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(Editors)

Analysis for Action:

Support for Policy towards Sustainability by Material Flow Accounting

Proceedings of the
ConAccount Conference
11–12 September 1997
Wuppertal, Germany

Wuppertal Special 6

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Wuppertal Institute for Climate, Environment and Energy
Science Centre North Rhine-Westphalia

the concerted action

coordinated by

Wuppertal Institute for Climate, Environment and Energy

in cooperation with

Centre of Environmental Science, Leiden University (CML)

Institute for Interdisciplinary Research and Continuing Education (IFF)

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Preface

ConAccount is the acronym of a concerted action titled "Coordination of Regional and National Material Flow Accounting for Environmental Sustainability". It is coordinated by the Wuppertal Institute in cooperation with the Centre of Environmental Science of the Leiden University, the Institute for Interdisciplinary Research and Continuing Education, Vienna, and Statistics Sweden.

As a part of the concertation process the ConAccount Conference in Wuppertal (11-12 September 1997) provided a panel open for output. The main objectives of the ConAccount Conference were to inform decision makers about the potentialities of national, regional and local Material Flow Accounting (MFA) and to exemplify the political relevance of MFA by providing an overview of main fields of research and application.

Plenary sessions of invited lectures highlighted essential aspects of Material Flow Accounting instruments to support sustainability oriented policies. Success and failure stories of the use of MFA were presented in parallel sessions. They demonstrated the problems and perspectives of MFA as an instrument for planning and monitoring effective policy measures. The parallel sessions focused on questions according to the following themes:

- A MFA and the Political Targeting Process
 - How can MFA be used to support environmental policy?
 - Can MFA help to define political goals?
- B MFA and the Provision of Policy Relevant Information
 - Which MFA based information should be provided by environmental reports?
 - Which problems and perspectives arise for the implementation of MFA results?
- C MFA for Regional and Local Materials Management
 - What is and could be the use of MFA for regions and cities?
 - Which are the benefits of MFA on the firm level?

This volume documents the plenary presentations as well as the presentations of the three parallel sessions. The "Research & Development Agenda for Material Flow Analysis" the draft of which had been discussed on the second day of the Conference is documented in another volume (Wuppertal Special 8).

We would like to thank the participants of the conference for their interest and their contributions and DG XII for supporting this conference and the concerted action which was conducted under the Environment and Climate Programme of the European Commission.

We would also like to thank Stephan Moll and the team of the Wuppertal Institute for the excellent organization of the Conference in the city hall of Wuppertal which provided a pleasant and inspiring atmosphere.

Stefan Bringezu
Marina Fischer-Kowalski
René Kleijn
Viveka Palm

Plenary Presentations:

Welcome and Introduction

Ernst U. von Weizsäcker

President of the Wuppertal Institute

Ladies and Gentlemen, I need hardly remind you of the challenges formulated at the Earth Summit of Rio de Janeiro, Agenda 21, biodiversity and climate change.

A major relief could come for biodiversity, for our climate and for our efforts to achieve sustainable development if material and energy flows through the human technosphere could be reduced, e.g. by a factor of two. On the other hand, economic growth worldwide can be expected – and justified – chiefly in the developing countries leading to a doubling at least of economic activities. Thus, a quadrupling at least of resource productivity can be seen as the requirement for meeting the Rio challenges.

Some countries are priding themselves for reducing their domestic energy and material intensity. However, closer analysis shows that they have mostly "exported the problem". The causal chains associated with our products and services typically involve worldwide material flows and energy inputs.

If we want to go to the roots of the problems, one of the most urgent tasks is to study and understand the interwoven worldwide material flows and their junctions with regional and local flows. This fascinating task has been taken up by several international research teams which come together at this ConAccount Conference. The Wuppertal Institute, through the initiative of Stefan Brinzeu and Friedrich Schmidt-Bleek, is privileged being a member of this international team and has the particular pleasure of hosting today's conference. The first such conference has been hosted by the CML in Leiden. Let me thank our colleagues at Leiden very cordially for having hosted that successful conference and for serving as a highly reliable partner, together with Statistics Sweden and the Institute for Interdisciplinary Research and Further Education in Vienna on our highly ambitious research project which was sponsored by the European Commission. I gratefully acknowledge also the collaboration of the World Resources Institute in Washington and the Institute for Environmental Studies in Tsukuba, Japan, with whom we were able to publish a report which, through the excellent distribution facilities of WRI, has found worldwide resonance.

Let me use this opportunity also to gratefully acknowledge the presence at our conference of Professor Philippe Bourdeau and Professor Martin Jänicke who both have given us the honour six years ago of giving a lecture at our inaugural conference. It is my particular pleasure to welcome among you Dr. Domingo Jiménez Bertrán, Executive Director of the European Environment Agency in Copenhagen. I learned from him that he has firm intentions of making practical use in his routine reporting of the findings and methods of ConAccount. I am also grateful to Andrew Sors of the European Commission who has demonstrated continued interest in the project's progress.

"Open for output" is the motto of today's conference in Wuppertal. We shall address methods and approaches to regional and national material flow accounting for environmental sustainability at corporate, municipal, regional, national and international levels. We do hope that this conference, which has attracted an astonishing number of policy makers and high level administrators from a large number of countries, will help facilitate the establishment of a continuous and reliable reporting system on material flows, with a view to opening avenues for a strategic reduction of damaging flows.

Providing for the Future Through Avoidance – a Precondition for Change in Ecological Structures

Bärbel Höhn

Minister of the Environment, Regional Planning and Agriculture
for the State of North Rhine-Westphalia, Federal Republic of Germany

Ladies and Gentlemen, Professor von Weizsäcker, I was very glad to accept your invitation to speak to you today at the start of your two-day conference.

I am delighted by the invitation because it gives me an opportunity to join an international forum which, in difficult economic times, is dealing with the key questions of ecological modernisation of our economies. The international environment situation urgently demands such a debate about the change in ecological structures. The sobering results five years after the Rio Environment Conference demand a public debate about how we can integrate the new sustainability rules into our social systems. A new quality of environment policy is certainly required. At the same time, however, we can be sure that in the process we also are rediscovering old pearls of wisdom:

Ecology is actually nothing other than biological economics. For the economy – if it is to serve mankind and its welfare – there is no other basic model than ecology, i.e. nature's economic policy. The new ecological strategies which we are discussing are therefore largely identical with the means by which the ecology avoids going into deficit. These strategies mean: a resource-saving approach to the use of raw materials and energy sources, and recycling of all materials used.

This takes me, ladies and gentlemen, to the subject of your conference.

Traditional environmental protection is concerned above all with pollutants, with simple damage-repair and symptom control. And it has contributed thereby to an improvement in the environment situation. It is becoming increasingly evident, however, that environment policy must become more concerned with the subject of conversion of materials, i.e. the conversion of raw materials into products and the future ecological acceptability of materials, production processes and products. The very quantity of material flows and energy consumed is the real problem because all conversion of materials raises major problems. In our industrial and manufacturing system, conversion of raw materials into products still regularly results in high emission levels, excessive effluents and excessive waste products. Natural spaces are disturbed to an unreasonable degree both in the extraction of raw materials and in manufacturing. (To quote just one figure from the Wuppertal Institute: the recorded levels for pollutants, nutrients and toxins from various sources are today still five times the level required by sensitive ecosystems.)

At this point, I would like to refute an argument which is currently the subject of much discussion and which some leading Social Democrats also subscribe to. The argument is that, after fifteen years of environment policy measures, the land, water and air in Germany are again largely clean – at least to the extent that it is now suggested that a breathing space should be given in terms of environment policy to allow attention to be focused on economic competitiveness. Unfortunately, this argument is based on wishful thinking.

There have been individual successes in the reduction of air pollution, in water conservation and energy/resource consumption. Such partial successes are very modest, however, when compared with the ecological needs, when compared with what is required to avert climatic change, to protect the ground water, to maintain biological diversity, to prevent

the final acidification of forest land and to implement the principle of waste avoidance. Today, the technological status allows much more to be done than is actually the case.

I would like to quote three examples from North Rhine-Westphalia:

First of all, the major industrial plants in North Rhine-Westphalia could save 50% on energy consumption compared with the base of 1987 by rigorous implementation of least-cost-planning procedures.

Secondly, the major power stations in North Rhine-Westphalia could increase their efficiency by 40% and reduce CO₂ emissions by 40% if they decided on a policy of power-heat coupling.

Thirdly, in an audit of 600 plants in North Rhine-Westphalia subject to approval procedures (foundries, iron and steel works, glass works and paper factories), the Environment Ministry established a possible recycling rate of 85%. Unfortunately, the level achieved falls well short of this.

The demand for a breathing space in environment policy also raises problems in another regard. It trivialises the current social crisis by reducing it purely to an economic crisis.

At the moment, we are in the middle of a modern structural crisis which affects the major foundations of our welfare society. The limits to growth are dictated not only by economic factors but also in essence by ecological considerations. Economic and ecological crises are mutually interdependent.

Our national economy is dragged down by vast environment burdens which it cannot make good, but for which it must pay. According to the Forecast Institute, these environment costs, which are passed on to all of us, today already account for between 15% and 20% of gross domestic product (GDP). The forecasts also show that environment costs are due to rise four times as fast as national product, i.e. they will in future erode our economic base unless something is done.

The logical consequence is that politicians and industrialists will first have to find a way to reduce the quantity of material flows as a whole. The term "innovation" will have to be given a wider meaning than in the past. Sustainable industry means first of all: less consumption of nature, less waste production, less material throughput.

Here I would refer to the reduction targets at the Rio Conference in 1992 (Agenda 21) which are set at 90% for material and energy flows over a period of fifty years. This means: savings by a factor of ten. Savings in material turnover and also in the number and size of production plants. In addition, it means a change from short-life to long-life products and a reduction in the product range.

I believe, ladies and gentlemen, that these objectives are only achievable if our economy draws up a new balance sheet which measures real progress. In addition to business management considerations, the ecological balance sheet must take account of energy, raw materials, water management and waste.

The decisive question must in future be: How much quality of life can be created from ten litres of water, from a ton of ore, from a cubic metre of air, from a kilowatt-hour? What procedures, what type of environment management are necessary in companies to achieve this? What technical innovations do we need?

International experience with such ecological balance sheets clearly shows that new impetus is then also created for technical innovations which reduce our requirements for energy and raw materials.

Those who close their minds to the ecological sustainability rules will suffer a disadvantage as an industrial location.

The key hypothesis of many scientists in this connection – and I explicitly support this thought - is as follows: The accent in industry must be shifted from labour productivity to resource productivity, i.e. to nature and energy productivity. This is the only way that integrated environmental protection which provides for the future can have a real chance.

On this basis, industry could define productivity progress differently – and make kilowatt-hours, tons and oil barrels redundant rather than people.

I am under no illusion, of course, that this objective can be achieved by political education alone. I naturally welcome it when the subject of material flows and product responsibility (product stewardship) is widely discussed in the chemicals or steel industry. I am, as far as possible, prepared to follow the discussion about voluntary undertaking of responsibility by industry to the extent that the objective is integrated environmental protection.

None of this alters the fact that the fundamentals of this economic order must be changed by political reforms, however, this is crucial. Ecological restructuring cannot in my view be achieved through economic self-direction alone. It must be promoted and reinforced through policy-making. I consider it irresponsible, for example, that decisions on material flows and products are generally still taken by manufacturers alone. In the development area and in the use of materials and processes, it is in particular the responsible people in the research and development departments of major industrial concerns who have the creative power – apart from a few prohibitions.

I believe, however, that the benefit and risk assessment of materials and processes must essentially be carried out through democratic society and through policy-making. This of course also means that policy-making itself must change in order to live up to this requirement.

It must, for example, embrace national and regional environment plans as defined in Agenda 21. National environment plans represent a new type of state planning because they regard the policy of sustainability as an interdisciplinary concept covering all policy areas.

The national or regional environment strategy must also pursue objectives in terms of economic policy and technology policy. In precise terms, it is necessary that integrated environmental protection is also regarded as a national export strategy and world-market strategy.

It is therefore very interesting for me to read what the Bundestag inquiry commission on "Protection of mankind and the environment" recently published on this subject. In the spirit of the familiar sustainability rules, it established for Germany as a whole and for major industrial sectors specific environment quality objectives which move in the direction of resource productivity. And it challenged those responsible in the field of politics and industry to develop on this basis concrete environment targets within the parameters of a national environment plan. This could incorporate the voluntary undertakings of industry.

In the NRW Environment Ministry, we are currently thinking about the development of a "North Rhine-Westphalia agenda" which in principle takes up the idea of a comprehensive environment plan. I therefore await with great interest, ladies and gentlemen, to hear your discussions on this subject at your conference.

The discussion of environment plans initially starts not with visions but where concrete policy-making takes place. No environment plan, however good it may be, can ignore public-order measures such as prohibitions and restrictions.

In connection with the subject of your conference, it is also urgently necessary for product liability law to be reviewed. This relates to the rules of the burden of proof with regard to ecological aspects and the extension of protection areas.

By this point at the latest, however, I consider the limits of public-order legislation to have been reached. I cannot achieve through prohibitions and restrictions the efficiency revolution which will be required in the future. Ecological reform of the economy will take place in the market or not at all. Here a new framework must be established by politicians.

I therefore believe that the political turning-point therefore relates first to today's tax and levy system which has historically outlived its day. This old system artificially increases labour costs and allows high environment costs to be passed on to the general public rather than being paid by the originators.

When at this conference you deal with the importance of material-flow analysis for political objective-setting and planning, this discussion naturally extends to practical implementation in the economic process. This subject is naturally of particular importance to me as the Environment Minister of a German state which is undergoing fundamental structural changes.

In North Rhine-Westphalia, the social fractures and experiences in the early years are currently returning in a different form and under much more difficult crisis conditions. For the first time in thirty years, there is now suddenly a danger that the great process of structural change in an old industrial region will be derailed on the last part of the long journey. Although this process of structural change has been accompanied by major problems, it has not – if we look closely – led to the social and economic turmoil with which we are familiar in the Walloon region, the Midlands of England or the coal and steel industry in the North East of the USA.

In this menacing crisis for the process of structural change, there are not a few who are dropping the project of "ecological restructuring of the industrialised society" like a hot potato. The opportunities which present themselves to emerge from economic crisis through an ecological turnaround are considered by many in view of the globalisation pressures not to be open to serious discussion let alone politically feasible.

Let me first comment on this as follows:

It makes a great difference whether this argument is used by multinational corporations which speculate on the stock exchanges with enormous profits instead of investing in environmental protection technology and resource productivity or whether medium-sized enterprises quote this argument because they fear for the survival of their business. The cost situation for small businessmen and self-employed people is often a problem. New ecological products and processes are in fact very expensive and financially risky.

At the same time, however, they represent an investment in the future which contributes to small companies' ability to stay abreast with domestic and world market demand. Small companies need special environment-policy assistance because today's environment problems will decisively influence future markets.

The state government of North Rhine-Westphalia is therefore making available economic development aid totalling DM 13 billion up to the year 2000 through a "Future Investment Programme for Employment and the Environment". These funds serve largely to support new ecological investments in medium-sized businesses. We have, for example, provided massive aid to the development of wind and solar power technology in NRW and through the programme are introducing the transition to a sustained water balance.

As far as large companies are concerned, I do not wish to question the general cost pressure on businesses through global competition. But when this cost pressure is so strongly emphasised, there is a danger that the real problem is overstated. The main problem in my view is the menacing investment backlog which cannot be reduced through savings alone and which above all may be expensive in the future.

The decisive cause of the current structural crisis is in my view the delayed and incorrect alignment to the global process of structural change. This is clearly confirmed by a new comparative study by the OECD (1996). This study reveals that the German economy was too late in aligning to the structural changes in the development economies. According to the OECD study, comparatively few products, processes and business fields have been developed and exploited in Germany despite its high level of technical expertise because, compared in particular with Japan and the USA, the orientation towards established product lines and markets is too strong. Innovation and structural change, says the OECD summary, are the

crucial factors for a successful response to the growth and employment crisis. Germany is faced with the threat of missing out on the development towards "knowledge-based national economies".

Here the area of new environment technology is particularly striking. While, for example, US industry can rely on a whole system of state support for the development and realisation of integrated environmental protection, Germany is only starting to set up a structure to promote the environmental protection industry and related services.

I can relate this general situation directly to NRW where we are faced with the task of establishing a new emphasis in the discussion about the environmental protection industry. The environmental protection sector in NRW is still one of the expanding fields of business, characterised by a large number of medium-sized companies. According to a forecast by the German Institute of Economic Research (DIW), the number of people employed by it will double from its current level of 90,000 over the next ten years.

But the boom in remedial environment technology is slowly reaching its limits in NRW. Expert studies are emerging for the first time, for example from the Gelsenkirchen Institute of Labour and Technology which talk about an "ecological innovation gap" in the environment industry in NRW. The environment industry is currently losing impetus because it is neglecting the area of preventive environmental protection. Complex techniques relating to efficiency and energy saving which are in demand from European, East Asian and recently South American markets are noticeably under-represented.

The first negative signs are therefore becoming evident that the environment industry in North Rhine-Westphalia is still firmly rooted in the old industrial region's past. Its key focus is very much on the traditional disposal business, on the familiar end-of-pipe operations which will certainly continue to be of great importance.

Too little importance continues to be attached to the components of forward-looking, production-integrated environmental protection. The most outstanding examples in NRW are to be found in energy and waste management.

For me, this closes the portentous circle of discussion about the crisis of our state of North Rhine-Westphalia. Those who reject environment investment for reasons of global competition are in reality obscuring the global view of the problem. Their view is too narrow because their deliberations are too narrowly focused on costs and economic burdens.

In contrast, I want to stress the importance of ecological modernisation for the future process of structural change in our economy. I believe that the structural-policy initiatives and vision which may emanate from an ecological efficiency revolution are extremely important.

From your conference, ladies and gentlemen, I therefore hope above all to obtain new information and ideas about this question of structural change.

Thank you for your attention. I do hope that our work together over the next two days will be very productive.

EU Environmental Policy and the Research Programme of the European Commission - Introductory Note -

Andrew Sors

Head of Unit Socio-Economic and Environmental Research, European Commission

This Conference will provide a valuable input into the development of EU policies on the environment and Sustainable development.

EU Environmental policy dates back to the early seventies, about the time of the Stockholm Conference. Since that time the scope, and importance of this policy has grown substantially. The emphasis has shifted from concern about local, acute pollution problems towards major long term global and regional issues, characterized by uncertainties and by high socio-economic stakes. The scope of the policy has also changed beyond purely environmental concerns, to a commitment for Sustainable development. The implementation of such new and ambitious policies requires innovative approaches and measures; materials flow accounting seems to offer considerable potential in this respect.

There are many reasons for this; by way of example, let me highlight two closely related issues.

The first is in relation to policy signals. A key objective of EU environment policy is the improved integration of environmental factors into sectoral policies (e.g. energy, industry, transport, agriculture, tourism). One of the ways to promote such integration is to modify national accounting systems (based on GNP) which currently do not reflect resource depletion or changes in environmental quality. The EU is committed to the implementation of its 1994 Communication on "Environmental Indicators and Green Accounting"; materials flow accounting can provide an important tool in this respect.

The second, related issue, concerns performance measures, in particular measures of progress towards sustainable development. A crucial aspect here is the sustainable utilization of natural resources and materials flow accounting clearly offers a very useful measure, at various levels from global to local and in respect of various "actors" e.g. companies, municipalities, etc.

Within the European Commission, the development of environmental and sustainable development policies is supported by EU level research Programmes, in particular the Environment and Climate RTD Programme. This major European RTD Programme is implemented through four research areas, including (Area 4) : "Human Dimensions of Environmental Change". The broad objective of this particular Area is to support socio-economic research in support of sustainable development policies.

While most of this Programme is carried out through shared-cost contract research, there are Concerted Actions in a number of critical themes. In such Actions, EU support is not for the research itself but for the coordination of ongoing research efforts (e.g. at the national level) in a particular field within the EU. The emphasis is on providing added value through focused discussions, workshops, publications, etc.

Con Account is a very good example of a dynamic Concerted Action in a rapidly developing field of research. I would like to congratulate Stefan Bringezu and all his research partners on organizing a timely and important Conference.

A Possible Role of Material Flow Analysis within a European Environmental Reporting System - Changing Course in Environmental Information

Domingo Jiménez Beltrán

Executive Director, European Environment Agency, Copenhagen¹

Thanks to the Wuppertal Institute and the concerted action „ConAccount“, supported by DGXII, for providing us with this opportunity to begin shaping our future. And thanks to professor Ernst von Weizsäcker, a man with a vision, sustainable development, a goal we all seem to share (and which the Amsterdam treaty is finally recognising) but one that we do not know how to get to. As Jacques Delors said, in '93, “The analysis and validity of sustainable development are fully accepted: but, in practice, there has been little progress.”

There is still an enormous gap between aspirations and the very stubborn reality and trends of sustained (and non-sustainable) increased consumption, driven by an economic system that is designed to maximise consumption. You may wonder what is the purpose of economic science, if it is only to create the conditions for increased consumption, and then explain the results.

It is true that we can not manage, or improve public awareness about something that we cannot measure, yet we are still measuring economic with GDP and the peculiar monetary indicators that will guide the process of EU monetary Union.

This is why we are here now “to support policies towards sustainability” and above all to develop new ways of measuring progress towards more sustainable socio-economic systems, where the main features are increased efficiency (in the use of all kinds of resources, not only natural), equity (now, and for future generations) and an improved quality of life. And where sustainable development and environment are two sides of the same coin, measured by similar and integrated indicators.

At the Agency we are working hard to respond to the regulatory mandate we were given of "providing the Community and the Member States with objective, reliable and comparable information at European level, enabling them to take the requisite measures and to ensure that the public is properly informed..." (Reg. 1210/90). This has now been translated into a more focused and operational mission.

"Through the provision of timely, targeted, relevant and reliable information to policy making agents and the public, the EEA aims to help achieve significant and measurable improvement in Europe's environment..."

We are also developing a vision that we call ENVISION, a framework for action, which is expressed in the medium term by our Multi Annual Work Programme (the one for 1999-2003 is now being developed), and in the short term by our AWP, and which together ensure the efficient delivery of products and services that clients require. The Agency aims to be the "gateway" for environmental information, at both EU and continental level and we also aim to be a leading force at global level as shown by work for the G7 and UNEP and other international programmes and recent cooperation with other leading environmental Agencies such as the US and Chinese EPA.

My objectives today are to describe the Agency, its work and to identify how we can develop a better monitoring, assessment and reporting system that provides not only past

¹ Note: The opinions expressed by the author are of a personal nature and do not necessarily reflect the views of the EEA, the European Commission or any other Community Institute.

statistics but anticipates trends and provides alternative scenarios, in order to improve decision making and public participation.

Environmental policy moves from a reaction (denouncing situations) to a proaction (favouring changes and providing solutions), and as civil society emerges to greater prominence via the change representative to participative democracy, so information becomes a powerful tool to develop and implement "the right mix" of policy instruments utilising the informatics and telematics new of the new "information society".

I would like to share with you:

- the EEA vision of an operational environmental information system. The ENVISION;
- the prospects in this context of indicator based environmental reporting;
- the possible role of material flow analysis (MFA); and
- to finalise with a call to this Conference to incorporate MFA into a European monitoring, assessment and reporting system, that helps us to move from "sludge" to "dreams", as Derek Osborn, Chairman of our Management Board, put it at the end of the recent Rio + 5 (June '97 session in New York): From "SLUDGE": Slightly Less Unsustainable Development Genuflecting to the Environment to "DREAMS": Development Recording Environmental And Material Success.

1. The ENVISION: A framework for operating environment information

For those not familiar with the EEA, it opened its doors in November 1994; it is a small office of the EU - but open to other European countries - with about 70 people - 50 staff and some 20 external "intramuros", (collaborators, including experts from PHARE countries) and with a budget of 16.5 MECU for '96. It is an example of a network administration, being the node of EIONET - **E**uropean **I**nformation and **O**bservation **N**etwork - which brings together and develops the monitoring and information capacities of Member States, involving more than 450 institutions, such as the NFP's, and ETC's.

The idea of the environmental information vision is to transfer in conceptual and operational terms, for transparency, guidance and accountability, the mandate of the Regulation (See also publication of EEA "The EEA progress and Prospects - The ENVISIONS Scenario" - March '97). It involves four main activities of the EEA:

- joining and building capacities ("networking")
- monitoring, assessment and reporting ("to know more")
- developing a Reference Centre ("to know better" and "for everybody"); and
- supporting action ("to do better")

A. Networking:

This mainly involves developing and joining the existing capacities *and means for obtaining information* on the environment, of the Member States (MS), EU and other European countries.

The Regulation mandates the EEA, with MS, to establish and develop the EIONET (Articles 1.1 and 2.i and 4), and joint programmes with related Community Services or Institutions (such as JRC and EUROSTAT) and to co-operate with international organisations and programmes (Art. 15 and 2.v and x); and crucially to avoid duplication. Networking and capacity building is a specific mandate of the EEA, which has become the node of an extensive operational network for the flow and exchange of data, for improving data (harmonisation and mutual support) and for conducting analysis and aggregation on such environmental topics as air quality, water, etc.

The **EEA Network** is conceived as a mixture of the EIONET, and also the EC related institutions and International Organisations and programmes, and stakeholder networks including socio-economic agents and the public which provides capacities for data and information gathering, exchange and dissemination.

The EEA is a new kind of bureaucracy, which "offers promising possibilities for developing more complex decisional strategies, for priority setting and transnational co-ordination" according to Professor Ladeur - from the Schuman Centre, European University Institute in Florence, ('The New European Agencies', 1996).

The main elements to be considered when analysing the EIONET and related progress are the following:

The EIONET Structure

- A **Network** at (European) EU level (EEA + National Focal Points (NFPs) + European Topic Centres (ETCs) and national networks; Organisations & people);
- A **Technical Infrastructure** linking components by informatics;
- and telematics (ITTAG/IDA);
- A **Programme** for **capacity-building** and development of technical specification and software for data generation (Monitoring), flow (Exchange mechanism), analysis (Quality assurance) and assessment (Data modelling);
- An **Operational System** - Storing, exchanging, aggregating retrieving and providing access to information (Data Banks, Data Warehouse, CDS).

EIONET is one of the success stories of the EEA, especially when considered in relation to where we were in 94, i.e. no effective cooperation on topics; no links or harmonised development of national systems; a limited European reporting process; no progress towards common and mutually supporting monitoring and reporting processes; and difficult access of/to constituents' networks. However, much still remains to be done.

B. Monitoring, assessment and reporting:

This involves providing data and information ("*to know more*") and defining, co-ordinating and serving a reliable, cohesive, (seamless, in words taken by US EPA), simple, lowest cost routine monitoring and reporting system.

As mandated by the Regulation, this **information** shall describe the present and foreseeable state of the environment, including pressures on it and its quality and sensitivity (Art. 3.1), including transfrontier and global phenomena, and taking into account the socio-economic dimension (Art. 3.2). The EEA shall draw up reports (also to be used by the EC to ensure implementation of legislation) (Art. 2.iii) and publish a Triennial State of the Environment report (Art. 2(iii) & (vi)).

This routine reporting system shall be based on networking and exploiting all existing and developing external capacities for data collection and analysis. It should deliver "Best Available Information" (BAI):

- comprising regular and routine **periodical reports** of reliable quality;
- on identified **topics, every year** and at a required time, mostly on progress (air, water ...), and related not only to environmental quality but also to monitoring, measures and legislation in those areas, and incorporating basic information for implementation and evaluation;
- a **yearly environmental report** based on a progressively improving package of **indicators** on situation, progress (towards a base line and with adequate yard sticks) and

prospects (towards goals, and if required with distance to targets according to different scenarios); and

- a comprehensive report every 3 years.

It should also support the reporting requirements of directives, conventions and international programmes.

The main elements of the EEA approach to "know more" on the environment are related:

- *To keep a comprehensive view on the current situation and prospects by thinking comprehensively, collecting and linking information to the **D** (Driving Forces) **P** (Pressures) **S** (State) **I** (Impact) **R** (Response) framework which is being established for reporting, with the collaboration of the JRC, Eurostat and DG XII.*
- *To establish a production and publication programme, including products and services, to be delivered or provided as building blocks in the chain from monitoring to reporting, linking data banks with partial or intermediate products and final annual and 3 year periodical reports.*

The EEA activities are summarised in the Information House (**Fig. 1**). We intend to bring more and more partners into our projects, both as suppliers and users.

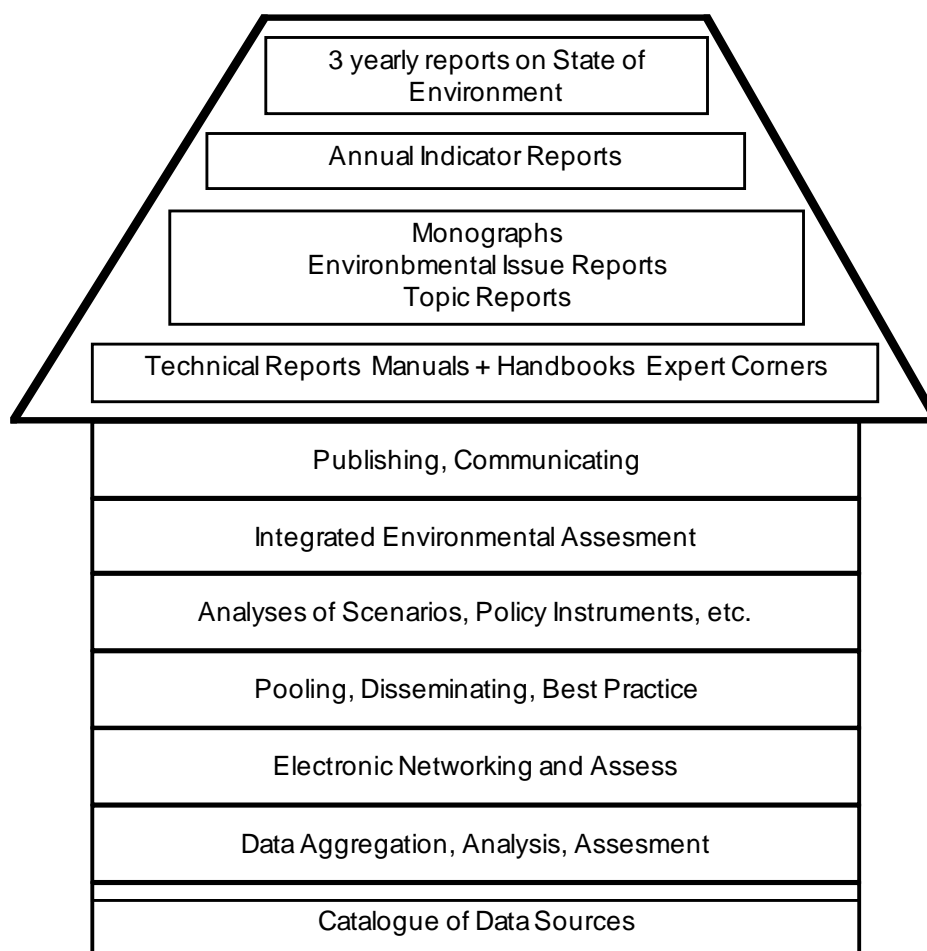


Figure 1: *Activities and Products of the EEA*

The EEA structured, top down approach which puts monitoring at the service of effective reporting, is being copied not only by some Member States of the EU, but also by some other European countries.

C. The Reference Centre

This involves becoming a Reference Centre for quality/excellence, and the "first door" or "gateway" for environmental data and information ("*to know better*" and "*for everybody*")

The information shall be objective, reliable and comparable (Art. 1.2), of direct use (Art. 3.2) and its dissemination (Art. 2(vi)) and public access (Art. 6) shall be assured.

In order to ensure better quality data and information, the Agency may encourage the harmonisation of methods of measurement (Art. 2.vi) and provide **uniform assessment** criteria for environmental data to be applied in all Member States (Art. 2.iii).

The Agency is mandated to improve - or support the improvement - of the quality of data and information on the environment at Member State and EU level, and to facilitate the general access (public) and use of this BAI. This means bringing order and understanding to "information overload" and complexity.

The EEA-EIONET should also provide for „one door of access“ to data on environmental quality, especially pollutants, emissions, discharges and wastes from different activities, including the integrated emissions inventories Pollutant Emission Register under the IPPC Directive. The different topic centre data bases can and should remain (while being progressively integrated) at their working level, (National or even Regional and Local), while the system should provide easy access for different users, including public authorities and, in particular, environmental inspectors and their coordinating network, IMPEL. **Fig. 2**, extracted from the US EPA, ENVIROFACTS system, offers a good example of a data warehouse providing access, via informatic capacities, to many different topic data bases.

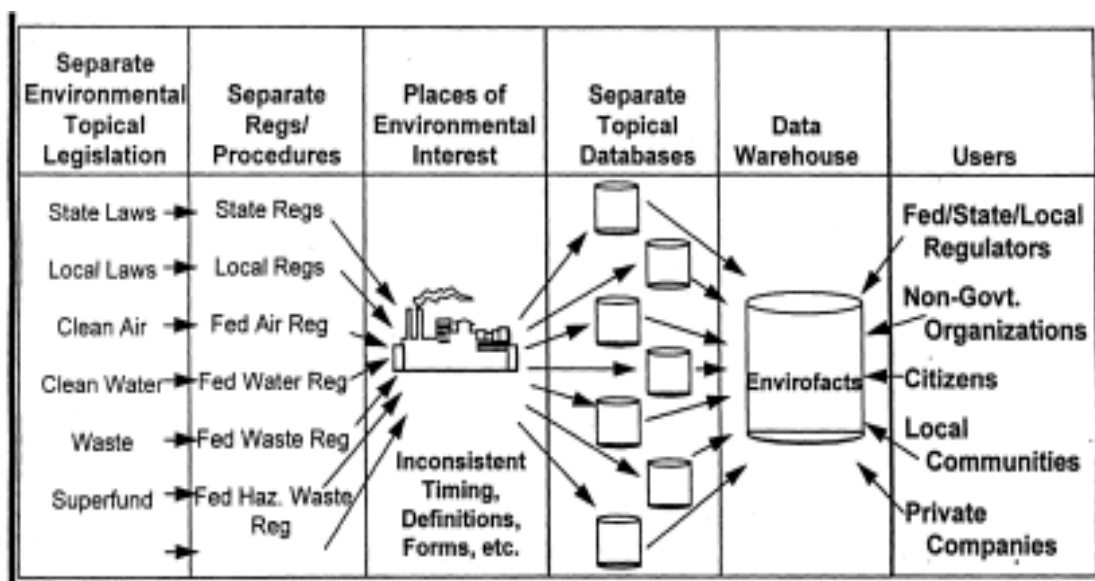


Figure 2: *One Point of Access to All Data*

The Agency is currently considering developing a voluntary pilot system for such an integrated system of cross media data related to discharges from different industries. This data base could offer a disaggregated picture of the industries materials and energy "metabolism" and offers them a show window for their environmental performance, since it could also be connected to their environmental reporting web pages, all presented in a standardised way.

This **New Data Management Approach** is of paramount importance to assure easy access, both for administrations and the public, to existing information, so as to improve

efficiency and transparency, and to provide support to enforcement and implementation, facilitating the key role of the public as political consumers.

The main elements for this new approach are that:

- data is owned by the public (public sources);
- the broadest possible access has to be granted (empowerment);
- the key to cross-topic analysis has to be provided;
- adequate standardisation is required.
- public access (and exposure) drives quality improvement.

This is a key role for the Agency implying the development of the required programmes to improve the coverage and quality (reliability and comparability) of environmental data and information, and to facilitate access to, and dissemination of such data and information. It is a basic function of the EEA that currently takes about 65% of personnel and budgetary resources.

But this data and information has to be disseminated and the related data and information banks made accessible, including those of interest from external services. The goal, already very advanced, is as foreseen in the review of the 5th EAP and of the Regulation, to develop EEA as a European Repository Centre, or public access door, or gateway to an extended system of Environment Information Agencies in Europe and in other parts of the world.

One of the ways of overcoming "information overload" and of adding value to data and information is to present new ways of perceiving environmental problems and their interconnections via "**structured knowledge**", which are frameworks of understanding (and boxes for labelling the information) designed to help policy makers and the public to deal with both complexity, and the "overload" of environmental information.

An example of structured knowledge is the DPSIR framework for reporting, which provides an integrated yet simple description of the complex interconnections between people and their environment. The illustrations of the shift in focus from "infrastructures supply", to "demand side management" (and from "products" to "services") and the "double dividend" of ecological tax return, are other examples of "structured knowledge".

D. SUPPORTING ACTION

This involves supporting policy-making, decision-making, implementation (action) and public information and participation ("*to do better*").

This is the **basic function** of the EEA, responding to the main mandate of the Regulation which is to provide information to Member States and the EU, enabling them to take the necessary measures, to evaluate the results of such measures and to assure that the public is properly informed (Art. 1.2), and to frame and implement sound and effective environmental policies (Art. 2(ii)), and in particular for the EC to identify, prepare and evaluate measures and legislation (Art. 2(ii)) and to ensure the implementation of Community legislation on the environment (Art. 2.iii).

For these purposes the information must be timely, targeted, relevant and reliable if it is to be of "direct use" (Art. 3.2). It should **support** not only "what to do" for framing policies (Art. 2.i), but also "how to do it" effectively, including supporting the implementation of policies (Art. 2.i) and the timely application of preventive measures (Art. 2.vii), making use of best technology (Art. 2.ix) and at lowest cost (Art. 2.viii).

This is the most important mandate given to the Agency. It involves delivering information that helps stakeholders to know more and better on the environment and trends, but it should also allow them to do better.

A major problem which has yet to be tackled in order to make the EEA information more timely and relevant, is the **synchronisation** of the MAWP (Multi Annual Working Plan) with the policy cycle, and its adaptation to the development of the policy Agenda.

In simple terms, this requires:

- matching the EEA routine reporting frequency with the timings of the policy cycle (3 or possibly 5 yearly reports);
- adjusting the MAWP/AWP to the developing policy agenda (short/medium term), so that information is targeted and timely;
- responding to unplanned requests, or emerging policy topics,
- via flexible Work Programmes, and
- reporting on “early warnings” which can feed the policy development process.

The role that information can play in supporting enforcement can also be improved by:

- specific or concrete tasks under existing or new mandates;
- targeted reporting activities;
- increased use of public information access;
- improved capacity building at Member States level for appropriate monitoring/assessment (EIONET);
- support for IMPEL and MS inspectorates;
- development of advisory and peer review programmes of EIONET and related MS monitoring and enforcement capacities.

II. Towards operational environmental monitoring and reporting: The use of indicators - situation and prospects

Why Indicators?

Information and *Communicating* are two key words for the Agency. Communication is also the main function also of environmental indicators. Environmental Indicators enable a clear information exchange regarding the issues they address. They serve to supply information on problems enabling policy makers to appreciate the seriousness of environmental problems and to support policy development and priority setting by identifying the key factors that cause pressures on the environment. Finally they serve to monitor the effects of policy responses and allow the public to follow and participate in the process, making it more accountable.

In the world of „information overload“ we need to provide policy makers, (but also the public), with the key information they need to understand whether policies are working or not and whether new approaches have to be developed. Good indicators provide the vehicle for getting across messages which are readily understood.

What makes a good indicator?

Simplification, aggregation, trends over time, and scientifically valid. To these well established criteria I would add integration. By integration I mean primarily the linkages between the Driving Forces (socio-economic) and the Pressures and State of the Environment parts of the DPSIR model. We need to develop the interlinkages between the DPS and also the IR if we are to deliver information and analysis which is relevant to policy makers and their need to understand whether matters are getting better or worse. Support to the 5th EAP from the EU is particularly important in this respect.

This translates into the need for the Agency to present indicators for each of the steps in the DPSIR framework, and on the links between elements in the DPSIR framework which provide information on the efficiency of products and processes and on the dynamics between the DPSIR elements. Indicators of Pressures related to Driving Forces, like energy consumption and air emissions per passenger kilometre, are especially useful to form an

opinion on progress made in conserving the environment in the production and consumption of goods and services.

If the DPSIR indicators, and the efficiency indicators, can be linked to concrete targets, they become powerful "performance indicators". Performance indicators are very relevant to all those cases where groups or institutions may be held accountable for the changes in environmental pressures or the state of the environment.

When making an analysis of the indicators from the point of view of functionality in the whole monitoring assessment and reporting system and of the possibilities of providing for changes it is quite clear that the interesting ones are those related to "efficiency" and "performance". The developments and application of those have been so far so very uneven in the EEA Member States but recent developments give some hope.

Material Flow Analysis (MFA) generally provides only the framework for the indicators: in most cases the information for the indicators is already there. But there is an area in which MFA is the crucial tool to develop indicators and that is for all those that take indirect effects into account. As soon as you are speaking of 'sustainability' not only within the borders of a country but also taking the rest of the world into account, there is a need for indicators that can incorporate the indirect effects of production and consumption processes.

Material flows and 'production chains' are intimately linked. MFA is the tool to produce the indicators of accumulated pressures by products, services or regions. We all know the trademark 'MIPS' (Material Input Per Unit of Service) of the Wuppertal institute as the archetype of an efficiency indicator based on cumulative resource consumption. I believe that there is a genuine need among policy makers for indicators and information to identify parts of the production and consumption processes where policy initiatives will be most effective.

So what is the EEA Role in all of this?

We have our mandate and EIONET which is still in the relatively early stages of development but which is unique at European level. We also have our colleagues at Eurostat who currently collect and analyse socio-economic data. We need to work closely with them on integrated analysis to share experiences and information. The challenge is to build EIONET and cooperation with other bodies in the international field to deliver an efficient reporting system which delivers what policy makers and the socioeconomic agents and the public in general wants. Indicators are a key part of this reporting process.

The European Environment Agency is currently preparing the, "Dobris+3" or "Århus" report as the second pan-European State of the Environment Report for the next European conference of Environment Ministers to be held in Århus/Denmark, June 1998. For the EU countries, and the accession countries in central and eastern Europe, the Agency will also prepare an environmental outlook to be delivered to the Commission in the beginning of 1999. And we are working on the development of a yearly indicator based report to provide a real up to date overview of the state of the environment in the EEA countries. All these overview reports will use indicators to pass their message. It is in this context that I would like to ask you to pay attention in all your analysis of material flows to the possibilities of developing easy to measure, timely and relevant indicators from your material.

In the forthcoming EEA '98 report there will be some examples of material flows but more comprehensive reporting on material flows is hampered by lack of data.

The Agency has recently set up the European Topic Centre (ETC) on Waste which will also "change course" in providing information and reliable reporting system to help reduce material flows to reach the targets of "Factor Four" in the medium-term and "Factor Ten" in the long-term.

What are we doing on Indicators?

We have several initiatives underway. We have recently completed a feasibility study and mock-up for a yearly indicators report which has been generally well received by Member States and we are looking at the development of key facts sheets for the most important issues and data sets.

We recognise, however, the need for more integrated analysis to support the 5th EAP, and the relative paucity of good indicators in the "R" section of the DPSIR framework. We therefore also have two studies underway to address these needs. The first is to develop a typology for indicators which takes us beyond indicators which just describe states of environment or action towards both eco-efficiency, and performance indicators (the latter links environmental trends to policy targets and sustainability levels).

This report is nearing completion and will be with Member States shortly. The typology, once agreed, will provide the framework for the development of more integrated indicators at the EEA. We have just published a report "Towards Guidelines for Response Indicators" which reviews current developments in this important area, assesses data requirements against the main environmental themes in the 5th EAP, and proposes further work in this area. We have a long way to go on this but it is a key part in our strategy to plug the gaps, especially the interlinkages, in the DPSIR chain.

III. The expected role of MFA within an European Environmental Information System

The EEA expects Material Flow Analysis (MFA) to have a very important role within an European Environmental Information System. And the EEA is expecting MFA to grow in its relevance, once it is established and information derived from it is exploited to its full extent.

In a nutshell: The overall aim of environmental policy is to reduce discharges and resource consumption. This can eventually only be done by reducing material flows on the input side substantially and "fine-tuning" remaining environmental problems. To this end, MFA will be of major importance in the reporting on all elements of the DPSIR-scheme applied by the EEA.

Allow me to illustrate the possible use of MFA for the EEA's reporting system. MFA could:

1. Provide several very important indicators for various stakeholders

Indicators could be first developed on a company level to assist them in evaluating their environmental performance and improve it towards the right direction. This could help them to better comply with environmental requirements since laws have become fairly complicated for them. The EEA is supporting the development of environmental performance reporting and ranking and providing information on management tools for business and industry which they can use to improve their environmental performance.

2. Serve as an early warning system

It is crucial to provide information on emerging issues and to be in a position of providing policy makers with such information so that they can develop and apply responses that mitigate the impacts of these issues. Since MFA would measure all the inputs into economy it would be at the earliest possible stage where trends become visible. However, there will then be a challenge for the EEA to link the trends derived from MFA to other environmental issues such as land use, climate change, acidification, waste and water quality. In this regard it is

worthwhile mentioning the dilemma of current environmental policy, which only reacts when damage is clearly visible: the precautionary principle is hardly applied. This is partly due to the current reporting system, which only provides limited prospective information.

3. Assist to improve environmental trends and scenarios and develop Integrated Environmental Assessments

Improving the environmental trends and scenarios, currently part of the forthcoming EEA98 State of the Environment Report, will also be of relevance in order to assess

- a) how far material flows and related environmental issues are likely to increase environmental stress on elements of the DPSIR scheme and
- b) whether the proposed responses prove to be effective. This will also help the development of more integrated environmental assessment.

4. Provide a much more comprehensive yet simple picture of economics and their impact on the environment

The description of the metabolism of the economy could reinforce the precautionary principle approach and facilitate its political implementation.

So far, threats or impacts had to be visible or at least measurable in a very clear way before policy would react. However, this often turned out to be too late to avoid serious impacts. It is thus clearly linked to what I mentioned before: the early warning system.

5. Assist our ETC on waste to tackle this issue at the source

This is a specific use of the data to be derived from MFA. The EEA will aim at ensuring that MFA is a major building block of the reporting and monitoring task of the ETC. Rather than looking at waste this ETC could focus on consequent waste prevention by concentrating on material flows in different economic sectors or following different production and consumption patterns. The ETC should certainly be involved in the development of methodologies to ensure optimal use of the data for the EEA reports.

6. Provide information on material flows and thus potential environmental impacts hidden in all kind of products, e.g. also in traded products

Since MFA would take into account trade flows a more comprehensive picture of potential damages could be given. For this it would at least need to be established Europe-wide from the beginning. This will be even of more importance in the future since trade volumes are expected to grow further. The enlargement of the EU could be a first practical case where such a MFA could help the EU to assess environmental impacts and apply instruments to mitigate negative impacts of the extended internal market, and above all to optimise the programmes for implementation of EU legislation by earlier integration of environment in all the economic programmes that will develop.

7. Examine the environmental effectiveness of the responses

Within the DPSIR scheme it is the task of the EEA to evaluate the effectiveness of responses. Evaluations of environmental taxes and environmental agreements have been carried out by the EEA in 1996 and 1997. While environmental taxes appear to be environmentally effective at reasonable costs, no statement can yet be made on the environmental effectiveness of environmental agreements due to lack of data. For the ex-post evaluation of the effectiveness of responses it is important to have a reliable MFA which also includes hidden material flows.

However, it is likely to be only a part of the information to be considered because the linkage between material flows and the environmental issue the responses aim at is often not a direct one.

8. Get a better understanding of the time lag between material flows entering the economy and environmental problems arising

Getting such an understanding will improve several elements in the DPSIR scheme, because it can be more precisely concluded when and which environmental problems are likely to occur respectively and how other parts of the DPSIR scheme will be affected. This would, again, also support more precise trends and scenarios.

9. Help to reveal the linkages between material flows, economic activities and fiscal flows and thus help to integrate environment and economy

This brings together all the previous points. It is all about the integration of economy and environment. Hence, their linkages have to be explored and established in a regular reporting system. To this end, a combination of the input-/output accounting of material flows, economic activities and fiscal flows is urgently required. As unemployment is the major concern of the public, it could also be considered to take effects of material flows, economic activities and fiscal flows on employment into account. The guiding principle “sustainable development” for policy makers comprises economy, ecology and society.

Let me finalise by mentioning some wishful thinking, some developments which I hope can take place with the push provided by this conference.

IV. EEA expectations to progress in MFA in the environmental monitoring and reporting system

Creating some "discipline" in the exercise

- A step towards developing a regular up to date and consistent reporting system on material flows providing comparable data.
- Building up an appropriate methodology (with DG XII support and under existing R&D programmes).

Establishing a "learning by doing process"

- Putting together experiences and establishing new pilot projects, if possible, at company, local, regional, national and European/international level, thus allowing for good practical, agreed examples of evaluations of material flows at various levels.
- Providing experiences allowing for different handling between renewable and non-renewable resources, and toxic/non-toxic substances. There are still different impacts of various materials on the environment and it would be sensible to establish a flexible and desegregated reporting system, involving Eurostat, the ETC on waste and to allow for the best benefit from the reporting system.
- Provide experiences linking MFA to the economic accounting system (e.g. the Input/Output data available) including the fiscal system to allow for better integration of environment and economy which is crucial part of EEA's reporting task. Links to

employment need to be made, too, if we want to move towards reporting on sustainable development.

Ladies and Gentlemen, thank you for your attention and above all for the effort you may make in the development of MFA to facilitate its introduction into the Environment Reporting System. The EEA can help to orchestrate it, on the basis of assuring some discipline and continuity for the exercise and above all by entering into a learning by doing process.

management often a separation is made between policy instruments (like eco-audit, ecolabelling, taxes etc.) and analytical instruments.

One of the analytical instruments for integrated chain management is MFA. SFA (Substance Flow Analysis) is seen as a part of MFA, while LCA (Life Cycle Assessment) is seen as partly overlapping MFA (figure 2, Udo de Haes / van der Voet / Kleijn 1997).

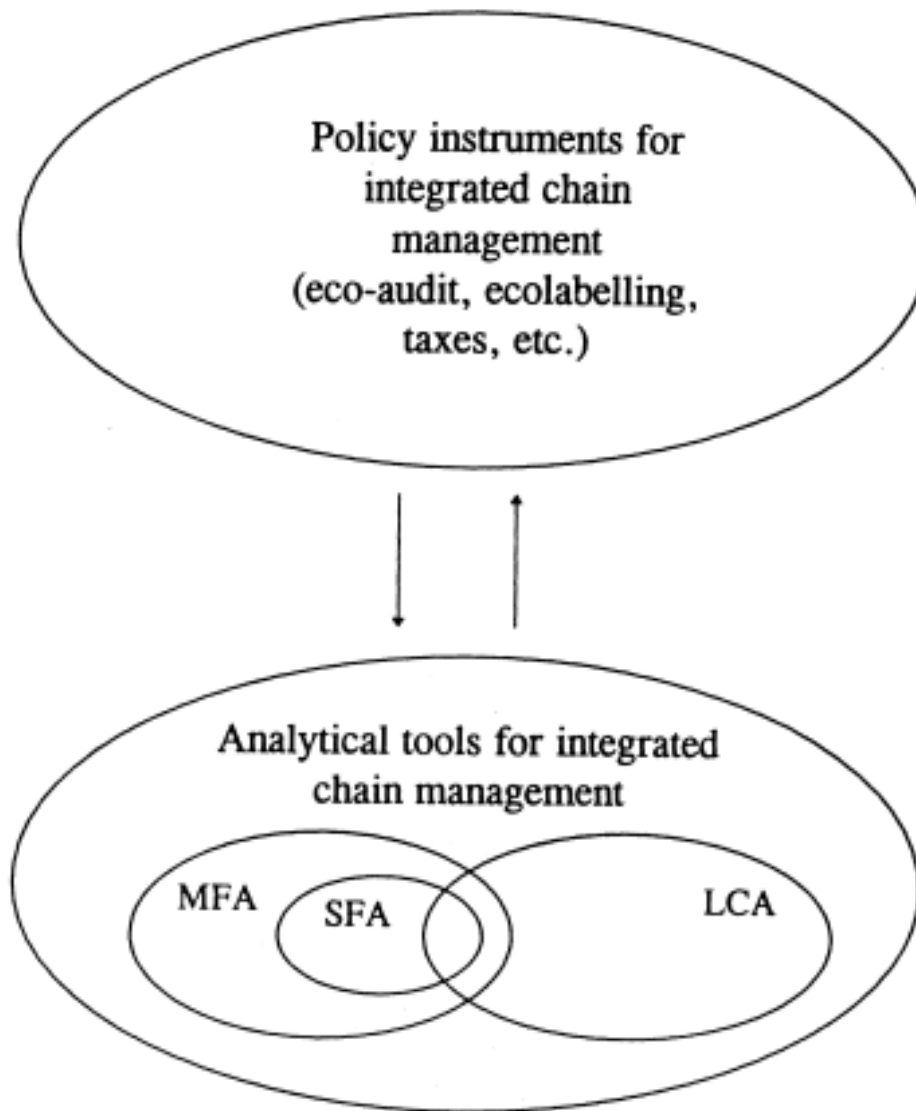


Figure 2: Positioning of policy instruments and analytical tools for integrated chain management (Udo de Haes / van der Voet / Kleijn 1997).

The "sales talk" of MFA (Bringezu / Moll 1998; Udo de Haes / van der Voet / Kleijn 1997) is very impressive:

- it can monitor environmental pressure;
 - it supports planning and evaluation of policies for sustainability;
 - it contributes to the integrated environmental and economic accounting;
 - it contributes to the quality control of data:
- by making use of a mass balance approach a check can be made whether the input of mass is equal to the output plus accumulation

- also a check on production and stock data can be made;

- it contributes to diagnose or awareness raising of environmental problems.

MFA is also a logical instrument for using in environmental policy, regarding the analysis made in the Netherlands in the first and trendsetting National Environmental Policy Plan about the cause of environmental problems: "the cause of environmental problems is the breaking or altering of substance cycles (at different scale levels), resulting in leak losses, through which substances end up in the environment at the wrong time, at the wrong place or in the wrong form". The solution for sustainable development was seen in closing of the material cycles, conserving energy and preferring quality above quantity (National Environmental Policy Plan 1989).

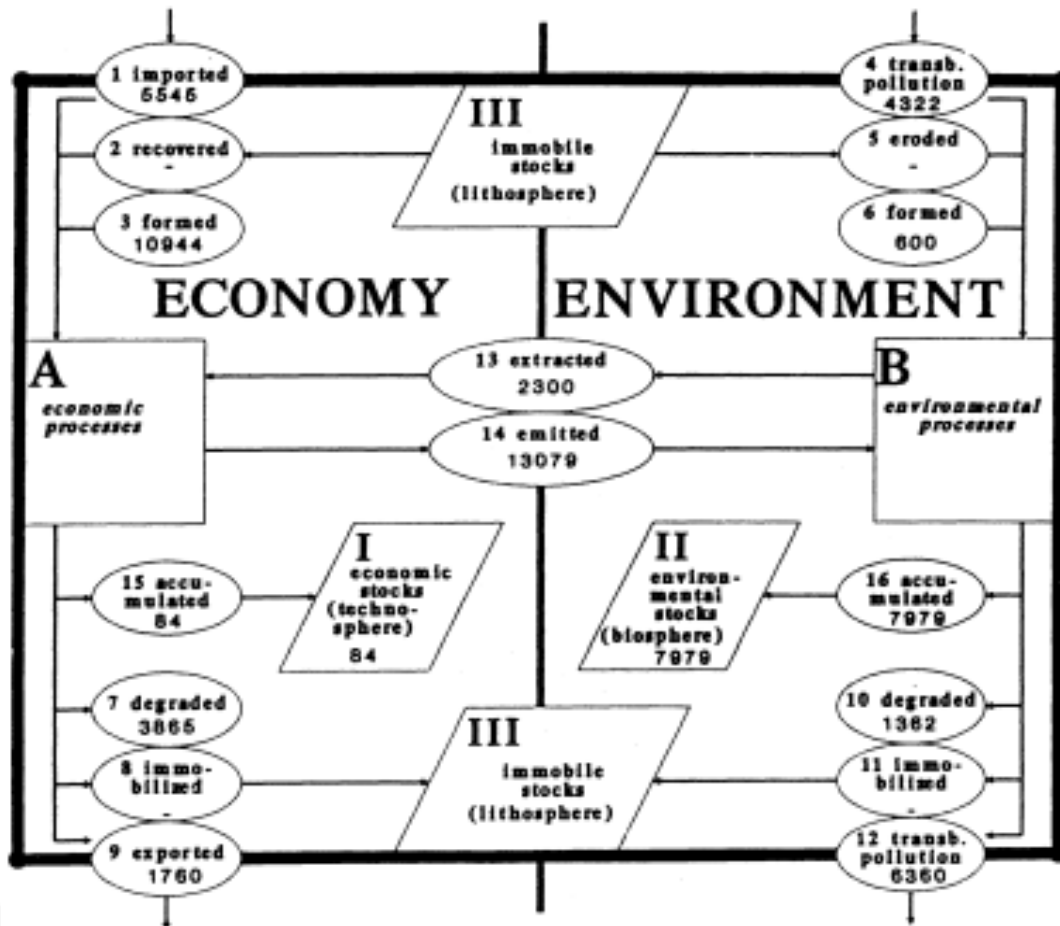


Figure 3: Substance Flow Diagram for nitrogen-compounds for the EU (in 1990) (van der Voet 1996)

However, when the results of a MFA study are presented (see for instance figure 3, van der Voet 1996), "after sales" questions come up to a policy maker, like:

- how to use the results of MFA in policy making?
- was MFA necessary regarding the policy conclusions which can be drawn and the effort and the cost of the MFA study?
- what will be the future use of MFA as a policy supporting instrument?

In order to illustrate how these questions were dealt with in the Netherlands, below the results of MFA (or better: SFA) and a discussion of the policy use of these results are presented for cadmium, chlorine and mercury.

2. Cadmium

At the end of the '80ies the ministry of environment in the Netherlands asked the Centre of Environmental Science of Leiden University to carry out a SFA study on cadmium, in order to support policy making.

The policy question was rather broad: to give an analysis of the cadmium problem and of the policy options.

The results of the SFA study (van der Voet et al. 1989):

- it gave a systematic overview of the available data on import, accumulation and export of cadmium and products containing cadmium;
- it led to a useful analysis of the sources of soil, water and air pollution due to cadmium; soil pollution was the major problem, 68% caused by deposition from air and 29% from manure;
- it led to the notice that increasing the use of NiCd batteries would lead to more air pollution and waste problems because of incineration of these cadmium containing batteries in their waste phase;
- the input in the economy and the environment was estimated at 142 tons of cadmium a year (mainly due to products, fuel and ore), the output was 83, so it became clear that accumulation of cadmium took place in the Dutch economy and environment.

The policy conclusions based on the SFA study (Second Chamber of the States General 1991):

- SFA led to a good and integrated overview of all the relevant data about cadmium and was seen as a useful basis for developing ideas and having discussions about the environmental policy on cadmium;
- since cadmium is non degradable, environmental problems will remain during the flow of cadmium through the economy and the environment. Prevention of input is needed to avoid these problems. Possible options are the use of phosphate fertilisers with a low cadmium content and the avoidance of the use of new zinc (cadmium is a by-product of zinc mining; using only recycled zinc or other materials would lead to input reduction of cadmium);
- in future the zinc stocks might be exhausted. Scarcity of cadmium could occur and strategic stockpiling of cadmium for future use might be useful;
- the analysis of the sources of soil pollution (the major problem in relation to cadmium) showed, that focus on deposition from air was necessary; to reduce the problem of cadmium emission at the waste incineration, a ban on cadmium as a pigment and stabiliser in plastics was created;
- a policy was developed to reduce the cadmium content in manure;
- for NiCd batteries a system for collection and dumping was developed and the development of cadmium free batteries was promoted.

The influence of SFA on the final policy on cadmium was limited; without SFA the same measures and policy actions would have been taken (on products, manure), however, with less supporting data. Without SFA no strategic discussions would have taken place, because of confusion and lack of consensus about basic data and flows of cadmium. However, probably a less detailed SFA could have served that purpose as well. A detailed SFA may be necessary for a check on data input and output, but in most cases it is not necessary for policy development.

3. Chlorine

Over the last decade the debate between environmental pressure groups, industry and the authorities over the risks of chlorine and chlorine compounds has become extremely polarised. In response, in order to be able to develop policy on chlorine, the Ministry of Environment in the Netherlands commissioned in 1993 a strategic study on chlorine.

The policy question was to identify the leaks from the chlorine chain in the Netherlands, to assess the risk of these leaks and to prioritise the leaks.

The results of the SFA-study that followed (Tukker/Kleijn/van der Voet 1995 and Kleijn/Tukker/van der Voet 1997, figure 4, 5 and 6):

- for the first time a systematic overview of the chlorine chain in the Netherlands was presented; 99% of the flows of chlorinated hydrocarbons through the Dutch anthroposphere was identified;
- the leaks out of the chlorine chain (the emissions to the environment) were identified;
- the emissions were evaluated using the characterisation step from LCA methodology. For some chemicals risk assessment data were used for the evaluation as well.

The policy conclusions based on the SFA-study (Minister of Environment 1995):

- the SFA of chlorine led to a very useful overview of data on chlorine and was a good starting point for policy making because there was consensus about the basic data;
- 25% of the chlorine flow was due to the emission of chloride salt to water, which was seen as something of no concern;
- the original policy idea that closing of the entire chlorine chain was the ideal solution, was modified into the policy idea that risks due to emissions from chlorine compounds should be reduced;
- the priority given by the government to reduce the risk of some chlorine compounds was in balance with the contribution of these chlorine compounds to environmental problems; for instance CFC's contributed most to environmental problems and were subject to the most stringent governmental policy;
- the risk from chlorine and chlorine compounds was seen as manageable with about 10 additional actions.

The most important actions were:

- to investigate the risk and possible actions about CFC's from old foam;
- to reduce the amount of PVC waste;
- to reduce the risk from tetrachloroethylene (dry cleaning and metal electro industry);
- to reduce the risk from 1.4-DCB and dichloromethane (indoor use);
- to reduce the risk from dioxins;
- to investigate the risk of trichloroethylene, hypochlorite and micro chlorine compounds.

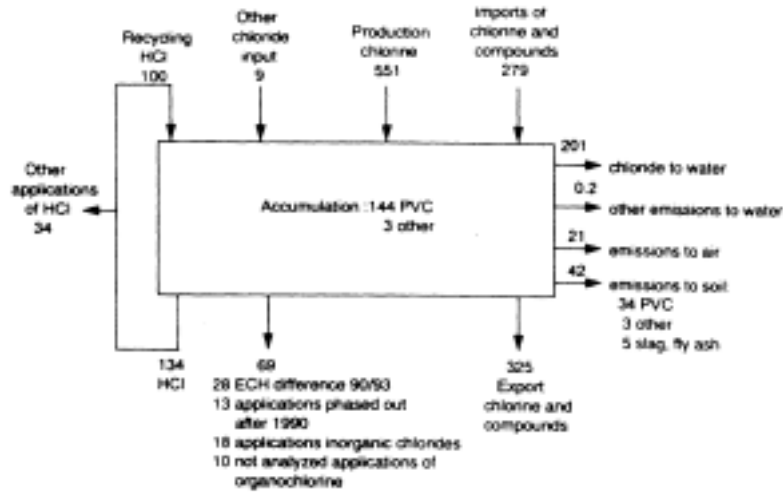


Figure 4: A chlorine balance for the Netherlands for 1990 (in ktons) (Kleijn/Tukker/van der Voet, E. 1997)

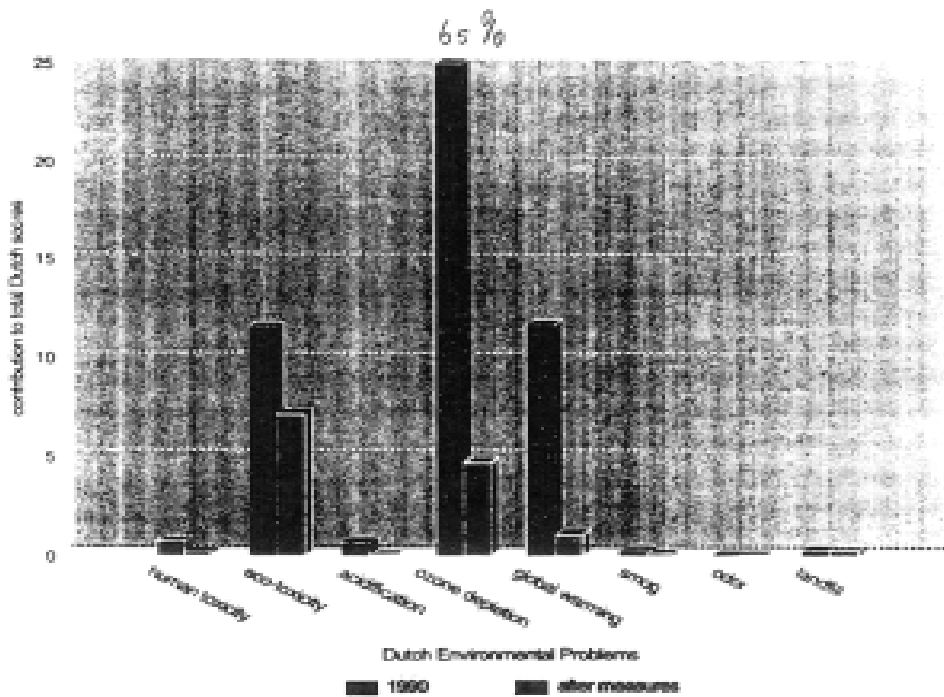


Figure 5: Contribution of chlorine-containing substances to Dutch environmental problems (in % of the Dutch scores in 1990 and after implementation of measures). The 0.4% line indicates the contribution of the chlorine chain to the total material flows through the Netherlands (Kleijn/Tukker/van der Voet, E. 1997)

The influence of SFA on the chlorine debate and the environmental policy of the government was rather big.

It was the basis for consensus on the data. One set of data was accepted and there was no confusion about different data or about the fact that there was too many data. Furthermore it helped focusing on priority problems and brought confidence in the possibility to put the problem under control (99% of the flow was known).

Weak points of the SFA on chlorine appeared to be that no risk data were created (existing data were used to give information on the risk of chlorine compounds) and that the rather detailed SFA was very time and money consuming. This was partly due to the fact that many discussions with industry were necessary to get to consensus on the data.

4. Mercury

In 1996 a SFA study was conducted on the mercury flow in the Netherlands.

The policy question was: what to do with the mercury surplus? This surplus will be created due to the coming ban on mercury in products and on export of mercury containing waste and due to the continuing input of mercury via reprocessing waste, recovery of mercury from natural gas and mining of primary mercury in Spain, China and in other countries.

The results of the SFA study (Maxson/Vonkeman 1996):

- a detailed SFA became available (fig. 7);
- accumulation of mercury in the Dutch economy and environment takes place;
- the mercury stock of mercury in Dutch chlorine plants (1000 tons) is big compared to the yearly input to the Dutch economy (100 tons).

The policy conclusions based on the SFA-study (anonymous 1996):

- in addition to the draft Dutch ban there should be an EU wide ban on mercury products;
- use recycled mercury instead of primary mercury (leading finally to the end of mining of primary mercury);
- when in 2010 chlorine plants will stop using a process using mercury (due to an OSPARCOM decision) storage in stead of usage of the mercury is needed.

5. General Conclusions

SFA/MFA is a useful tool for environmental policy making; it gives insight in and oversight of the (sometimes overwhelming amount of) data. Consensus on policy is easier when there is consensus on the data. SFA/MFA helps to get consensus on the data.

Using SFA/MFA can lead to new insights and to changes in environmental policy (e.g. closing of the chlorine chain). It also can lead to discovery of new problems (e.g. the mercury stock in chlorine plants) and new solutions (e.g. input reduction in the case of toxic, non degradable substances).

However, in some cases (like chlorine) SFA/MFA requires much effort, time and discussions about the data. Also the scope is limited; no data on the risk of the chemicals are created.

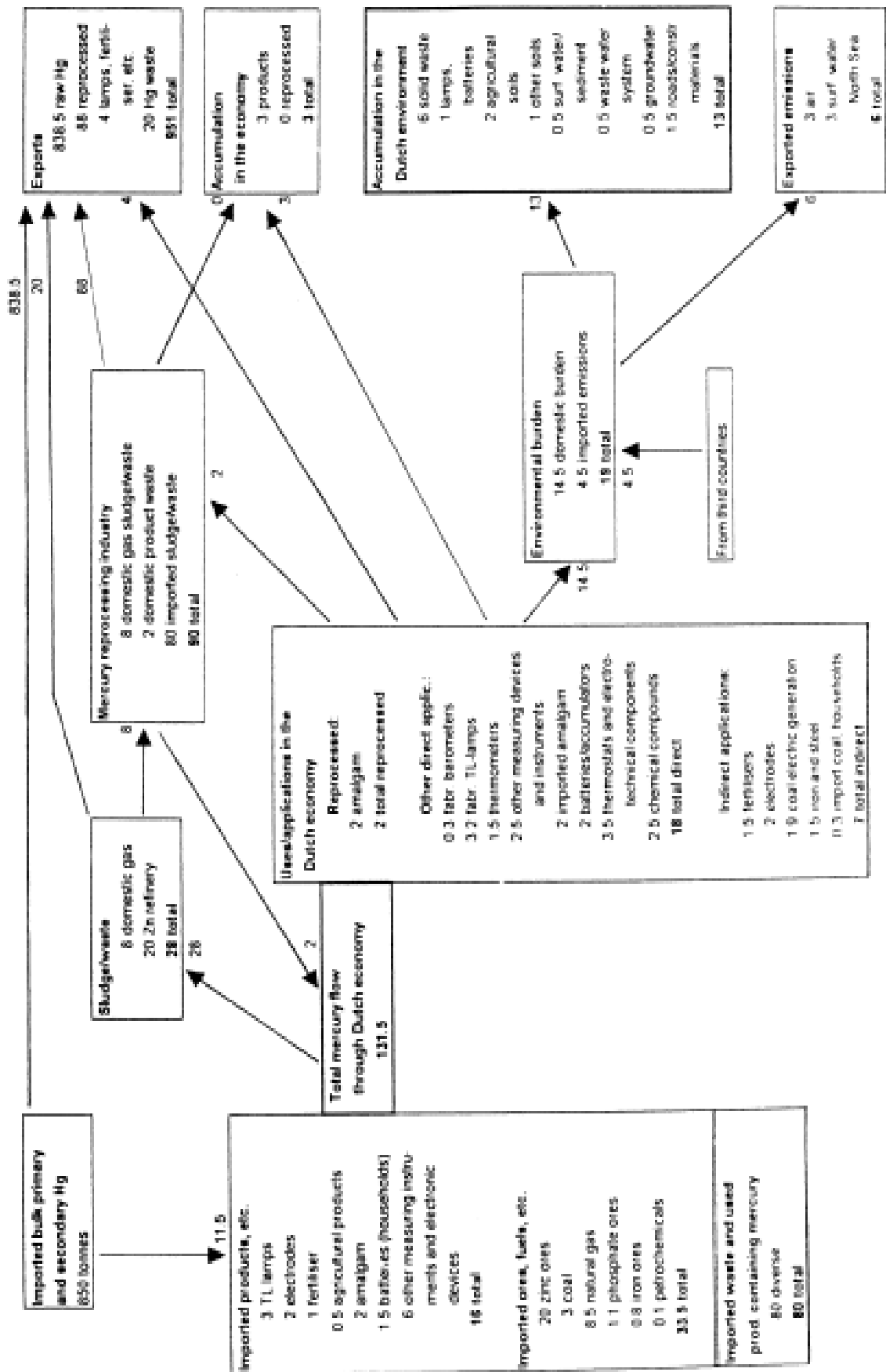


Figure 7: Primary mercury flows (tons) in the Netherlands - 1995 (Maxson/Vonkeman 1996)

In order to make an efficient and effective use of SFA/MFA in policy making, the next steps are necessary:

- • define a clear policy question,
- • determine whether SFA/MFA is the right tool for answering the policy question,
- • indicate how detailed the SFA/MFA should be,
- • describe the limitations of the SFA/MFA.

With these steps I foresee a sustainable future for SFA/MFA as a tool to support environmental policy making.

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