be answered a number of input, output, and consumption indicators can be derived from that scheme.

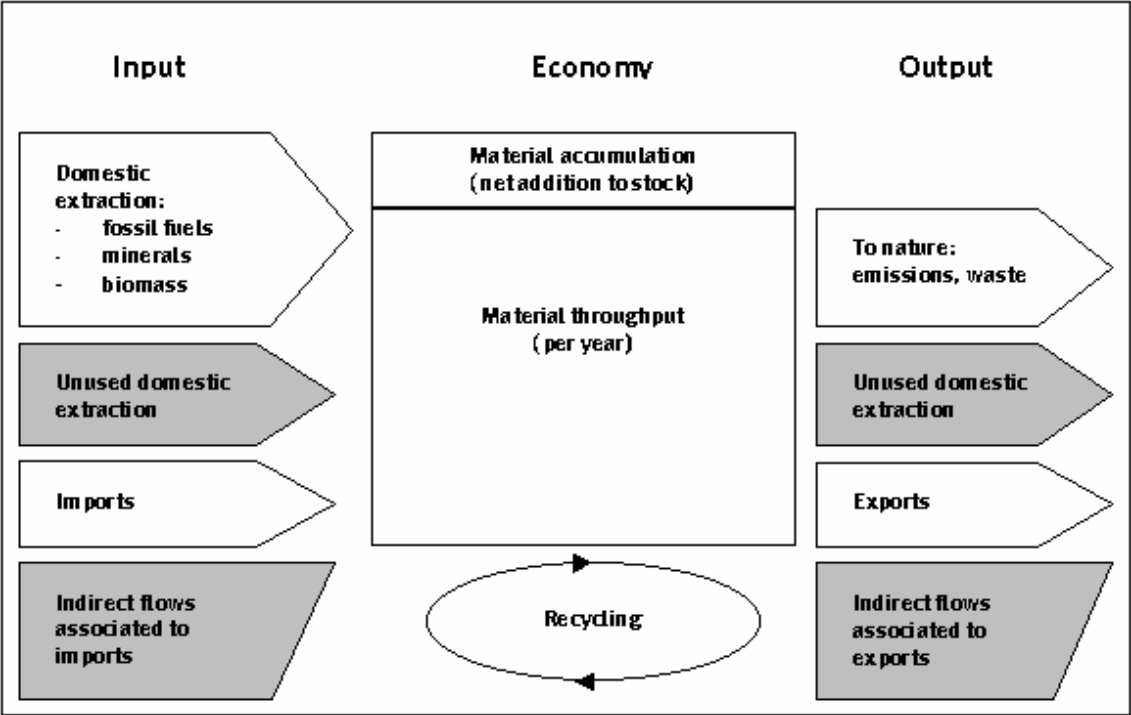


Figure 1

Source: Modified after Eurostat (2001)

According to Eurostat (2001, 20) material flows can be characterized by three dimensions (see also Table 1): The *first dimension* is territorial and indicates the origin or destination of the flows, domestic or foreign. Domestic flows are extracted from or released to the national environment. The *second dimension* is a product-chain or life cycle dimension accounting for direct and indirect flows. Direct flows enter the national economy physically as input. Indirect flows occur up-stream in the production process. As the economy is treated as a black box in an economy-wide MFA, no indirect flows of the national production process have been evaluated. The *third dimension* – the product dimension – tells us whether materials enter an economic system or not: used or unused. Unused flows are materials that have been extracted from the environment, but never entered the economy for further processing.

Table 1: Terminology of material flows

Life cycle dimension	Product dimension	Territorial dimension	Input category
Direct	Used	Domestic	Domestic extraction (used)
Not applied	Unused	Domestic	Unused domestic extraction
Direct	Used	Foreign	Imports
Indirect	Used	Foreign	Indirect flows associated to imports
Indirect	Unused	Foreign	imports

Source: modified from EUROSTAT 2001, 20.

Various material inputs can be described by four categories as shown in the right column of Table 1. Domestic extraction (used) contains materials that are extracted from the national environment and enter the economy for further processing. This includes materials that enter the economy and either become part of a product or appear as waste during the production process. For example, the total weight of a metal ore is by convention of Eurostat classified as material input of domestic extraction (Eurostat 2001, 46). But this includes not only the metal – later be found in products – but also ancillary mass, which becomes waste during the production process. Unused domestic extraction consists of flows that were extracted from the national environment, but do not become part of a product or a production process. For example, soil and rocks covering metal ores and have to be removed to get access to the ores are overburden waste and do not enter economic production. The borders of the economy or of production processes are not self-evident, they have to be defined. For example, in previous studies the ancillary mass of metal ores has been accounted as unused flows. The methodological guide from Eurostat provides detailed definitions, so that forthcoming studies can be undertaken and compared on a common basis.

The term *imports* refers to all commodities as reported by trade statistics. Indirect flows associated to these imports consist of two parts. Used indirect flows enter the exporting economy and are used to produce the imported commodity (for example, the ancillary mass of a metal ore). Unused foreign flows do not enter the production process of the exporting economy (for example, overburden of foreign metal extraction). These two components of indirect flows are not reported separately. Indirect flows associated to exports do not enter the

importing country but remain as waste in the export country. Therefore a shift of production to foreign countries could also shift the environmental pressure generated by material extraction to these countries.

What has until recently been described as ecological rucksacks (Schmidt-Bleek 1994, Schmidt-Bleek 1998, Schmidt-Bleek *et al.* 1998, Mündl *et al.* 1999) or hidden flows (Adriaanse *et al.* 1997, Bringezu/Schütz 2001) is defined in further detail by Eurostat (2001, 20). Ecological rucksack means “the entire life-cycle-wide material input (MI) deducted by the own weight of the product,” which was necessary to produce the product (Schmidt-Bleek *et al.* 1998, 27). This includes both used and unused flows. Eurostat 2001 differentiates between indirect flows and hidden flows that form the ecological rucksack. Indirect flows are defined as “up-stream material input flows that are associated to imports, but are not physically imported.” These flows can be either classified as used (for example, materials used by the exporting country for the production of traded goods and staying in the exporting country as production waste) or as unused (materials as by-product of resource extraction remaining within the exporting country). Hidden flows refer to unused materials associated with the extraction of raw materials, both nationally and abroad. Therefore unused domestic extraction could be called “domestic hidden flows”. Indirect flows of unused extraction broad associated to imports could be called “foreign hidden flows (associated to imports)” (Eurostat 2001, 22).

### **3.3 First applications**

Material flow analysis builds on earlier concepts of material and energy balancing, as presented e.g. by Ayres (Ayres/Kneese 1969). The first material flow accounts on the national level have been presented at the beginning of the 1990s for Austria (Steurer 1992) and Japan (Environment Agency Japan 1992). Since then, MFA has been a rapidly growing field of scientific interest and major efforts have been undertaken to harmonise the different methodological approaches developed by different research teams. The Concerted Action “ConAccount” (Bringezu *et al.* 1997; Kleijn *et al.* 1999), funded by the European Commission, was one of these milestones in the international harmonization of MFA methodologies. The second important co-operation was guided by the World Resources Institute (WRI), bringing together MFA experts for 4 (5 for the second study) countries. In their first publication (Adriaanse *et al.* 1997) the material inputs of four industrial societies

have been assessed and guidelines for resource input indicators have been defined. The second study (Matthews et al. 2000) focussed on the material outflows and introduced emission indicators. Finally, with the publication of a methodological guide “Economy-wide material flow accounts and derived indicators” by the European Statistical Office (Eurostat 2001), an officially approved harmonized standard was reached. Economy-wide material flow analyses have recently been published or are in progress for a number of (mainly industrialized) countries. Several countries have integrated material flow statistics into their official statistics or are planning to do so (Austria, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands and Sweden, according to Fischer-Kowalski/Hüttler 1999). The United Nations integrated physical flow accounts into its System of Environmental and Economic Accounting (SEEA) (UN 2000).

### **3.4 Specific problems of regional MFA**

A number of empirical MFA studies on regional or local levels have been carried out in the past (Amann *et al.* 2002, Bringezu/Schütz 1996, Brunner *et al.* 1994, Gorree *et al.* 2000, Hendriks 2000, IHOBE 2002, McEvoy *et al.* 2001, Singh *et al.* 2001). But so far the number of published regional or local studies is still much lower than of national ones and a standardized methodology like presented by Eurostat (2001) for the national level yet does not exist. In this project it is intended to apply the methodology of the Eurostat guide to the regional level.

A main difference between regional and national MFAs concerns the data sources. At the national level most of the data needed can be obtained from statistical publications and offices directly in published form. Almost all input and trade data in physical units is accessible. On a regional level data availability seems to be much weaker. Data may have to be gathered in a more time consuming process as it may be dispersed among several institutions and not be available centralized (like on national levels at national statistical offices or from the United Nations). Further for a number of material flows data may not be available in physical units at all and therefore may have to be estimated from more general data.

Two main methodological differences between the national and the regional level concern import (and export) flows and confidentiality of data. On national levels trade flows for the whole country are reported by official statistics. On a regional level trade flows have to be

separated into interregional or intranational trade flows (between the region and the rest of the country) and international trade flows (between the region and the rest of the world outside of the country). For both kinds of flows different statistical sources and methods of estimation may have to be used. Confidentiality of data on a regional level could be a problem if the production structure in a certain branch within the region is dominated by a small number of firms. In that case data for the whole region could allow conclusions on the production quantities or technologies of single firms and could therefore be confidential.

On the political level the need for increased eco-efficiency and resource productivity on a regional level has been expressed by the 5th Environment Conference of the Regions of Europe (ENCORE 2001). MFA-based indicators can be used for measuring eco-efficiency. Hinterberger and Schneider (2001) describe potentials and constraints for reducing the total material input of regions. Fels and Noell (-) present an overview of MFA concepts and models. In the course of the European process to integrate ecological affairs in all levels and areas of politics, the European regions play an important but hitherto rather neglected role. Therefore, this project is an initiative to make this topic politically more relevant. An important role has been identified for the introduction of headline indicators of an economically, environmentally, and socially sustainable development (Hinterberger 2000).

#### **4. Discourse analysis**

Following Hajer (1995, 44), we can define a discourse as “a specific ensemble of ideas, concepts, and categorizations that are produced, reproduced, and transformed in a particular set of practices and through which meaning is given to physical and social realities.” We emphasize that with this definition, discourse is more than “the way we talk” and that it includes speeches and written texts, but also institutional settings influencing decision processes and policy outcomes (of course the persons applying discourse analysis are themselves part of a discourse and never outside of it). In a very fundamental sense, no social activities take place outside of discourses. Everything societal is “made” within discourses (see below).

Since Hajer includes institutional factors into his definition, his analytic effort tries to get to grips with this definition as well, “considering where things are said, how specific ways of seeing can be structured or embedded in society at the same time as they structure society.”

(Hajer 1995, 263) This consideration of “material” factors is of course crucial for the actual “doing” of a discourse analysis. The point is that it is not sufficient to “only” read texts but that institutional settings and constellations of actors must be considered as well. “Pure texts”, however, will be a crucial source for our work. Among other things (which include the role of science and engineering), we are interested in the relationship between economic science and ecological reality – or “the economic construction of ecological reality” (Luks 2000). Hence, we will analyze scientific texts, newspapers, speeches and regional documents. We do not intend to dwell on the details of DA in this paper (for a brief overview, see Jäger 2001, 96-106). Important steps of analyzing discourses are the distinction between scientific and societal discourse, the identification of certain parts of the discourses under consideration (thematic clusters, relation to other discourses, discursive events such as “Chernobyl”), the context of the discourses analyzed, collecting the material, and a detailed analysis of certain crucial documents.

Discourse analysis, as used in this paper, has little to do with Habermasian ethics but much to do with a “French” (more specifically, Foucauldian) interpretation of discourse and constructivist approaches in the social sciences. Central for this approach is recognizing that our ways of knowing (“nature”, the economy, political processes) are always historically, culturally and socially *specific ways of knowing* that are embedded or situated in contexts that are themselves historically and culturally specific and not “natural” (for an overview and application to planning, see Sharp/Richardson 2001; see also Hajer 1995, 273). Acknowledging this leads to a focus on how problems and possible solutions are conceptualized. *This conceptualizing is absolutely central for the whole process of environmental policy* (the most influential study on this is Hajer’s [1995] work on *The Politics of Environmental Discourse*). Before this background, changes in society can be interpreted as “shifts in the relative influence of different discourses” (Sharp/Richardson 2001, 196). How ecological problems, for example, are seen and debated in science and public, is a result of discourse.

Hajer shows how certain “visions” (Hajer does not use this Schumpeterian term) shape political action or non-action towards environmental problems. He argues that “the developments in environmental politics critically depend on the specific social construction of environmental problems” (Hajer 19995, 2). From a discourse-analytic perspective, MFA is

“just” one way of constructing environmental problems. Hence, the use of MFA could serve as an ecological-economic case-study in this respect. Just as “mainstream” methods such as contingent evaluation are one way of constructing problems, physical indicators are another attempt to do so. We argue that it is worthwhile to try to understand better what function these different constructions have in the public sphere. In the best case, we will find partial answers to the questions why the debate on sustainable development is not dominated by ecological-economic concepts but by concepts based on mainstream (economic) rationalities. Hence, we will focus on economic reasoning based on the argument that “the developments in environmental politics depend critically on the social construction of environmental problems.” (Hajer 1995, 264) It seems obvious to us that a method like MFA is one attempt – and one favoured by many ecological economists – that tries to support a certain way of constructing environmental problems.

It is important to note that our analysis, inspired by social constructivist ideas, differs from “realistic” approaches. Everybody familiar with ecological economics will acknowledge that very many ecological economic ideas are “realistic” in their assumption that we can directly deal with environmental problems, the most important example probably being the work of Herman Daly. Environmental problems are of course “out there”. To pick up a joke heard in discussions about the social construction of environmental problems, we do not believe that climate change stops as soon as we stop talking about it! We absolutely agree with Rees/Wackernagel (1994, 387) that “whatever one's ideological persuasion, *there is a biophysical reality 'out there'* that is totally indifferent to human habit or preferences, important dimensions of which will always remain inaccessible to understanding. Our models and paradigms can only ever be more or less reliable descriptions of mere particles of nature” (our emphasis). The critical question is how we deal with the fact that society can only deal with certain pictures of the environment and never with the environment “itself”. In the words of Hajer (1995, 16): “A realist approach assumes incorrectly that the natural environment that is discussed in environmental politics is equivalent to the environment ,out there’. This assumption fails to recognize that *we always act upon our images of reality and are dependent on certain discourses to be able to express ourselves.*” (our emphasis) Turning to the political aspect, problems need “a definition that gives policy making a proper target” (Hajer 1995, 22). This is a fundamental point: society never ever reacts “simply” on ecological problems “out there” but always dependent on how problems are defined as problems in the first place (on the connection of this idea to the work of Luhmann, see Luks

2003). MFA is of course, in a sense, a fundamentally realistic approach. We believe that it is worthwhile to confront it with an approach that tells us something about how social constructions shape its internal logic and concrete policies resulting from this approach. The central point is that a discourse can be seen as a something regulative, insofar it determines what can be said and what cannot be said (Jäger 2001, 84), what is heard and not heard, what gets attention and what does not.

Discourse-analytic approaches inspired by Foucault take into account that discourses “imply prohibitions since they make it impossible to raise certain questions or argue certain cases; they imply exclusionary systems because they only authorize certain people to participate in a discourse; they come with discursive forms of internal discipline through which a discursive order is maintained; and finally there are also certain rules regarding conditions under which a discourse can be drawn upon.” (Hajer 1995, 49; with reference to Foucault) No economist can be surprised to hear about “discursive forms of internal discipline”, since when we talk of a “mainstream”, we talk exactly about that. This is not to say that the success of a theory is only due to some kind of discursive closure, but that discursive mechanisms play an important role in this respect. Not taking into account these features of discourses can produce overly optimistic and technocratic ideas about policy change (Hajer 1995, 275). This is an important factor for the success of ecological-economically inspired concepts. All too often scientists (especially natural scientists and engineers) wonder why so little is achieved when the problems and solutions are so “clear”. The upshot is that they are never that clear and that many non-technical and even non-scientific factors shape the debate about environmental problems and ways to avoid them. Of particular importance in this respect is a mechanism called “black boxing”. It refers to the “black box” as containing something that has not to be considered. This way of treating things is, according to Hajer (1995, 272), “perhaps one of the most fundamental of discursive mechanisms. Making things appear as fixed, natural, or essential is the most effective way of steering away latently opposing forces. Storylines of course almost always lead to black boxing. To become symbolically effective and politically manageable one almost by necessity will have to sacrifice some relevant relationships.”

All this also means that discourses do not simply “reflect” social reality but that this very *reality is “made” by discourses*. Insofar, discourses are just as material as the “real” reality (Jäger 2001, 85). Discursively constructed knowledge leads actions, and again the relevance

of applying this notion to MFA is rather obvious, for it affects both the internal logic and the external use of MFA. Our reality is shaped discursively, and this is also true for the individual level, which makes it (at least for us) a bit easier to understand the general idea. A thing “for itself” remains diffuse and without meaning, since one cannot make “sense” of it without lingual concepts. A simple example is the “forest ranger syndrome” (Jäger 2001, 91). Walking through a forest, the forest ranger sees the bird, but a layperson does not. Maybe one sees a red spot, but it remains just that: a red spot. If one has no idea of that it “actually” can be, this is indeed the meaning of what one sees: a red spot. One cannot determine whether it is a bird, a flower or the hair of our colleague Doris Schnepf. When someone tells us “Hey, there's Doris”, *then* we can say “right” or “no, it's just a red spot, probably a bird.” The upshot is: meaning exists insofar as we *give* meaning to something.

The implication of this regarding the political sphere becomes evident when one views politics “as a struggle for discursive hegemony in which actors try to secure support for their definition of reality.” (Hajer 1995, 59) That is, of course, what one central goal of ecological economics is about. Whether a “story” about sustainable development “sounds right” or not is not a negligible factor for the political process. Discourse analysis can be used “to explore certain practical questions about the operationalization of rhetorical constructions such as ecological modernization, environmental integration and sustainable development” (Sharp/Richardson 2001, 199). In our study, we will analyze the scientific as well as the regional political discourse. Specifically, we will try to analyze how ideas and concepts stemming from the scientific economic and technical discourse shape regional discourses on sustainable development.

## **5. MFA and DA**

### **5.0 Introduction**

Some authors see discourses as *flows of knowledge through time* (e.g. Jäger 2001). MFA, on the other hand, analyzes *flows of materials through space* (and time). We want to try to *link these streams of meaning and matter*. One early hope was indeed to be able to track links between the symbolic and the material level, or in other words: finding how certain symbolic developments lead to an increase, decrease or changed composition of the material flows of a region. After working several months, we are very sceptical about this goal by now. We acknowledge that this hope raises grave methodological problems, especially with respect to

the time frame involved. It is definitely true that “long research time-spans are needed if the effects of policies are to be analysed over time” (Sharp/Richardson 2001, 201), especially regarding the topic in question here. *If* it is possible to analyze very long time spans, however, we cannot exclude the possibility of finding links that reveal that certain policy steps remain “only” symbolic, and other have an impact on material flows. Hence, with respect to a central topic of discourse analysis, making informed statements about the “difference between what is said and what actually happens” (Sharp/Richardson 2001, 201), we are not as optimistic as when we started our research. Since we will not be able to investigate a period longer than the time span from 1992 to 2002, finding a direct link between symbolism and throughput seems not impossible, but also not very probable. Nevertheless, we are convinced that our project will be a step towards a better understanding of what “sustainable development between throughput and symbolism” is all about.

While we find the combination of DA and MFA meaningful in its own right and helpful for strengthening DA by carefully considering material developments, here we want to focus on the benefits of confronting MFA with DA. In this context, we can distinguish between *internal and external* dimensions. In another paper (Luks 1998), we have distinguished between internal and external rhetoric. Rhetorical awareness can be helpful for methodological discussions and transdisciplinary communication. This can be called *internal* rhetoric. Secondly, rhetoric can help to understand the communication in the public sphere. This can be called *external* rhetoric. This distinction can be applied when combining MFA with DA. The internal aspect in this context relates to the assumptions that are made in applying MFA, the external implications relate to how MFA is used or not used in the political discourse. Hence, we will show

- how the project can contribute to a methodological critique of MFA and
- how we will try to understand its function within the (regional) discourse on sustainable development.

### **5.1 “The construction of material flows”: boundaries, weights and other methodological decisions**

The model shown in Figure 1 demands a definition of system boundaries for the distinction between society/economy and nature and the distinction between different societies/economies. The system boundary between nature and society is defined “by the

extraction of primary (...) materials from the national environment and the discharge of materials to the national environment” and “by the political (administrative) borders that determine material flows to and from the rest of the world (imports and exports)” (Eurostat 2001, 17). But this definition does not clearly state what is part of the environment and what is part of the socio-economic system (for a discussion of this aspect see Fischer-Kowalski/Hüttler 1999, 114 and Fischer-Kowalski 1997). Livestock and plants, for example, could be treated as part of the environment and their harvest and products (for example, milk) would be inputs into the economy – or they could be seen as a compartment of the society. Then the food of the animals or the nutrition taken up by plants would be the material input. Eurostat suggests considering livestock as part of the economy (Eurostat 2001, 17). Therefore meat and other products from animals are not part of domestic extraction. Cultivated plants and forest on the other hand are considered to be part of the nature and production of agricultural and wood products is included in domestic extraction. These distinctions also influence the definitions of stocks and flows. After a comparison of the results of material flow analysis of Japan, Germany and Austria Hüttler et al. (1997, 75) state that the differences in the results between industrialized countries caused by different sets of system boundaries are bigger than differences caused by production technologies or consumption behaviour. They express the need for international harmonization of methodologies in material flow accounting, which has recently been provided by Eurostat (2001).

According to the boundaries between different economies economy-wide material flow accounts and balances should be consistent with the national accounts. The national accounts define a national economy as the activities and transactions of producer and consumer units that are resident (i.e. have their centre of economic interest) on the economic territory of a country. Some activities and transactions of these units may occur outside the economic territory and some activities and transactions on the geographical territory of a country may involve nonresidents. Standard examples for illustrating this difference are tourists or international transport by road, air or water. Due to such activities the environmental pressures generated by a national economy may differ from the environmental pressures generated on a nation’s geographical territory. Trans-boundary flows of emissions through natural media (e.g., emissions to air or water generated in one country but which are carried by air or rivers and have impact on another country) are not part of economy-wide MFA.

For physical accounts to be consistent with the national accounts means the application of the residence (rather than territory) principle. Hence, in principle, materials purchased (or extracted for use) by resident units abroad would have to be considered material inputs (and emissions abroad material outputs) of the economy for which the accounts are made. Likewise, materials extracted or purchased by non-residents on a nation's territory (and corresponding emissions and wastes) would have to be identified and excluded from that nation's economy-wide MFA and balances. Current knowledge suggests that the most important difference between residence and territory principle results from fuel use and corresponding air emissions related to international transport including bunkering of fuels and emissions by ships and international air transport as well as to fuel use and emissions of tourists. Framed like this, MFA accounts for the overall material throughput, i.e. the overall metabolism, of a given socio-economic system.

Water is excluded in this scheme, as it represents enormous mass flows of one order of magnitude more than all other materials (ibid. 2001, 16). Further, flows of air are excluded from this study, as they are not treated as material inputs for the derivation of input indicators (ibid. 28). Also soil erosion is not part of the derived indicators (ibid. 49) and therefore not accounted for in this study, although it has been included in other publications (Adriaanse *et al.* 1997, Mündl *et al.* 1999, Bringezu/Schütz 2001). In their overview Fischer-Kowalski and Hüttler (1999, 117) state, that water and air tend to be excluded from material flow analyses for not “drowning” the economically valued raw materials, as air and water would account for about 85 to 90% of total material flows. The conclusion in this overview is that water and air are kept separate because of their sheer amounts, assuming that their use has a low environmental impact – which may of course not be true in general – or their flows vary widely among regions – which may also occur for other material categories.

MFA views environmental problems and the relation between society and environment in terms of physical units (weights) of metabolism. One of the most common criticisms on material flow analyses concerns the adding up of material flows each with very different inherent qualities and thus impacts on the environment. Therefore the need for a qualitative description of the analyzed flows has been expressed (Lifset 2001, Kleijn 2001). If we want to describe the environmental impact of material flows we have to be aware that this impact depends on the material's form and the material's fate, which means where it ends up. For

example, nitrogen absorbed in agricultural plant tissue may be good, whereas nitrogen in groundwater may be harmful (Matthews *et al.* 2000, 9).

A pilot scheme for characterizing the quality of material flows has been introduced by Matthews *et al.* 2000, 116). They characterize material flows by three ways: the mode of first being released to the environment (M), quality categories such as physical and chemical characteristics (Q), and their velocity through the economy (Y) ("MQV scheme"). Adriaanse *et al.* 1997 (6) presented two characteristics of material flows: the mobilization (the spatial domain affected by a flow or the ability to reverse the impacts caused by a flow) and the potential for harm. An overview of concepts describing the quality of flows is given by Fröhlich *et al.* ---. Possibilities for characterizing material flows are manifold: verbal-argumentative description of the results, listing emissions and toxic substances, describing the ecological quality of certain flows, input-oriented accounting of toxic substances, description of land use intensity of flows (Fröhlich *et al.* ---, 51).

Discourse analysis as a method to analyze ways to produce meaning can focus our attention on the way methodological decisions in MFA shape the way we see and conceptualize and react upon environmental problems. The above also shows that methodological decisions (system boundaries, exclusion of water, emphasizing quality aspects) strongly influence the results of the analysis and therefore the basis for political decision processes.

## **5.2 MFA as part of a regional ecological-economic discourse**

“Solutions that are invented to deal with a purely technically defined physical problem but that are insensitive to the common sense social construction of a problem are likely to become regulatory failures.”  
(Hajer 1995, 23)

Hajer (1995, 264) points out that his discourse-analytical approach “does not accept that the ecological conflict is inherent in the physical facts of environmental change, let alone that it would go along with suggestions that this physical crisis immanently produces (or calls for) certain patterns of social change.” In other words: Political struggles on the regional level (just as on other levels) are crucially dependent on conceptions of environmental change, one of which is material flow analysis. “Local struggles over policy-making”, as Sharp/Richardson (2001, 198) state, “could be seen as shaped by wider struggles between

competing economic, social and environmental discourses.” These struggles shape political rhetoric, from the global to the local level. This is the context in which, we argue, discourse analysis can contribute to a better understanding of what is (not) going on, for example regarding MFA and dematerialization.

Political change can indeed be supported by “the emergence of new story-lines that re-order understandings.” (Hajer 1995, 56) Dematerialization could be such a story line. When the emergence of a new discourse can “alter the individual perception of problems and possibilities and thus create space for the formation of new, unexpected political coalitions” (Hajer 1995, 59), then there is hope. Something like that actually happened with dematerialization. It is an alternative view to environmental policies aiming at certain toxic substances that has gained more and more attention at different levels. The actual harm done by environmental damage is obviously not dependent on human communication about it (see above), but measures for the protection of the natural environment are just as obviously impossible without communication. Communicating about environmental problems is so difficult (and therefore so important), because the ecological repercussions of our actions often occur far away, and because an understanding of the problem is often oriented toward the reality as produced by the media. This is the context of MFA’s role in the discourse on policy making. It is important understand and communicate the potential of environmental consequences of human actions, which is what MFA is all about.

The significance of MFA and the concept of dematerialization, then, goes beyond the analysis of material flows (“counting”) (see also Hinterberger et al. 1996, 258-261). The calculation of material intensities and ecological rucksacks is essential to furnishing the information necessary to make ecological actions easier for economic actors. Information is also needed about the degree to which economy and society have moved away from a sustainable path. At least in terms of a rough estimate, the extent to which the “is” of matter-energy-flows differs from the “ought” should be known. However, “counting” alone is not sufficient; story telling and metaphors in public debate are just as important – not least because many people do not know what to do with numbers and tables and do better with pictures. Others need “hard facts” in order to acquire an understanding of the problems and possible solutions.

Sachs (1995) points out that while reduction goals such as the Factor of 10 inform, they do not enthuse anyone. Dematerialization “tells stories” about a different interaction between society and nature. Other stories are, for example, “ecological footprints” and “environmental space” (both, by the way, being related to the notion of MFA). Guiding principles can change the *values* of consumers, producers and politicians. Dematerialization is not only the basis for new environmental and economic policy instruments, but also “a new story” about responsible “models of wealth”. Values are not enough if knowledge is missing on what is ecologically better or worse. Neither technical improvements in efficiency nor new models of wealth alone will be sufficient *by themselves* to achieve a sustainable development path. What is needed is a combination. The concept of dematerialization can contribute to both as “quantitative-numerical foundation” and as a “story”. In this context, MFA can have a complex function in (regional) discourses on sustainability.

### **5.3 Dematerialization and (economic) rhetoric**

Our thesis is that regional discourses on sustainable development are dominated by economic goals (such as growth and efficiency) and that this situation is detrimental to successfully approaching ecological goals such as dematerialization, and, consequently, also to the implementation of MFA. That is why we will try to find out whether and how “economic rhetoric” influences the regional policies toward sustainable development. It should be noted that we do *not* only analyze the role of “external rhetoric”, since our thesis includes the “suspicion” that the *internal* rhetoric of economics, i.e. how economists argue among themselves, is relevant for the external function of economic concepts in the discourse about sustainable development. The dominant discourse on ecological modernization, according to Hajer (1995, 31), “uses the language of business and conceptualizes environmental pollution as a matter of efficiency, while operating within the boundaries of cost-effectiveness and administrative efficiency.” Here we can find an important part of the answer why (absolute) dematerialization is not as important as many ecological economists would wish. It may not be compatible with the dominant discourse. Taking into account Foucauldian approaches of discourse analyzes then can contribute to better understand ecological-economic concepts and their success or failure.

Since we believe that economic (and scientific and technical) rhetoric shapes and indeed dominates regional discourses on sustainable development, we will focus on the importance

of certain terms and concepts used in the scientific and political debates. One important question is what kind of terms and concepts we will focus on, and what specific words will be searched for. Obvious candidates include “environment”, “nature”, “growth”, “development”, “efficiency”, and “material flows” or “dematerialization”. To give a concrete example for a study focussing on the role of terms: Myerson/Rydin (1994) have analyzed the use of the word “environment” in planning discourses. They make a distinction that may prove to be helpful for our approach. They distinguish between “mundane” and “sublime” meanings of the term “environment”: “One set of senses we call 'mundane' – senses which indeed bring 'environment' down to earth – phrases such as 'pleasant environments', 'residential environments'. These senses relate to a 'normal' world, *a world of recognizable perceptions* and ordinary experiences, of problems posed in soluble terms and *measured limits*. The other set of senses we call 'sublime' – phrases as 'man and his environment', 'the natural environment'. The sublime phrases have an extra resonance – they bring in spiritual values or raise global questions.” (Myerson/Rydin 1994, 439f.; our emphasis)

Clearly, what is termed here “mundane” refers to more material aspects, while “sublime” meanings has a clear bias toward symbolic content. Moreover, Myerson/Rydin emphasize the role of “genres” in planning processes, which obviously links our topic to rhetorical issues. Just as there is a “planning discourse”, there is a “literary discourse” or “political discourse”. These are distinct genres. “It is these genres, with their rules of formation, which shape the senses of particular phrases, or, equally, which are responsive to the senses in different ways. It is an important feature of planning that it enables linkages to be created between different genres without violating their individual sovereignty.” (Myerson/Rydin 1994, 443) In our focus on the economic factors governing regional discourses, we will have to take into account economic genres (see also McCloskey 1985).

## **6. Conclusion**

The combination of MFA and DA can be useful in various ways. First of all the combination of these two types of analysis could help to understand existing interlinkages between discourses and the physical world (consumption of energy and resources, impact to nature). Discourses (political, scientific, technical) influence our actions and shape our society. The development of society is (amongst other factors) determined by the views, visions, and goals of the society and its actors and stakeholders. These views and visions are part of the

discourse. And what is important in the discourse could lead to corresponding developments. What is not part of our discourses cannot have an effect on the development of society. We can think of the environmental or sustainability discourse during the last decades. Without this discourse development would have gone a different path and environmental and sustainability issues may not have been important in development planning and for actions of the society. On the other hand a discourse about sustainability clearly does not “guarantee” sustainable development.

But there is also a link in the other direction. Without environmental, social and economic problems (e.g. forest dieback, acid rain, extinction of species, loss of nature, industrial catastrophes, Chernobyl, starvation, joblessness) there would not be a discourse about these problems and development in general. Therefore it must be taken into account that discourse is embedded into the history of society (e.g. environmental problems as a result of the industrial revolution or of mass consumption) and that development is influenced by a discourse that is only possible under certain historic conditions (e.g. the change of values, taboos, information technology). Therefore, the interlinkage between discourse and development seems to be a constant “feed-back” between the discourse and the material development.

DA helps to understand discourses and MFA is a tool to understand the material development. The combination of these instruments could, therefore, help to understand the interlinkages between “discourse” and “development”. Dematerialization is a telling example for this. Dematerialization is a political goal (the aim to reduce consumption of resources). This goal develops in the scientific and political discourses. Therefore DA can help to understand why dematerialization is on the political agenda (or why not) and what are the – discursive – constraints in the development and implementation of such a target. MFA can measure the success of a strategy of dematerialization. It provides us with the necessary information to monitor development by means of indicators. On the other hand the results of an MFA could influence the discourse – or the development of a goal like dematerialization. We may discover that our consumption of resources is too high and that we need dematerialization for sustainable development. Without recognizing this, a discourse on dematerialization may not exist.

Hajer (1995, 294) concludes his influential study with the following statement: “Modern society will constantly have to renegotiate what behaviour is tolerable and what is not, what is ecologically and socially feasible and what is not. Yet it would be a great improvement if ecological politics could shed its prevailing techno-corporatist format and create open structures to determine what sort of nature and society we really want.” We believe that this goal is shared by the community of ecological economists, and we hope to have shown that combining material flow analysis and discourse analysis is an important step towards this goal.

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