

EXECUTIVE SUMMARY

With this study, the MIRA agency wishes to obtain an overview of the different possibilities of environmental input-output (IO) models with regard to (environment-related) policy in general, Flemish policy in particular, and to estimate the usefulness of and the modifications required to the Flemish environmental input-output model for the applications most relevant to the Flemish policy.

This study can be subdivided into 2 major phases. In the initial phase, a needs analysis is performed, in which literature research and interviews with Flemish policymakers are used to assess concrete application options and interesting analyses regarding the need for these within the Flemish policy. Following this, the efforts required to perform such analyses for Flanders using the existing models are estimated in the next phase, including the modifications required for this.

General application options

In the initial phase, a literature study was performed, which resulted in an extensive list (longlist) of all kinds of documents that describe applications of environmental IO models to support environmental policy. This may concern both i) environmental effects of all kinds of policies (not environment-specific) and ii) socioeconomic effects of environment-related policies. A search for these concrete examples was performed on a Flemish, Belgian, European and international level. The following table presents a summarised overview of possible applications for environmental IO models and provides an example of such an analysis on each occasion.

Table 0: Overview of application options for IO analysis

	Problem analysis	Ex-ante effect analysis of (future) policy	Monitoring and ex-post effect analysis of implemented policy
Footprint calculations (country)	Ecological footprint of a country or region.	Effect of (future) policy on the footprint of a country or region.	Monitoring and/or effect of implemented policy on the ecological footprint of a country or region.
Upstream environmental pressure from import	Analysis of the environmental pressure of the preceding chain of a sector abroad.	Analysis of (future) (Flemish) policy measures on the environmental pressure that occurs in the preceding chain abroad.	Monitoring and analysing the evolution of greenhouse gas emissions linked to our import.
Direct and indirect environmental pressure and intensity of a sector	Analysis of the eco-efficiency of sectors	Effect of technical changes to products and processes	Following up the evolution of the eco-efficiency of sectors
Direct and indirect environmental pressure and intensity of a final product group/consumer group/consumption domain	Identification of the consumption domains causing the highest environmental pressure in Flanders and abroad	<ul style="list-style-type: none"> • Effect of changes to life and consumption patterns • Effect of changes to prices and costs • Analysis of both socioeconomic and environmental impact of certain policy measures 	Monitoring of environmental pressure linked to final consumption of Flemish households
Structural Decomposition Analysis (analysis of factors that contribute to environmental pressure)	Hotspot analysis of the value chain of a particular product group or sector	Analysis of the key causes of effects linked to possible policy scenarios	Identification of causes for evolution in eco-efficiency of a sector

Combination of environmental, economic and socioeconomic data	Analysis regarding Flemish dependence on import for materials, greenhouse gases (GHG), and the added value and employment linked to this	Potential for policy aimed at recycling or reuse, in terms of added value, GHG and employment	Monitoring of relative or absolute decoupling
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Based on the literature analysed, the project team made an initial selection of applications that may also be interesting to and relevant for the Flemish policy. These were subsequently discussed with VITO experts who are well-informed on Flemish environmental policy domains, such as climate, waste, materials policy, etc., which led to the bundling of 40 publications deemed to be the more interesting ones for the Flemish policymakers in an inspiration list. From this inspiration list, five application examples were selected for a more detailed analysis with a specific focus on the model specifications (shortlist).

This analysis shows that most of the analyses using environmental input-output models answer an ad-hoc question. There are few examples in which an environmental input-output model is systematically updated and used to answer recurring questions. Another notable aspect is that multi-regional (MR) environmental extension (EE) IO models typically focus on one specific aspect and further specify that: e.g. focus on a time series for many different countries and environmental extensions, but with data that is less substantiated (EORA, www.worldmrio.com); focus on environmental extensions (very extensive list) and high sector level of detail (over 100 sectors), for larger countries and regions, but no time series (ExioBase, www.creea.eu); limited sector level of detail and a limited number of extensions for a time series (WIOD, http://www.wiod.org/new_site/home.htm).

The same analyses can be reproduced partially, but not fully, using the Flemish environmental input-output model. One requirement for almost all the analyses is linking the Flemish model to a multi-regional model. Such a link is easy to make. Most problem and hotspot analyses can be performed for Flanders using the current model, and this has already been done for the base year 2003³. An analysis focusing on different types of households can be performed for Flanders, if the Flemish final demand of households can be subdivided into different household types. This subdivision is relatively easy to make if the data regarding the spending patterns of the households are available. Analyses involving the link to the Ecological Footprint are possible and have already been partially performed in a previous study using the Flemish model⁴. The ex-ante scenario analyses described can also be performed, provided limited adjustments are made. No time series with constant prices is available for Flanders, so it is not possible to monitor a time series of indicators just like that.

Interesting application options for Flemish policy

Flemish policymakers were subsequently asked to assess the findings and proposals, which led to a limited selection of the most relevant and interesting applications of and analyses with environmental input-output models (policy applications) for the Flemish policy.

The concrete questions that are based on a problem analysis are grouped in the following clusters:

³ Vercalsteren A., Van der Linden A., Dils E., Geerken T. (2012), *Milieu-impact van productie- en consumptieactiviteiten in Vlaanderen*, study commissioned by the Flemish Environment Agency (VMM), MIRA, MIRA/2012/07, VITO.

⁴ Van der Linden A., Vercalsteren A., Dils E. (2010), *Berekening van de ecologische voetafdruk van consumptieactiviteiten in Vlaanderen met behulp van het Vlaams input-outputmodel*, study commissioned by the Flemish Environment Agency (VMM), MIRA, MIRA/2010/08, VITO.

- analyses that link environmental, economic and social aspects;
- analyses relating to the dependence of Flanders on import;
- analyses involving use of materials on the one hand and closing material cycles on the other;
- analyses that focus on and are based on a well-defined sector;
- analyses based on final consumption;
- other.

In general, Flemish policymakers consider the problem analysis applications to be relevant for materials- and greenhouse gas-related analyses. Additionally, this type of analysis is interesting for mapping out the level of dependence on import. By evaluating the current situation, these analyses provide new insights into value chains, in particular the foreign value chains. Their additional value also lies in linking economic aspects, such as added value, with the environment (use of materials, greenhouse gas emissions, etc.) and socioeconomic aspects (employment).

The ex-ante effects analysis applications are grouped as follows:

- analyses in which the effect of certain measures on or changes to a sector are studied;
- analyses in which the effect of certain measures on or changes to specific consumption domains or final demand actors are studied;
- analyses in which the effect of a change to import or export is established;
- more general analyses in which the effect of possible policy measures is considered;
- other.

An ex-ante effects analysis (of future policy) is typically used in those cases where an insight is required into indirect effects (throughout the preceding chain) and 2nd order effects (on other sectors of the economy). Therefore, this type of analysis is interesting for estimating/evaluating possible future policy.

Fewer applications that focus on monitoring were indicated. The key themes here are monitoring use of materials and greening the economy. Monitoring implemented policy is interesting anyway, to establish the evolution of certain indicators, to investigate absolute and relative decoupling and also to analyse certain new indicators (e.g. relating to materials policy).

Provided it is linked to an MR EE-IO model, the Flemish model allows most of the problem analysis applications relevant to the Flemish policy to be performed without additional modifications to the model. The only applications for which the Flemish model in its current form is not suitable are analyses related to recycling activities and/or secondary use of materials and bio-economy. Its added value mainly lies in linking the environment, economy and employment, and the fact that the value chains can be mapped out and investigated in detail.

Most ex-ante effects analyses are relatively easy to perform using the available environmental input-output models, provided they are linked to MR EE-IO models (where applicable). The advantage of this type of analysis lies in the fact that effects of possible (environmental) policy measures or scenarios on an entire economy, including the preceding chain, can be mapped out and the fact that it covers effects on an economic, environmental and socioeconomic level. A preliminary study, required for defining the shock that has to be introduced, determines the substantiation and correctness of the shock provided and therefore partially of the analysis as well. In this case, analyses relating to recycling and renewable energy cannot be performed either using the current model.

Monitoring of implemented policy is currently more difficult to apply for Flanders, because no time series is available for the Flemish environmental input-output model. It is clear that this type of analysis mainly requires model-related efforts at the moment. Once the time series (2003-2007-2010) is available, analyses will be possible. These monitoring studies provide specific added value by linking environmental, economic and socioeconomic parameters, and by the fact that a decomposition analysis can be performed, which focuses in detail on the global value chains.

In general, it can be concluded from this study that, provided there is a link with MR EE-IO models (if required), the current Flemish model can answer most questions of the problem analysis and ex-ante effects analysis type. If this analysis focuses on recycling/secondary materials or sectors that are fragmented within environmental IO models (e.g. renewable energy/bio-economy), this will not be possible with the current models. It will be possible to answer recycling issues in the short term, when models such as ExioBase 2.1 and the Flemish model 2010 are available. Monitoring applications absolutely require a time series for Flanders. With the Flemish model 2010, it will be possible – with due care – to start talking about a 2003-2007-2010 time series, but a solution will have to be found for the fact that the Flemish monetary tables state current basic prices rather than constant prices.

The Flemish monetary supply and use tables (SUT) and IO tables for 2010 are currently being prepared by the Federal Planning Bureau. It would appear interesting to link environmental extension tables to these once again. By now it has become clearer which environmental extensions are important to Flanders, allowing us to focus on a limited set of environmental extensions.

Regardless of the type of analysis, a key advantage of environmental IO models is that, in addition to environmental aspects, economic and socioeconomic aspects are also mapped out, and that the entire global economy is included in the model. Additionally, the possibility to focus more on the global value chains via decomposition analysis provides an additional advantage.

Conclusions

The study shows that mainly the following aspects determine the typical applications and added value of environmental IO models:

- possibility to map out the indirect effects on the rest of the economy;
- link between environment-economy-employment;
- availability of different environmental parameters (e.g. greenhouse gases, use of materials, etc.) and the possibility to expand these;
- possibility for a detailed analysis of the value chains (decomposition analysis).

IO models provide specific added value in comparison to other macroeconomic models and tables, especially due to the fact that they provide a link between environmental, economic and socioeconomic parameters for the entire global economy within the same framework. The relationships between different sectors and regions have been mapped out, which also allows the effects and impacts throughout the value chain to be included and analysed in detail from a consumption perspective using decomposition analysis. This added value applies to the 3 types of applications, i.e. problem analysis, ex-ante effects analysis and monitoring. Here, problem analysis focuses on analysing the current situation, for example, to identify hotspots (in a value chain, in an economy, in a consumption pattern of households or others), to calculate footprints (materials, carbon, water, country) or to map out relationships with other regions (import and export). Ex-ante effects analyses are mainly used, not just to estimate the direct effects of certain (environmental) policy measures or strategies, but also to estimate the indirect effects on the entire economy (other sectors in the country and abroad). Monitoring is mainly used to follow up certain specific indicators to ascertain whether decoupling may be occurring, what the possible causes are for any decoupling or improvements, and to learn from the approach and results for different countries and types of economies.

In order to perform these analyses, a number of minimum requirements are set for environmental IO models. Problem analysis and ex-ante effects analysis set no specific minimum requirements for the models. Monitoring, on the other hand, requires a time series, with monetary tables that

ideally list constant prices. The scope of the analysis mainly determines the minimum requirements.

A fragile balance between the efforts remains required to feed the environmental IO models and the analyses that can be performed with these models. This balancing act is important on both a European and a Flemish level. Environmental IO models provide highly interesting opportunities for policy-supporting research, but rely on vast amounts of data and therefore on efforts to collect them.