

# **Towards an International Data Base on Resource Intensity**

**April 2009**

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## **1. Summary**

The establishment of an international data base and data centre on the resource intensity of products and services is urgently needed, in order to monitor the success of strategies and measures to increase resource productivity, on the macro-economic level and the level of companies and product-service-systems including the customers and consumers activities. Such a data base could satisfy increasing demand by policy-makers, businesses and consumers on consistent and validated data, which enables directionally-safe decision-making towards a more sustainable development. This paper provides the framework for the establishment of such a data base and centre on resource intensity of raw materials, semi-manufactured goods, finished products and services. The centre will be able to qualify people in using adequate data for optimizing their processes and deliver services that help SMEs to participate in the development of eco-efficient technologies and processes. We first explain why effective implementation of environmental and resource policies and business activities towards improved eco-efficiency requires such an international data base and identify its main users. We then summarise recent developments in methodological harmonisation, in data management and in institutional integration of material flow accounting and analyses on the national and international levels. Finally, we outline the structure of such an international data base and the requirements regarding a host institution and list the concrete next steps regarding the set-up of such a data base. The data base will be designed in a way that allows compatibility and integration with other key indicators for life-cycle wide assessments, such as GHG emissions / Carbon Footprint, land use / Ecological Footprint and water rucksacks.

## **2. Motivation for establishing a data base on resource intensity**

Issues of resource productivity, resource consumption and related environmental impacts have significantly gained in policy importance in the past ten years. A number of European and international institutions have established policy processes, which aim at increasing resource productivity on different levels of economic activity (products, sectors, countries) and at reducing the negative environmental impacts related to resource use along the whole life-cycle of products and services. Increased resource productivity would also contribute to climate protection and a more decarbonised economy.

In 2006, UNEP established an International Panel for Sustainable Resource Management, which aims at further decoupling resource use from economic development. OECD environmental ministers have adopted a second Recommendation on Material Flows and Resource Productivity in April 2008; at the same time, the OECD published improved guidelines for the implementation of material flow accounts in OECD countries. Resource productivity indicators and material flow indicators are part of the EU sets on Structural Indicators and Sustainable Development Indicators. A number of EU policy processes aims at increasing resource efficiency and decoupling and at reducing negative environmental impacts related to resource use; among those are, for example, the EU Sustainable Development Strategy, the Thematic Strategy for a Sustainable Use of Natural Resources and the Action Plan for SCP.

On the level of companies and products, worldwide Cleaner Production Centres carry out a large number of projects on increasing eco-efficiency of products and enterprises within the framework on the UN Marrakesh Process on Sustainable Consumption and Production. The UN also supports the UNEP/Setac Life Cycle Initiative, which aims at improving life cycle assessment of products and services. The Global Reporting Initiative, which develops guidelines for sustainability reporting of enterprises, also includes indicators on material throughput of companies.

All these processes demand for improved monitoring and reporting of material flows and resource productivity on all levels of economic activities. While the data situation has significantly improved in the past years (see below), important gaps remain, which impede the exploitation of the full potential of material flow accounting and resource productivity analyses for policy-, business- and consumer-oriented applications. In particular, there is a general lack of data regarding indirect resource flows of processes, products and services, i.e. material and energy requirements along the up-stream stages of a production process (also called ecological rucksacks). However, these indirect flows have increasing importance in the age of globalisation, in which production processes are re-structured on the global level. Environmental assessments within the borders of a country or an enterprise therefore provide an ever smaller insight into the overall environmental performance.

The establishment of an international data base on the resource intensity of products and services is therefore urgently needed, in order to monitor the success of strategies and measures to increase resource productivity, both on the macro-economic level, the level of value chains as well as the level of companies and single products. Such a data base could satisfy increasing demand by policy-makers, businesses and consumers on consistent and validated data, which enables directionally-safe decision-making towards a more sustainable development.

### **3. Objectives of a data base on resource intensity**

The main objective of an international data base is to provide users with validated, internationally harmonised and periodically updated data regarding the resource intensity and related key indicators of raw materials, semi-manufactured goods, finished products and services. These data support a sustainable management of material flows in value chains and economies and a dematerialisation of currently unsustainable production and consumption patterns.

The methodological and conceptual basis for such an effort is already sufficiently developed (see below). In particular, this concerns the calculation of coefficients on material inputs following the MIPS (material input per service unit) concept, which is compatible to LCA (Life Cycle Assessment, standardised in ISO 14040) and which provides an important input to Material Flow Analysis (MFA) on the macro level. Such a database should contain data on total material inputs (including unused extraction of raw materials) along the analysed production chains, in a cradle-to-material, cradle-to-product, cradle-to-grave and cradle-to-cradle format.

In order to use synergies and to enable direct compatibility with other indicators, the data base should also contain (or at least link to) other categories of resource use, in particular GHG emissions / Carbon Footprint, land use / Ecological Footprint and water use. Thereby, all main components of eco-efficiency, which are of global importance, could be integrated within one consistent framework.

It is the explicit objective to link this data base initiative with other existing data bases on the product and process level, such as the Swiss Centre for Life Cycle Inventories ([www.ecoinvent.org](http://www.ecoinvent.org)) or the consultancy PE International ([www.gabi-software.com](http://www.gabi-software.com)), as data on material intensities could complement and extend these existing data bases. However, as recent experiences e.g. within the German network of life cycle assessments proved, interests of these existing networks towards cooperation and integration will be very diverse and will need to be evaluated in advance.

It is also planned to link the establishment of this data base to ongoing work at Eurostat, in particular the creation of the Data Centres for Natural Resources and Products. IDARES could complement the Eurostat data base particularly through providing coefficients of the indirect resource requirements of traded products and the unused domestic extraction of materials, which in many countries official environmental statistics do not report.



## **4. The users of a data base on resource intensity**

Two groups of institutions can be identified as the main users of the data base.

**A. National and international administration and statistics.**

Currently, this group of potential users is of particular interest, as increasing demand can be observed by national statistical institutions towards a comprehensive assessment and reporting of the indirect material flows related to external trade. However, requirements to perform such an assessment in many cases exceed the mandate and the capacity of national institutions. Therefore, an international host institution is required, which allows establishing and maintaining such a data base in cooperation between different national institutions and which provides a standardized and quality-checked dataset for national applications. With this regard, the establishment of such a data base could build on experiences gained in the course of the Kyoto-Protocol, where many national and international administrations are currently working on monitoring GHG emissions, the emission trading scheme and the flexible mechanisms.

**B. Companies, business consultants and public administrations.**

This group comprises all actors, which aim at assessing the environmental impacts of processes, products and services for decision-support. Among those are companies, business consultants, as well as consultants of public institutions on regional, national and international levels. Here it should be particularly emphasised that demand by companies for life-cycle wide information on resource intensities of products has significantly increased in the past few years. Main reasons are sharply rising prices for raw materials as well as increasing demand by consumers for more comprehensive information on the environmental impacts of products as an orientation for their purchasing decisions. Material flow-based indicators therefore should be further integrated into life cycle assessments of products and infrastructures. Direct synergies could be established with ongoing efforts regarding CO<sub>2</sub> balances (Carbon Footprint) of products, services and organisations.

In addition to those main user groups, two other groups shall be mentioned:

**C. Intermediate institutions (associations, unions, educational institutions, etc.),**

which could use the data for their clients and members.

- D. **Consumers (C2B), clients (B2B) and public procurement**, which could use the data as an orientation for their purchasing decisions.

## 5. Methods and activities to build on

In the past 10 to 15 years, assessments of material flows and resource productivity were advanced in a number of national and international institutions, covering an ever wider range of applications.

- **United Nations (UN):** In 2003, the UN published the latest version of the so-called System of Integrated Economic and Environmental Accounts (SEEA). SEEA provides detailed instructions, how to establish environmental accounts compatible to the standard economic accounts. Material Flow Analysis (MFA) is a core part of the physical satellite accounts within SEEA. The next SEEA update is planned for 2012. This update will include an improved integration of MFA in the overall SEEA framework.
- **International Standard Organization (ISO):** In 2006, the international standard ISO 14064 was published, containing a guide for quantification and reporting of GHGs.
- **Global Reporting Initiative (GRI):** GRI provides standards for non-financial reporting of enterprises, which are applied world-wide by around 15.000 enterprises/institutions. A core indicator within GRI is the overall material throughput.
- **World Business Council for Sustainable Development (WBCSD):** The WBCSD develops guidelines and materials for best practices to support companies in their eco-efficiency improvements. Guidelines exist e.g. for the areas of energy-efficient construction and water use.
- **OECD:** In April 2008, OECD organised an international conference on Resource Efficiency, where the outcomes of the programme "Measuring material flows and resource productivity" were presented to the public. These included a detailed MFA guide, a description of the relations between MFA and other accounting frameworks and an inventory of country activities in this field.
- **EUROSTAT:** The publication of a methodological guide for MFA by EUROSTAT in 2001 marked an important step in the international harmonisation of economy-wide MFAs. EUROSTAT currently collects MFA data through national statistical offices.

Methodological improvements were in particular achieved in the following areas:

- Calculation of sectoral resource use, in particular through combinations of material flow accounts with input-output analysis.
- Calculation of indirect material flows of traded products, following methods of life-cycle assessments to calculate resource intensity coefficients or methods of international input-output analysis, combining national IO tables and trade data with data on physical extraction.
- Integration of material flow data in econometric models, in order to consider resource use aspects in (policy) scenarios.
- Methods to assess the environmental impacts of resource use, which combine information from life-cycle assessment with physical data on material flows.
- Integration of material flow analysis with other indicators, in particular the Ecological Footprint and the Carbon Footprint.
- Integration of resource efficiency systems and management systems, in order to support the implementation of resource efficiency measures in companies.

## 6. Advances in data availability

The availability of data on material inputs and resource efficiency has considerably improved in the past few years. The following developments shall be emphasised:

- **Global level:** In several EU projects, data bases on resource extraction in all countries of the world were developed ([www.materialflows.net](http://www.materialflows.net)) and linked with economic data, such as input-output tables ([www.feem-project.net/exiopool](http://www.feem-project.net/exiopool)).
- **European level:** Data on resource extraction and resource use of European countries are published by Eurostat and are currently available for 1970 to 2004 for the EU-15. Data are currently updated to 2005 and expanded to the EU-27. Eurostat has also started a process of collecting MFA data through national statistical offices.
- **National level:** For a large number of OECD countries, but also increasingly for emerging economies (such as China), national MFA data are available. These data are normally collected and published by statistical or research institutions.
- **Product level:** The Wuppertal Institute in Germany hosts the most important data collection of material intensities of raw materials, semi-manufactured goods and (to a smaller extent) final products ([www.mips-online.org](http://www.mips-online.org)). Other

product-related data are available from the Factor 10 Institute ([www.faktor10.at](http://www.faktor10.at)) and the Finish Nature Conservation Organisation. Advances have also been made regarding the development of methods to derive average values for particular product groups, for example in the areas of construction and food. These data on the product level are closely linked to life-cycle data, such as the Swiss Centre for Life Cycle Inventories ([www.ecoinvent.org](http://www.ecoinvent.org)) or the consultancy PE International ([www.gabi-software.com](http://www.gabi-software.com)) and the different LCA networks (e.g. LCA network for food).

## 7. Institutions and policy processes supporting resource productivity

Issues of resource use and resource productivity are addressed in an increasing number of international, European and national policy initiatives and documents.

- **United Nations:** UNEP hosts the International Panel for Sustainable Resource Management, which aims at further decoupling of resource use and economic growth. The Panel explicitly highlights the importance of comprehensive and effective reporting mechanisms. The UNEP Centre for Sustainable Consumption and Production at Wuppertal organizes the Marrakesh Process, where resource efficiency plays a fundamental role in a number of working groups (see [www.scp-centre.org](http://www.scp-centre.org)).
- **OECD:** OECD environmental ministers adopted a second Recommendation on Material Flows and Resource Productivity in April 2008, aiming at further improvement of resource efficiency and extended reporting on resource use, for example regarding indirect material flows of international trade. OECD work in this area is supported by UNEP.
- **EU Commission and EUROSTAT:** A number of EU policy processes aims at increasing resource efficiency and at reducing negative environmental impacts related to resource use; among those are, for example, the EU Sustainable Development Strategy and the Thematic Strategy for a Sustainable Use of Natural Resources. Material flow-based indicators have been integrated both in the EU set of Structural Indicators as well as Sustainable Development Indicators. Resource productivity, expressed as GDP / DMC, a measure on economic performance per Domestic Material Consumption of a country, is the current headline indicator. In the medium term, the EU wants to extend the indicator by data on the indirect flows of traded products and unused domestic

extraction of resources, thus arriving at Total Material Consumption (TMC). For a regular reporting of TMC, an international data base such as IDARES would be a prerequisite through providing coefficients for both indirect flows and unused extraction.

- **European Environment Agency (EEA):** Since 1997, the EEA finances a so-called Topic Centre on Waste and Material Flows. From 2009, this Topic Centre will be transformed into a Topic Centre on Sustainable Consumption and Production.
- **National institutions:** Material flow-based indicators form an integral part of national environmental and sustainability reporting in many EU member countries.
- **International institutions for product-oriented analyses:** A number of international institutions have integrated issues of eco-efficiency and resource productivity into their work programmes. Many institutions worldwide work with Life Cycle Analyses (LCA) and related instruments for the impact analysis of products and services; in general, they work based on the ISO 14040 standard for LCAs. System boundaries. These institutions gather data systematically, important parts of which could be easily used or adapted for the analysis of material flows and resource productivity. Examples are enterprises and their associations, such as the WBCSD or the UNEP/Setac Life Cycle Initiative.
- **Cleaner Production Centres:** UNEP initiated a worldwide network of Cleaner Production Centres focusing optimization of business processes, development of PSS and technical installations. A data centre could be helpful to use and create a worldwide knowledge base initiating a life-cycle perspective for implementing resource efficiency potentials along whole value chains.
- **Businesses: several multinational cooperations** (e.g. BASF, Sony, Toyota, Panasonic), the GRI network and the WBCSD support eco-efficiency. They have developed eco-efficiency criteria and management rules regarding resource efficiency to implement sustainability strategies.
- **Consultancies:** The subject of resource efficiency has reached important business consultant groups (McKinsey, PWC, Roland Berger). They give advice to governments and MNCs. This shows the strategic economic impact of this issue. The reports and advices often contain lead market strategies concerning green product development and technologies for the upcoming sustainable future markets. On the micro level there are several smaller consultancy groups close to the SMEs with a high knowledge base in the field of specific sectoral

process engineering tools, sometimes funded by governments or by state support programmes.

## 8. What is required?

**Policy-makers, businesses and other societal groups demand for a data base containing validated, internationally harmonised and periodically updated data regarding the resource intensity and related key indicators of the production and consumption of products and services.**

In order to complement other existing data bases or data bases currently under compilation, in particular the Eurostat Data Centre on Natural Resources and Products, IDARES should contain the following components:

- **Data on indirect resource flows of internationally traded raw materials, semi-manufactured goods and finished products.** These data are required for analyses on the macro level, in particular for calculating comprehensive resource use indicators such as Total Material Requirement (TMR) and Total Material Consumption (TMC) of countries and world regions. At the same time, these coefficients are required to complete assessments on the micro level with regard to the consideration of indirect (up-stream) material requirements of raw materials and semi-manufactured goods in process analyses. Despite the numerous activities in this field, only a limited number of data on indirect material requirements (also called “ecological rucksacks”) of traded commodities and products are available. So far, coefficients for the calculation of life-cycle wide material inputs from extraction to the transport to the border are mainly available for raw materials and products with a low level of processing. Many of the coefficients in the Wuppertal database refer to specific conditions for Germany. Existing data on coefficients of indirect material flows needs to be collected and the data set needs to be expanded, in order to develop a larger number of country-specific coefficients, which reflect differences in material and energy efficiency in different world regions.
- **Data on unused extraction per unit of used extraction.** Huge data gaps can still be observed in the area of unused domestic extraction (UDE). Although efforts have started to integrate existing data bases on UDE coefficients (for example, WI and SERI have recently harmonized their UDE data bases), significantly more resources are required in order to generate a larger number of country- and raw material-specific factors, either through screening of existing literature

What is required?

or through expert interviews. In the medium run, a significant improvement of the data situation will only be achieved, if companies of the extractive sectors are actively integrated into reporting on material flows.

As described above, national institutions lack resources to set up and maintain such a data base. Therefore, an **international host institution** is required. Such a host could either be an institution on the European level (Eurostat, EEA, JRC, etc.) or an international organisation (OECD, etc.). It would also be possible to create a European or international network of smaller institutions, which host different modules of the database.

Such a host institution should receive data from the different national and regional data bases and experts, but also from all support programmes dealing with material flow data. A direct link between material flow-related research programmes and data centres is needed based on a harmonized format for data exchange. The host institution/s would implement the following tasks:

- **Facilitating set-up and maintenance.** The international host institution would need to support the set-up of this database both through financial and technical resources. This includes providing resources to collect existing data on resource intensities and transform them into a harmonised format. Furthermore, the host needs to set up the principal structure of the data base, which should be user-friendly and easy to maintain, both regarding the import of new data and data export (data queries).
- **Guidelines and standards for data provision and application.** The data base also needs to provide guidelines and standards for the preparation, transformation and import of new data. As the data base intends to cover the European (and global) level, many institutions will contribute basic data. Formalised procedures have to be developed in cooperation between the host institution and other experts, how the data are harmonised and integrated into the general data base structure.
- **Quality insurance and transparency.** One key precondition for ensuring acceptance by the different user groups and wide-spread use of the data is to establish a sound system of data quality insurance. Providers of new basic data should be fully transparent on which methods they applied and which primary sources they used to compile the data delivered to the data base. This information should also be available to the end-users of the data base.
- **Work programmes for regular updates and extensions.** Regular updates of the resource intensity data will increase the application of the data base in policy-oriented uses, which often aim at measuring short-term impacts of policies.

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The host institution would need to provide resources for performing such updates, as well as implement work to continuously extend the scope and depth of the data base (i.e. increasing number of country- and products-specific data).

- **Guidelines for using and reporting data.** Each product and each process underlies different specific conditions, in many cases only known by experts. Using a data base needs knowledge about the limitations and about the system boundaries. Therefore – similar to the GRI-Process – users require step-by-step guidelines for their branch or product group. The host institution can use the existing reporting and indicator guidelines to specify and lead users through the offered data network focusing on the indicators of interest. Companies active in sustainability reporting will thereby reduce their work and cost load for data collection.
- **Supporting implementation and qualification.** Newcomers and experts need assistance concerning the use of data, development of product strategies, networking, decision making with material flow-based indicators and implementation of identified strategies. Additionally, users want to evaluate their performance in regular intervals. The regional and national data centres could be the information and qualification interlinkage, but qualification and performance tools must be developed together with an adapted communication and diffusion strategy by the international host. The experience and evaluation of the German material efficiency agency and its SME supporting programmes could be used as a model.



What is required?

## **The Aachen Foundation**

The **Aachen Foundation** is a politically independent, private and operative non-profit organization based in Germany (full name: Aachener Stiftung Kathy Beys). The foundation is focused on resource productivity and dematerialisation the benefits of which it communicates to different target groups such as SME, politicians and interested public. It does so by using different communication tools.

The foundation sees strong evidence that only a dramatic increase of resource productivity by a factor X can help to maintain the life sustaining ecosystem's services. Our present lifestyle exceeds the carrying capacity of the earth and thus cannot be sustained. Sustainable development demands a quantum leap in present resource productivity.

Competition and innovation can lead us there.

[www.aachener-stiftung.de](http://www.aachener-stiftung.de)

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