Full integration of LCA with other assessment tools – new application areas and harmonized modelling approaches

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1. Introduction

Commonly, life cycle assessment (LCA), input-output analysis (IOA) and mass flow analysis (MFA) are seen as separate assessment tools each with specific application areas. Recent and ongoing EU 6th and 7th framework projects are creating and integrating several different national accounts enabling for a full integration of the above mentioned assessment tools. The following projects together have led to the creation of the, to date, most detailed and complete set of integrated model for LCA, IO analysis and MFA: FORWAST [1], EXIOPOL [2], CREEA [3] and DESIRE [4]. The integrated model, which is called the exiobase, is a global multi-regional hybrid IO database which is based on fully balanced monetary, mass and energy accounts (supply use tables). The database has several application areas for use as an assessment tool for policy development at different levels of scopes like product, corporate, project, program and policy impact assessment, at different levels of organization from individual company to government/ intergovernmental, and at different geographical scales from local to global.

2. Materials and methods

The framework of the integrated database is the socalled supply-use framework which is the common basis of all input-output models. A supply-use table contains two core tables, typically for one country during one year; a supply table and a use table. The supply table contains information on the supply of products from industries. The product and industry classification is an all inclusive system meaning that the included products and industries include all product groups and all industry sectors in economy. The use table contains information on the inputs (use) of products by each industry. Besides the core tables are tables of primary inputs enabling for creating a balance of inputs to and outputs from each industry.

The integrated database currently includes three sets of supply use tables; monetary tables, physical (mass) tables and energy tables. The primary inputs tables of the different types of supply-use tables include economic value added for the monetary tables, resource inputs and emission outputs for the physical tables, and energy resource inputs and energy losses for the energy tables.

The database include trade balanced supply-use tables for 43 countries and four rest-of-world regions, i.e. it has global coverage. With the three types of tables, the database include total accounts of all economic, physical (mass) and energy transactions in economy world-wide.

The socalled extensions of the current database include: economic value added, and physical accounting for resources, emissions, land use, and water consumption.

The creation of the physical supply-use tables involves a detailed mass balanced procudere for calculating all waste flows as well as the treatment or recycling of all waste flows.

The level of detail of the database is much higher than typical economic input-output models which is normally 40-60 products/industries. The starting point of the database has been the more aggregated products/industries, but these have been subdivided, e.g. by use of detailed information on physical flows and from life cycle inventory databases such as ecoinvent. The current level of detail of the database is ~200 product groups (including goods, services and waste treatment/recycling services) and ~160 industry sectors.

Having one integrated framework enables for using any new data together with existing data in a complete database rather than having several separate incomplete and inconsistent models, databases and assessment tools.

3. Results and discussion

The resulting integrated database, the exiobase database, represents a full integration of life cycle assessment, input-output analysis and mass flow analysis. It is an integration of various global accounts and statistical data (economic accounts, trade accounts, land accounts, resource accounts, water accounts etc.). When using the database for modelling purposes, it can be used for several purposes such as environmental footprint of nations, municipalities and companies (corporate footprinting; e.g. environmental profit & loss accounts) as well as environmental assessment of products (specific products, industry averages), projects as part of environmental impact assessment, EIA (infra structure projects, industry development projects etc.) as well as programmes and policies. Hence, with the same database, environmental footprints of nations can be calculated using exactly the same models and data as corporate environmental footprints of enterprises as well as product specific LCAs. This creates a high degree of consistency and coherence between sustainablity assessments at different levels. The fact that the database contains price information on all flows of products makes it easy to couple it with existing corporate annual purchases (for corporate sustainability accounting) and project/programme/policy budgets (for creating life cycle based environmental impact assessments and strategic environmental assessments).

Activities are ongoing in order to increase the scope of the database. Some of these activities include integration with more detailed LCA databases such as ecoinvent (i.e. increasing the level of detail of product grops and industry sectors), adding social issues to the extensions, and to separate land use change activities from existing industries enabling for explicit modelling of indirect land use changes (iLUC). Further, as part of the DESIRE project [4], time-series of the database are produced which include historical time series as well as scenario building for now casting and future scenarios. This enables for the calculation of various sustainablity indicators over time as well as having databases for different points in time (with different energy mixes, waste treatment mixes and recycling rates etc.).

4. Conclusions

The integration of many existing assement tools and data sets into one consistent framework has shown to produce several new opportunities for application of life cycle based sustainability assessment in a consistent manner. Hence, the same database and model can be used for creating national and corporate environmental footprints. Some of the footprints or indicators that can be produced with the current version of the database are carbon footprints, water footprints, waste accounts, various MFA-based indicators, e.g. total material requirement (TMR), cumulative energy demand etc.

Some of the advantages of integrating the different assessment tools and data are that much overlap and inconsistency are avoided. Further, the use of a common classification and terminology also adds to increasing consistency.

With an integrated assessment tool the advantages of several separate tools and datasets are merged, and coherence between international and national policy development with lower levels such as projects, programmes, products and enterprise is facilitated.

5. References

[1] FORWAST project. FORWAST is a Specific Targeted Research Project of the 6th European Union Framework Programme. Project web-page: http://forwast.brgm.fr/
[2] EXIOPOL project. EXIOPOL is an integrated project funded by the European Commission under the 6th framework programme. Project web-page: http://www.feem-project.net/exiopol/
[3] CREEA project. CREEA is a FP7 project on compiling and refining environmental and economic accounts. Project web-page: http://creea.eu/
[4] DESIRE project. DESIRE is a FP7 project that will develop and apply an optimal set of indicators to monitor European progress towards resource-efficiency. Project web-page: http://fp7desire.eu/