value
balancing
alliance

Methodology

Impact Statement

Extended Input-Output Modelling

Version 0.1

VBA METHODOLOGY V0.1
Impact statement

- Extended Input-Output Modelling -

CONSULTATION DRAFT

May 2021

Note on this document

This is the first version of our Impact Statement methodology for general, cross-cutting aspects. We piloted this version in 2020 and the learnings will inform the further development in 2021. In addition, we have developed two specific documents for a) environmental indicators and b) for socio-economic indicators.

We are very aware that this is a work in progress. We are still discussing with third-party experts and our members important elements and we will be using a review panel and formal consultation and piloting process to test and improve the standardised approach.

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About the Value Balancing Alliance

The Value Balancing Alliance e.V. (VBA) is a non-profit organisation that aims to change the way company performance is measured and valued. The alliance's objectives are to create a global impact measurement and valuation (IMV) standard for monetising and disclosing positive and negative impacts of corporate activity, and to provide guidance on how these impacts can be integrated into business steering.

VBA was founded in June 2019 and represents several large international companies, including Anglo American, BASF, BMW, Bosch, Deutsche Bank, DPDHL, Kering, LafargeHolcim, Mitsubishi Chemical, Otto, Porsche, Novartis, SAP, Sana Kliniken, Schaeffler, Shinhan Bank, SK and ZF. The alliance is supported by the four largest professional services networks – Deloitte, EY, KPMG and PwC – and by the OECD and leading academic institutions, such as the University of Oxford and the Impact Weighted Accounts Initiative at Harvard Business School. Furthermore, in partnership with the Capitals Coalition, the alliance receives funding from the EU through its LIFE programme for the Environment and Climate Action[1] and is member of the EU Platform Sustainable Finance.

A global IMV standard is needed not only to foster long-term thinking and performance comparability but also to consolidate the knowledge already available in this field. Therefore, the VBA is building on the work of leading universities and well-known organisations, such as the World Bank, the OECD, the Capitals Coalition, the WBCSD, the Impact Management Project, the GRI, SASB and the IIRC. The envisioned transformation and system change require the cooperation of all players in the business ecosystem. The alliance will make its work available to the public and encourages more companies to join along the way.

[1] The EU has provided the VBA with financial support to develop a first set of accounting principles and guidelines regarding environmental impacts for business. Over the next three years, the VBA (in partnership with the Capitals Coalition) will develop a standard for measuring and valuing companies' environmental impacts in monetary terms.

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1. INTRODUCTION

The current economic system focuses on financial value and excludes many of the impacts of business on society, such as environmental and social impacts. These impacts are often referred to as externalities for this very reason. Many of these impacts are directly or indirectly linked to current and future business value, and to stakeholders' interests. Therefore, businesses are becoming increasingly interested in these impacts and ways of taking them into account in their strategies and business decisions.

There are two major perspectives on value. First, the stakeholder perspective focuses on the positive and negative impacts of corporate activities on the environment and, by extension, society. This is known as ***the value to society perspective***. Second, a financial view of how these impacts (and dependencies) affect the (longer-term) financial performance of corporations is known as ***the value to business perspective***. Both perspectives are inherently connected. As such, they have been widely acknowledged as "double materiality".[2]

The VBA aims to embrace both methodological streams – one focusing on impacts and the other on dependencies – as they are fundamental for understanding a company's long-term value creation.

Our aim is to work towards global standardisation. Moreover, our methodology is not limited to environmental impacts – we believe that the same principles should apply to all sustainability impacts.

Value to society – Impact Statement

The General Method paper introduces the calculation methodology for monetary impact valuation and is followed by deep-dive topic papers on socio-economic and environmental impacts. Notably, these papers focus on topics that are already reasonably mature rather than a comprehensive set of impacts:

- General Method paper – sets out the overarching framework as well as the key concepts and process of methodology development,
- Environmental Method paper – explains the IMV details for specific environmental topics and specific sub-indicators, and
- Socio-economic Method paper – explains the IMV details for specific socio-economic topics as well as specific sub-indicators.

The General Method paper is the foundational document. It sets out the guiding objectives, outlines the methodology development process, explains the document's development process, and summarises key concepts and general choices that need to be made and that should be common for all economic, environmental, and social impacts.

[2] On double materiality see, e.g.: Accountancy Europe (2020): Interconnected Standard Setting for Corporate Reporting, https://www.accountancyeurope.eu/wp-content/uploads/191220-Future-of-Corporate-Reporting.pdf;
CDSB (2020): Falling short?, https://www.cdsb.net/sites/default/files/falling_short_report_double_page_spread.pdf; EU Commission (2019) Guidelines on reporting climate-related information, https://ec.europa.eu/finance/docs/policy/190618-climate-related-information-reporting-guidelinesen.pdf.
Natural Capital Protocol, p.15

The aim of the Environmental Method paper is to provide specific details for Natural Capital Accounting per impact driver and summarises key concepts.

All documents and described methodologies are in an interim state and will be finalised after the piloting and learning in 2023 (expected).

The method is being developed using an iterative process. The methods currently described in this document are version V0.1. The methodology has been piloted with international companies.

2. IO ANALYSIS/TABLES – BASIC DESCRIPTION

Background and concepts

2.1. BASIC DESCRIPTION

The economist Wassily Leontief (1906 to 1999) developed the system of IO analysis in the 1930s and 1940s, and was awarded the Nobel Prize in Economics in 1973. One important goal of IO analysis is to examine the interdependencies between production and goods within an economy in detail. Such analyses include the flow of goods between the economy and the rest of the world, and they focus on flows of goods within production processes.

Today, IO tables are an integral part of national accounts and usually presented in monetary terms. They are usually derived from the supply and use tables produced by national statistical offices at the state level.

IO models can be used as a basis for analysing the effects of a company's activities on upstream production (supply) industries along the value chain. With the help of IO analysis, the intermediate goods incorporated in the production process can be allocated to different sectors of the economy. In other words, the supply links among the individual sectors can be shown. This enables the input structures to be differentiated by sector. The company’s purchased goods and services serve as a starting point (tier 1). On the basis of the structure of the goods and services actually required or obtained, the intermediate goods and services (tier 2 – tier n) statistically required for the production of the company’s production input (tier 1) are calculated using IO analysis. As a result, the (statistically) required total input of goods and services is determined along the upstream stages of the value chain.

Classical IO analysis or IO models can be used to quantify the effects of corporate activities along the upstream value chain. The analysis of the effects of business activities is based on company-specific data on factor consumption as well as general statistical data compiled in the IO table. The statistical data are essentially the input-output tables.

IO tables and models are widely used in the context of classical economic impact analysis (EIA) and in environmentally extended IO analyses (EEIO). The application of IO models in these contexts has increased due to the general availability of extensive structural data sets, especially multi-regional input-output (MRIO) tables. Figure 1 provides a simple example of a symmetrical multi-regional IO table with two countries and two sectors. To make the design logic clear, the relationships within the IO calculations are presented with only four sectors in total (two countries and two sectors).

Multi-Regional Input-Output table (MRIO)

Input / Output →		A	A	B	B	Total (I)	Final Demand (II) A	Final Demand (II) B	OUTPUT (I+II)
country ↓	sector	1	2	1	2				
A	1	10 €	5 €	15 €	5 €	35 €	20 €	5 €	60 €
A	2	3 €	10 €	8 €	9 €	30 €	15 €	5 €	50 €
B	1	4 €	4 €	20 €	12 €	40 €	5 €	10 €	55 €
B	2	8 €	3 €	5 €	24 €	40 €	5 €	20 €	65 €
Total intermediates		25 €	22 €	48 €	50 €	145 €	45 €	40 €	230 €
VA - wages and salaries		18 €	8 €	2 €	6 €	34 €			
VA - operating surplus		11 €	8 €	3 €	6 €	28 €			
VA - fixed capital dep.		4 €	6 €	1 €	2 €	11 €			
VA - taxes		4 €	6 €	1 €	2 €	12 €			
VA - Value Added total		35 €	28 €	7 €	15 €	85 €			
Production value (INPUT)		60 €	50 €	55 €	65 €	230 €			

Inter-mediate Inputs; Transaction matrix T; Final Demand; Output x = T+Y; Primary Inputs + Taxes; Gross = Value Added; Input = Output

Satellite systems

	country	A	B	B	B
	sector	1	2	1	2
Category	variable				
Employment	Persons [FTE]	1.000	200	4.000	5.000
Emissions	CO2 [tons]	200	150	700	350

Figure 1: Multi-Regional Input-Output table

In general, IO tables describe an economy's production structure (or several economies/regions in the case of a multi-regional IO table). The IO table represents the economic activities (output) of the economy. The production sectors (primary, secondary and tertiary sectors) and categories of final demand (consumption, investment) are listed in the columns. The corresponding intermediate inputs of these activities and sectors as well as their primary inputs (value-added; composed of wages, salaries and operating surplus) are reported in the rows of the table. Consequently, the columns represent the cost structure of a sector ("input") and the corresponding rows represent the composition of that sector's revenues ("output"). For each sector, the sum of inputs equals the sum of outputs.

The matrix below the IO table in Figure 1 covers satellite accounts or systems, which can be integrated into the IO framework. These tables are extensions of the IO table and provide useful information on, for instance, investments (machinery, buildings), capital (machinery, buildings) and employment (wage and salary earners, self-employed) in the various industries. Furthermore, the satellite accounts can provide linkages to physical flows (e.g., land use, energy), other physical flows related to environmental issues (e.g., emissions, waste, sewage) and other forms of satellite systems (e.g., social conditions, health and education).

2.2. IO MODELLING FOR IMPACT MEASUREMENT

A broad range of different IO models and applications based on IO tables exists. Simple static IO (quantity) models often serve as a starting point in the context of basic impact analysis. These models, which are used for comparative-static impact (scenario) analyses, allow for measurement of the economic activity of a company (or some of its activities) in terms of the demand created in supplier (upstream) industries.[3] Inter-industry linkages reflected in the IO tables enable the basic calculation of the resources (e.g., workers) required in upstream industries to generate a specified value of a company's production. With the help of these IO quantity models, statements can be made about direct and indirect effects based on exogenous changes in demand. The structure of a simple static IO model is illustrated in Figure 2. A brief description of the basic elements (the "A" matrix with technical coefficients and the "Inverse" matrix) is provided in the Annex.

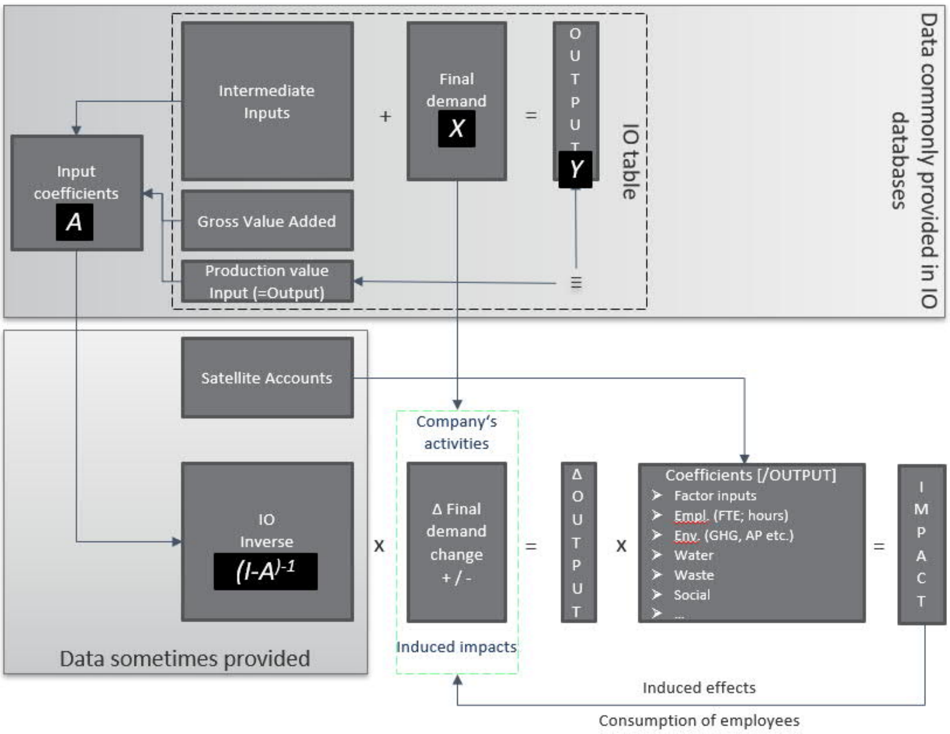

Figure 2: A static IO quantity model with extensions

A primary application of the model is to assign production factors to the final demand for goods. In the context of impact analysis, the change in final demand due to a company's activities is considered. In this model, those factors employed by suppliers in all upstream stages are calculated and assigned to the change in demand generated by the company's activities. The allocation of production factors (e.g., employees) to final demand is calculated using the Leontief inverse, and gives the total production output (including upstream) involved in producing the company's output.

[3] Contrary to the static IO quantity model, the static IO price model (or "Gosh" model) is downstream oriented. It captures the effects of input factors, such as wages, on sectoral production prices. As such, they assume that cost/price changes are passed on completely and directly ("cost push/through"). The price model is not relevant in the context of classical EIA and EEIO analyses.

The entire production necessary for the company's production process at all stages of production can be determined by multiplying the Leontief inverse by the vector of the changes in final demand. Then, the impact of the company/activities in focus can be calculated by linking the various coefficients (e.g., emissions from the satellite accounts) to these output values. The calculation of these multipliers is discussed in the Annex.

These standard IO multipliers/coefficients make it possible to estimate the flow-on impacts on gross output, value added, wages, employment and various satellite accounts that are generated by a company or certain company activities. The activity generated is the sum of direct indirect and induced components, with the indirect and induced effects calculated using the IO framework.

- The direct effect measures economic activity directly associated with the company's production of goods and services. These impacts are usually measured directly.
- The indirect component measures the effects generated by a company's activities through its demand for the outputs of other industries (Type I multipliers).
- The induced component measures the effects of income being spent (i.e., when employees of the company and those in its supply chain spend their wages), where that income has been effectively derived from the company's activities. These "induced" effects are created for, for instance, local retailers, leisure outlets and other consumer-facing businesses, and for suppliers to those businesses. The calculations require additional assumptions and additional data sources (e.g., income taxes and saving rates) (Type II multipliers).
- Multipliers referring to negative extra relations, such as reduced consumption expenditures induced by less spending financed by unemployment benefits, are usually disregarded in impact analyses. These calculations require additional assumptions and additional data sources (Type III multipliers).

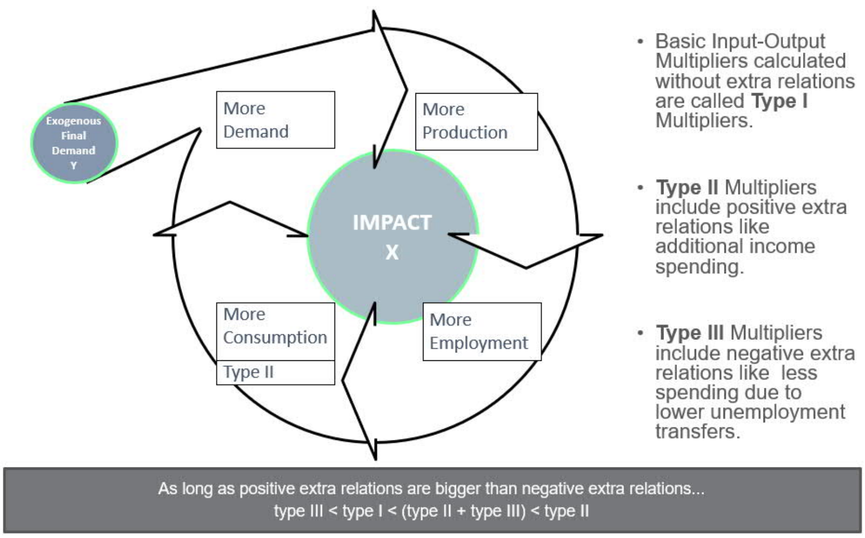

Figure 3: IO Multiplier

The following multipliers describe a company's economic contribution. Similar multipliers can be derived for the satellite systems.

- The gross output multiplier measures the total economy-wide induced/indirect gross output of all other industries/businesses in the economy in relation to the company's gross output.
- The gross value-added multiplier measures the ratio of the total economy-wide induced/ indirect gross value of all other businesses/industries in the economy to the company's gross value-added output.
- The labour income multiplier measures the ratio of the total economy-wide induced/indirect labour income of all industries/businesses in the economy to the company's labour income.
- The tax and social contribution multipliers, respectively, measure the total economy-wide indirect/induced taxes and social-security contributions from all industries in the economy in relation to the company's gross output.
- The employment multiplier measures the ratio of the total economy-wide indirect/induced employment of all industries in the economy to satisfy a one-unit increase in the company's total employment.

The mathematical background and a simple numerical example for the above-described type of impact calculation are presented in the Annex. However, to conduct an IO-based impact assessment, the necessary IO tables need to be collected first. Therefore, the focus of this document in the following chapters is to provide guidance on the selection of underlying IO databases. This is important because existing IO databases vary in terms of sectoral and geographical coverage, granularity, actuality, reliability, update cycles and the data provided. While national statistical offices provide official IO tables at the national level, existing MRIO tables are compared in the following sections.

2.3. OVERVIEW OF MULTI-REGIONAL IO DATABASES

MRIO tables usually (but not necessarily) require that all countries included have a uniform sectoral structure. Furthermore, export and import data must be available or calculated within the same sectoral structure. In practice, the underlying national IO tables are usually not uniform and, hence, need to be harmonised when creating an MRIO table. Different approaches to harmonisation can be used, which leads to different results. Furthermore, for a detailed multi-regional MRIO table, it is, in theory, necessary for all monetary transactions between all economic sectors worldwide to be measured consistently and uniformly. As this is not given, MRIO tables are constructed based on national IO tables, national account data, production statistics, household surveys, international trade data and other data sets. Numerous assumptions have to be made in this regard (e.g., allocating trade data to intermediate usage and final demand). In fact, exports reported by a source country to a destination country often do not exactly match the imports reported by that destination country. Reasons for such differences may include different valuation methods, time delays between exports and imports, and different sector classifications of products. Furthermore, exchange rates must be applied, as national IO tables are provided in national currencies and must be converted to a uniform currency for the MRIO table. The compilation of data to build an MRIO table must also address the fact that row and column totals are usually not equal. Therefore, different balancing techniques can be applied. In order for an MRIO table to map the entire world, countries that are not explicitly covered are usually included in one or more residual regions (e.g., Rest of the World, or “RoW”). While the sum of transactions for that region can be calculated, there is no detailed mapping of the economic structure.

Given the above, it should be noted that there is no single solution for compiling an MRIO table. Therefore, MRIO tables might differ significantly, even if the underlying national IO tables are the same.

The number of data sources for MRIO tables has recently increased and the update cycles have become shorter. For desktop data processing, most data providers offer MS Excel, CSV (comma-separated values), txt (tab-delimited) or XML (extended markup language) files. In order to be able to use an IO model, the data must be processed. While small IO tables or models (e.g., national tables) can easily be computed in MS Excel, large MRIO tables usually require mathematical or statistical software, as the number of entries in a symmetrical IO table increases exponentially.[4] Some calculation software or model-building tools require the data to be rearranged in a certain layout (e.g., “flat” tables with values in columns).[5] Even more importantly, variable names (and types) have to be assigned to the data before it can be accessed in the model. Despite the availability of various software packages, the task of building IO models remains a challenge. A potential model builder needs not only IO theory but also knowledge of data analytics or programming (i.e., the software technologies).

The available MRIO databases and models differ greatly in terms of size and possible applications. The databases include:

- OECD: ICIO database and the Trade in Value Added database,
- EORA: MRIO Multi-Region IO database,
- EXIOBASE,
- GTAP: Global Trade Analysis Project (GTAP),
- WIOD: World Input-Output Database,
- FIGARO/Eurostat: Full International and Global Accounts for Research in Input-Output Analysis,
- ADB-MRIO: Asian Development Bank: Multi-Regional Input-Output Tables,
- IDE Jetro: Asian International Input-Output Tables (AIIOTs),

[4] With “a” countries and “b” sectors (a * b = x sectors total), the IO table consisting of a * b = x rows and a * b = x columns has x^2 entries. While, for instance, the OECD IO table with approximately 2,500 x 2,500 = 6 million entries is computable in Microsoft Excel to a certain extent, larger tables, such as EXIOBASE with approximately 7,800 x 7,800 = 60 million values are not.

[5] This means that a matrix with, for instance, 5,000 rows x 5,000 columns will have to be arranged to a column vector with approximately 25 million values.

- FMO and
- Encore.

Some of the databases were originally developed in response to different policy needs and scientific aims. For example (UN 2018):

- EXIOBASE and EORA were developed to address environmental issues,
- GTAP-MRIO was developed to analyse trade-policy measures and impacts, and
- OECD-ICIO, FIGARO and WIOD were developed to illustrate global production and value-added trade. WIOD was also designed to provide data on socio-economic and environmental indicators at the industry level for use in a wide variety of applications.

The MRIO data sets differ in their underlying data sources in terms of country coverage, the timespan of available data, and the level of detail for industries or products. They also differ in terms of databases accessibility (e.g., paywalls and data formats) and the methodological choices made in the compilation process. Table 1 provides an overview of the data sources and a comparison of selected dimensions.

			Latest version	Base year	Sector	Sector	Currency	Final demand	Country	Tables	Tables	Data format	Data sources
IO-Models	Description	Version	Update frequency / age	Base / reference year	Nomenclature	Sector coverage [NACE (EU) | SIC (US) | ISIC (global)	Currency	Categories	Country coverage	Tables [industry x industry | product x product]	Form of IO tables provided	Data format	Data sources
GTAP	The centerpiece of the Global Trade Analysis Project is a global data base describing bilateral trade patterns, production, consumption and intermediate use of commodities and services.	GTAP10	N/A	2004; 2007; 2011; 2014	ISIC Rev. 4	65	USD		121 countries (98% of the global GDP)	N/A	technology matrix (A) domestic IOT bilateral trade	?	Country based data + various intl datasets (e.g.: OECD; JRC; EU; WTO; WDI; IMF; IEA)
EXIObase	- EXIOBASE is a global, detailed Multi-Regional Environmentally Extended Supply-Use Table (MR-SUT) and Input-Output Table (MR-IOT). - Full trade matrices with insights on which product from which country is exported by	Version3 Version 3.7 provided independently	last update 2015 | two updates until now	2011	ISIC Rev. 3	160	EUR		43 (95% of the global GDP) + 5 rest of the world regions (150 smaller countries clustered)	industry x industry | product x product	technology matrix (A)	.txt	Developed by a consortium of several research institutes in projects financed by
OECD Database	The OECD database of harmonised national IOTs takes the industry × industry approach.	OECD.Stat	last update 2018 | annual updates (data provision since 2000)	2015	ISIC Rev. 4	36 (ISIC Rev. 4)	USD	- Final consumption expenditure of households - Final consumption expenditure of non-profit institutions serving households - Final consumption	65 (36 OECD + 28 Non-OECD + 1 RoW) plus 2 separate "regions" for China and Mexico each	industry x industry	IOT	.csv .Rdata (on request)	National sources; OECD; UNSD; UNIDO
WIOD	The World Input-Output Database (WIOD) November 2016 Release consists of a series of databases and covers 28 EU countries and 15 other major countries in the world for the period from 2000 to 2014.	REV4 (latest)	irregular - published 2016 (without environmental extensions) | three	2014 ; environmental & skill-level data from 2012/2011	ISIC Rev. 4	44 (ISIC)	USD	- Final consumption expenditure by households - Final consumption expenditure by non-	43 + rest of the world	industry x industry	IOT	.xlsb Stata format R format	EUROSTAT OECD Klems FP6 Exiopol EDGAR
EORA26	The Eora global supply chain database consists of a multi-region input-output table (MRIO) model that provides a time series of high-resolution IO tables with matching environmental and social satellite accounts EORA26 provides data in a homgenous 26 sector structure	EORA26 (combined)	1990-2019 | annual	2015	ISIC Rev. 3	26	USD		190	Only EORA26: industry x industry | product x product			(1) input–output (I–O) tables and main aggregates data from national statistical offices (2) I–O compendia from Eurostat
EORA full	The Eora global supply chain database consists of a multi-region input-output table (MRIO)	EORA full	1990-2019 | annual	2015	ISIC Rev. 3	16,000 in total (individual no.	USD		190		IOT		
FMO	In 2014, FMO developed its impact model, measuring the direct and indirect impact and	FMO Model	N/A	2014		16			23	N/A			GTAP; World Bank Databank; National
Encore	Exploring Natural Capital Opportunities, Risks and Exposure helps global banks, investors and	ENCORE	N/A	N/A		11 sector (157 sub-industries)			Global; Colombia, Indonesia, Peru and S.	N/A			Inventories of all available data
ADB MRIO						35			62 countries + 1 RoW				
FIGARO (Eurostat)	experimental - 27 Countries (EU-28 and USA)					64	EUR		27 EU MS and US				

Table 1: Input-Output table overview

A brief description of the most prominent databases is presented in the following.

- EORA

  The EORA data set is a hybrid framework that uses multi-regional IO tables as well as supply and use tables for the period from 1990 to 2015. It covers 190 countries and around 16,000 sectors. However, the sectoral structure of the individual countries is not homogenous, and varies between 25 and 500 sectors. Notably, global EORA26 MRIO tables (IOT format) are provided, including satellite accounts, in a harmonised 26-sector classification.

- OECD-ICIO

  The OECD inter-country input-output (ICIO) table was developed as part of an OECD-WTO project to measure the value added in trade. The current version (International Standard Industrial Classification of All Economic Activities (ISIC) rev. 4) was released in December 2018 and spans the time period from 2005 to 2015. It includes 67 countries (35 OECD countries, 28 non-OECD countries), and provides separate information for China and Mexico as well as the "Rest of the world". It covers 36 industrial sectors (industry x industry). The table includes several categories of final demand but only one component of value added (total). Complementary data are provided via OECD STAN, TIM and the Environmental Accounts database, but they lack a full and homogenous scope.

- GTAP

  The GTAP data set was developed in 1992 with the aim of using it in computable general equilibrium (CGE) models, mainly for trade analysis. The GTAP-MRIO model is a multi-regional IO model based on the GTAP data set. The GTAP data set contains data on bilateral trade, production, consumption and use of intermediate goods. The domestic IOT, technology matrix (A) and trade flows are provided.

  The currently available tenth version of the data set contains the years 2004, 2007, 2011 and 2014. It covers 121 countries and 65 sectors. The GTAP data set makes it possible to create a multi-regional IO model. However, an MRIO table is not provided and must, therefore, to be compiled based on the data set.

- EXIOBASE

  The EXIOBASE data set was developed as part of several projects carried out under the European research framework (EXIOPOL, CREEA, DESIRE). EXIOBASE 3 is the culmination of work in the FP7 DESIRE project and builds on EXIOBASE 2 undertaken during the FP7 CREEA project and on EXIOBASE 1 undertaken during the FP6 EXIOPOL project. These databases are available from the official EXIOBASE website. EXIOBASE 3 covers the period from 1995 to 2011. The original EXIOBASE 3 data series ends in 2011. In addition, estimates based on trade and macro-economic data up to 2016 are provided by a group of researchers from, for instance, the Norwegian University of Science and Technology.

EXIBOASE takes all EU-28 countries as well as the EU's 16 most important trading partners into account.

The rest of the world is represented in five groups (Asia and Pacific, America, Europe, Africa, and the Middle East), and 163 industries and 200 products are covered. The data set also contains a variety of environmental data, such as information on energy consumption, water abstraction, and air and water pollution. The database provides the technology matrix "A". Categories of final demand and value added are provided separately.

- WIOD

  A first version of the WIOD data set was released as part of the official WIOD project funded by the European Commission from 2009 to 2012. The current version of the data set, "Release 2016", was published in 2018, and includes an update of the MRIO table and the socio-economic accounts. However, the environmental accounts still refer to "Release 2013". The database covers 28 EU countries and 15 other major countries from 2000 to 2014. These countries represent approximately 85% of the world's gross domestic product. A Rest of World region is included for the remainder. The database provides an industry x industry IOT with a total of 56 sectors.

In addition to the descriptions and comparisons of the IO databases, this document provides an evaluation of selected databases in the following subsection. The most prominent and suitable MRIO databases are compared in the context of impact measurement.

2.4. COMPARISON OF IO DATABASES FOR IMPACT MEASUREMENT

This subsection compares selected databases in terms of their relevance for impact valuation. More specifically, it compares certain dimensions of the databases that are relevant in the context of impact valuation. The advantages, disadvantages and limitations of each database are highlighted. However, this document does not aim to recommend individual databases. Instead, it aims to provide users of the VBA methodology with an orientation to the use of IO databases. In this sense, this document should be interpreted as a supplement to the VBA's general methodological guidelines.

Regional coverage/countries

The IO data sets differ with regard to the regions or countries covered. Some data sets focus on the most important industrial nations, and have one or more "Rest of World" regions as residuals. In contrast, EORA and GTAP cover significantly more countries. However, missing data for individual countries are partially imputed. IO data sets that cover many regions might be advantageous for companies active in a large number of countries and for analysing impacts by region. Nevertheless, the need to close data gaps is associated with a lower degree of reliability.

- EORA

  The EORA model has the broadest country coverage with 190 countries. However, the full version (EORA full) lacks a homogeneous sectoral structure. The number of sectors varies widely among countries. For example, 26 sectors are available for some countries, while more than 400 are available for the US. With regard to this data set's application in the context of impact analysis, this is a limitation, as (worldwide) operating expenses are usually based on a uniform sectoral structure. Moreover, in order to achieve the very high country coverage, data gaps for countries with less well developed statistical systems must be closed. An MRIO table with a homogeneous sectoral structure is offered (26 sectors per region) in a reduced version (EORA26). To achieve the high degree of country coverage, data gaps for countries with less well-developed statistical systems must be closed. This lowers the degree of reliability and highlights the trade-off between coverage and data quality.

- WIOD

  WIOD data cover 43 countries, including 28 EU countries and 15 other major countries. It also includes one residual region (Rest of World (RoW)) in which all other countries are aggregated. This is a limitation in terms of analysis by region for value added outside of the available countries.

- OECD

  The OECD database includes 65 countries: 36 OECD countries, 28 non-OECD countries and 1 region (RoW). In addition, it includes two separate regions for both China and Mexico.

- GTAP

  The GTAP database covers 121 countries (98% of global GDP) and 20 RoW regions. However, as GTAP was originally developed for trade analysis, it provides IO domestic technology matrices and bilateral trade data. Accordingly, more data processing is required for multi-regional IO analyses.

- EXIOBASE

  EXIOBASE includes 43 countries (95% of global GDP) and 5 RoW regions (150 smaller countries in clusters). The number of countries is limited (similar to WIOD), but at least five RoW sectors are available.

Sectoral coverage

The number of sectors and related products is an important decision criterion. To calculate the upstream impact of goods purchased by a company, the goods need to be mapped onto the economic sectors of the MRIO. Accordingly, the required mapping of the company's financial data is influenced by the model's sectoral structure. Furthermore, the more detailed the classification of goods and services in the MRIO, the more precisely company-specific inputs can be mapped, and the more specifically the effects can be calculated and analysed.

- EXIOBASE

  Of the selected IO databases, EXIOBASE has the highest level of sectoral detail (160 sectors), which is applied to all countries in its database. However, the sectoral classification follows the older ISIC 3 nomenclature.

- GTAP

  In its latest release, GTAP covers 65 sectors following ISIC 4 classification.

- EORA

  The full version of the EORA database (EORA full) covers around 16,000 sectors. However, the number of sectors differs from country to country (from 26 sectors to over 400 sectors). The lack of a homogeneous sector structure can be a limitation for use in an impact-analysis context with regard to the mapping of company data to sectors and the analysis of the impact itself.

  A data set with a homogeneous sector structure of 26 sectors is offered in a reduced version (EORA26).

- WIOD

  The WIOD MRIO includes 44 sectors. The newer classification ISIC rev. 4 is used in WIOD, but it has a rather aggregated industry classification. This is particularly true for the agriculture and energy-producing sectors, where detail is important when it comes to analysing issues related to land, water or resource use.

- OECD

  The OECD data set offers 36 sectors based on ISIC 4 classification.

Reliability, update cycle and satellite coverage – suitability for impact measurement

IO tables are constantly published by national statistical offices and other institutions (e.g., supra-national organisations and members of the scientific community). The availability and usage of multi-regional IO tables has increased in the last ten years. Therefore, results and IO tables quickly become obsolete as existing databases are updated or new tables are developed. Most MRIO data sets are updated relatively frequently, including GTAP, EXIOBASE, OECD, WIOD and EORA. Different versions are provided for different base years and time series (e.g., WIOD, OECD).

The data provided differ in terms of the indicators available with respect to economic, environmental and social satellite accounts (see Table 01). For example, in the environmental dimension, EORA covers a wide range of indicators from various sources. These have a high country resolution that results in a high degree of uncertainty and gaps in the database. In contrast, WIOD and EXIOBASE provide carefully compiled indicators with a significantly lower level of uncertainty.

One option is to choose a reliable and official data source that fulfils high standards of data quality (e.g., data provided by national statistical offices). However, multi-regional IO tables with a global focus are not provided by national statistical offices. Eurostat, the EU's statistical office, has provided MRIO tables (FIGARO) for the EU. However, these tables only cover the EU28 member states and the US. Consequently, they are less suitable for analyses with a worldwide focus. Furthermore, the data are only available for the year 2010.

The OECD's ICIO table was developed during an OECD-WTO project to measure the trade-related value added. The data reliability is relatively high because of the suitability to national statistics. However, satellite accounts (especially environmental) are only provided for a limited number of indicators and countries. Accordingly, rather extensive additional data-collection and preparation processes that fit the sector structure used by the OECD are necessary. Another downside of the OECD's MRIO tables is the relatively low degree of sectoral coverage (36 sectors). The OECD frequently updates the data. The latest update, which was released in 2018, covers the base year 2015. Data are also provided as time series starting with 2000.

GTAP is a provided by a global network of researchers and covers numerous satellite accounts. The latest version (GTAP 10) was released in 2019 for the base year 2014. Previous versions cover 2004, 2007 and 2011. As the data is provided by a research network, future updates can be expected.

EORA data is fee based and provided by a private company. Thus, future updates are likely.

As WIOD and EXIOBASE are large-scale research projects, their updates depend on the allocation of future research grants. However, the latest update for EXIOBASE MRIO was released by a research network in 2019 for the base year 2016. The original EXIOBASE 3 data series ends in 2011. Estimates based on trade and macroeconomic data are provided up to 2016. Nevertheless, data for the EXIOBASE satellite accounts have been updated less frequently or are provided for different base years. For instance, the end years are 2015 for energy, 2016 for greenhouse gas (GHG) emissions, 2013 for materials and 2011 for most others (e.g., land, water). With regard to WIOD, the latest update, which was provided in 2016, includes MRIO tables and socio-economic accounts for the base year 2014. Environmental satellite accounts are provided in the 2013 release (base year 2011). Time series are provided from 2000 until 2014 in the latest release.

Concluding remarks

The tables currently available differ in terms of country coverage, sector granularity, and satellite accounts and indicators offered. None of the available data sets can be viewed as a "one size fits all" solution with respect to the choice of which data to use.

No database couples a high level of harmonised sector detail with high country resolution. Currently available databases either aggregate minor countries into RoW (e.g., WIOD and EXIOBASE) or achieve high country resolution at the cost of non-harmonised or lower sectoral detail (e.g., EORA, ICIO and GTAP-MRIO). The appropriateness of a model is determined by the scope of the impact assessment and related company specifics. Therefore, additional data preparation and adjustments of existing MRIO tables are unavoidable. Additional data must be acquired and adapted to the structure of the selected MRIO data set (e.g., additional satellite accounts/socio-economic indicators).

3. APPENDICES

3.1. BASIC IO ANALYSIS

Basic IO analysis starts with the calculation of the input-output coefficients, which are sometimes referred to as “technical coefficients”. The input-output coefficients, often denoted as “A” matrix, are calculated by dividing each value in the IO table by the corresponding column total (i.e., the production value). Input coefficients for intermediate inputs of goods and services (1) and for the components of value added (2) are then defined:

$a_{ij} = x_{ij} / x_j$ and (1)

$v_{ij} = z_{ij} / x_j$, (2)

where:

a_{ij} = Input coefficients for intermediate inputs,

v_{ij} = Input coefficients for other primary inputs,

x_{ij} = Flow of commodity *i* to sector *j* (transaction bloc of the IO table),

z_{ij} = Flow of primary input *i* to sector *j* (value added bloc of the IO table) and

x_j = Output of sector *j* (production value).

The input coefficients can be interpreted as shares (%) of costs for intermediate inputs (goods and services) and primary inputs in total output (production value). The input coefficients for all of the intermediate inputs and all value components add up to one (100%).

Input (technical) coefficients matrix (A)

	country	A	A	B	B
country	sector	1	2	1	2
A	1	0,17	0,10	0,27	0,08
A	2	0,05	0,20	0,15	0,14
B	1	0,07	0,08	0,36	0,18
B	2	0,13	0,06	0,09	0,37
Total intermediates		0,42	0,44	0,87	0,77
VA - wages		0,29	0,17	0,04	0,09
VA - operating surplus		0,18	0,17	0,05	0,09
VA - fixed capital dep.		0,06	0,11	0,01	0,02
VA - taxes		0,06	0,11	0,03	0,02
Value Added		**0,58**	**0,56**	**0,13**	**0,23**
Production value (OUTPUT)		**1,00**	**1,00**	**1,00**	**1,00**

Table 9: Input (technical) coefficient matrix (A)

The basic IO table, including the table of final demand, the value added and the input coefficients matrix, is usually provided by national statistical offices for the national economy.[6] With regard to multi-regional input-output databases, some provide both the IO table and the coefficients matrix, while other provide only the IO table or the input coefficients matrix. However, the input coefficients matrix is required for impact measurement. Together with the inverse matrix, which is either provided by IO databases or must be derived from the coefficients matrix, it serves as a starting point for impact calculations.

[6] The symmetrical industry-by-industry IO tables show inter-industry transactions. In other words, they show all purchases an industry makes from all other industries. The symmetrical IO tables are analytically derived from the industry by product supply and use tables, which are part of the national accounts statistics. Alternatively, product-by-product IO tables are compiled and provided. The product-by-product tables show flows of final and intermediate goods and services defined according to product outputs.

3.2. LEONTIEF INVERSE

The following equation shows the reduced form of the Leontief equation, which serves as the basis for analyses conducted with the basic static IO model:

$$x = x * A + y, \tag{1.a}$$

$$x - x * A = y, \tag{1.b}$$

$$x * (I - A) = y \text{ and} \tag{1.c}$$

$$x = (I - A)^{-1} * y, \tag{1.d}$$

where:

A = Matrix of input coefficients for intermediates (technology matrix),

I = Identity matrix,

(I - A) = Leontief matrix,

$(I - A)^{-1}$ = Leontief inverse,

y = Final demand vector and

x = Output vector.

The production output, *x*, is determined by final demand, *Y*, and the Leontief-inverse $(I\text{-}A)^{-1}$, which incorporates the input coefficient matrix, *A*, and the identity matrix, *I* (Eurostat 2008, Leontief 1986). All components of this equation can be derived from an IO table. The resulting set of linear equations (the Leontief quantity model or the demand pull model) can be used to analyse the impact of a company's production on the economy-wide output and various indicators linked to that output. The results show the impacts of satisfying the company's demand on the sectors of the economy and provide insights into the industry-wide direct and indirect effects.

In addition to the output effects, implications can be derived for the value-added components and the satellite systems. Based on equation (1.d), various production-induced effects can be calculated by multiplying with the coefficients *s*:

$$s = b_s * (I - A)^{-1} * x, \tag{2}$$

where:

s = Vector of specific satellite account and

b_s = Vector of coefficients for satellites.

3.3. LEONTIEF STATIC IO QUANTITY MODEL FOR IMPACT MEASUREMENT

A well-known IO model is the Leontief static IO system – a linear model based on Leontief production functions and a given vector of final demand. The objective is to calculate the unknown activity (output) levels for the individual sectors (endogenous variables) for the given final demand (exogenous variables). For example, for a two-sector economy, the balance between total input and output can be described by the following set of equations:

$z_{11} + z_{12} + y_1 = x_1$ and (A1.a)

$z_{21} + z_{22} + y_2 = x_2$, (A2.a)

where:

x_{ij} = Intermediates from sector *i* to sector *j*.

y_i = Final demand for commodity *I* and

x_j = output of sector *j*.

All sectors are assumed to produce with linear Leontief production functions. All inputs (intermediates, capital, labour) are used in fixed proportions in relation to output. Furthermore, it is assumed that inputs cannot be substituted. Therefore, changing factor prices have no influence on the technical input coefficients. Input coefficients are defined as:

$a_{ij} = z_{ij} / x_j$. (A3)

Accordingly, the requirements for intermediate inputs can be defined as the set of input coefficients weighted by the corresponding output level:

$z_{ij} = a_{ij} * x_j$. (A4)

If we accept the assumption that the sectors produce with fixed technical-input coefficients, the equation system (A1)-(A2) can be rewritten by replacing the intermediates z_{ij} with the term $a_{ij} * x_j$. These equations describe the dependence of inter-industry flows on the total output of each sector.

Leontief equation:		In matrix terms:	
$a_{11} * x_1 + a_{12} * x_2 + y_1 = x_1$	(A1.b)	$A * x + y = x$	(A5)
$a_{21} * x_1 + a_{22} * x_2 + y_2 = x_2$	(A2.b)		
$y_1 = x_1 - a_{11} * x_1 - a_{12} * x_2$	(A1.c)	$y = x - A * x$	(A6)
$y_2 = -a_{21} * x_1 + x_2 - a_{22} * x_2$	(A2.c)		
$y_1 = (1 - a_{11}) * x_1 - a_{12} * x_2$	(A1.d)	$y = (1 - A) * x$	(A7)
$y_2 = -a_{21} * x_1 + (1 - a_{22}) * x_2$	(A2.d)		
		$y * (1 - A)^{-1} = x$	(A8)

3.4. CONCEPTUAL FRAMEWORK: MODELLING THE COMPANY'S IMPACT

Every sector *i*'s (or firm's) gross output x_i can be expressed in terms of its uses:

$$x_i = \sum_{i=1}^{n} z_{ij} + y_i, \qquad \text{(B1)}$$

where x_i is sector *i*'s gross output, z_{ij} is sales of intermediate goods from sector *i* to sector *j*, and y_i is final demand for sector *i*'s output. This framework can be further refined by adding IO coefficients (often referred to as "A" matrix), which measure the value of sector *i*'s output that is required as an intermediate input in the production of one unit of sector *j*'s gross output:

$$a_{ij} = \frac{z_{ij}}{x_j}. \qquad \text{(B2)}$$

There is an economy-wide analogue to (B1) that takes the following form (expressed in matrix terms):

$$x = A * x + y, \qquad \text{(B3)}$$

where *x* is a vector of sector gross outputs with i^{th} element x_{ia}, *y* is a vector of sector final demands with i^{th} element y_i and *A* is a matrix with ij^{th} element a_{ij}.

This framework can be adapted to analyse the economic activity of a company (or, e.g., a project or activity). For convenience, the vector and matrix elements of (B3) can be partitioned into company (subscript *L*) and non-company (subscript *O*) components:

$$\begin{bmatrix} X_O \\ x_L \end{bmatrix} = \begin{bmatrix} A_{OO} & A_{OL} \\ A_{LO} & a_{LL} \end{bmatrix} * \begin{bmatrix} X_O \\ x_L \end{bmatrix} + \begin{bmatrix} Y_O \\ y_L \end{bmatrix}, \qquad \text{(B4)}$$

where X_O is a vector of non-company sector gross outputs, Y_O is a vector of non-company sector final demands and A_{ij} the matrix/vector of IO coefficients for sectors included in *i* and *j*.

Empirical data and estimations indicate that A_{LO} is effectively a zero vector in the context of a worldwide IO table for most considered companies and activities. This reflects the fact that most companies and activities represent relatively small inputs in the gross output of much larger sectors represented in the IO tables. Similarly, companies' financial accounts usually indicate that they do not use their own products and services as inputs for their own production processes, which suggests that a_{LL} is zero.

In light of these assumptions and observations, the economy-wide system of equations (B4) can be written as two separate systems:

$$X_O = A_{OO} * X_O + A_{OL} * x_L + Y_O \text{ and} \qquad \text{(B5)}$$

$$x_L = y_L. \qquad \text{(B6)}$$

Equation (B5) can be used to derive the relationship between the company's sector gross output and non-company (all other industries) sector gross output:

$$X_O = (I - A_{OO})^{-1} * (A_{OL} * x_L + Y_O), \qquad \text{(B7)}$$

where I is an identity matrix.

The non-company industry output that is tied to the company and can be derived by setting the elements of the final demand vector for non-company output to zero ($Y_O = 0$) in (B7) is:

$$X_O = (I - A_{OO})^{-1} * A_{OL}\, x_L. \quad \text{(B8)}$$

Note that $A_{OL}y_L$ represents the vector of the company's intermediate inputs (tier-1) used for its production process. In particular, a one-unit increase in the company's gross output ($x_L = 1$) generates the following vector of non-company sector outputs:

$$C_{OL} = (I - A_{OO})^{-1} * A_{OL}. \quad \text{(B9)}$$

The i^{th} element of C_{OL}, c_{iL}, represents the increase in sector *i's* gross output required to meet the intermediate demands of a one-unit increase in the company's gross output. These elements can be summed to estimate the increase in output required by all (other) industries to accommodate a USD 1 increase in gross output of the company under consideration. This implies that the economy-wide increase in gross output required to accommodate a one dollar increase in the company's output x_L is:

$$mx_L = \sum_{i\in O} c_{iL} + c_{LL}, \quad \text{(B10)}$$

where c_{LL} represents the increase in the company's gross output required to meet a one-unit increase in the company's gross output, which is one given the assumptions underlying (B6). The resulting estimate of mx_L is the company's gross output multiplier.

After calculating the gross output multiplier, it is relatively easy to derive the other multipliers. The key is to define a set of coefficients that link value added, labour income and employment as well as other indicators of the satellite systems (e.g., social and environmental indicators) to gross output. For instance.:

- The value-added coefficient for the i^{th} industry is $v_i = va_i / x_i$, where va_i is the i^{th} sector's total value added,
- The labour income coefficient for the i^{th} industry is $w_i = l_i / x_i$, where l_i is the i^{th} sector's total labour expense, and
- The employment coefficient for the i^{th} industry is $e_i = fte_i / x_i$, where fte_i is the i^{th} sector's total number of full-time equivalent (FTE) workers.

These coefficients imply the following total to direct effect multipliers for the company under consideration:

Value added: $mv_L = (\sum_{i\in O} v_i c_{iL} + v_L c_{LL}) / v_L$

Labour income: $mw_L = (\sum_{i\in O} w_i c_{iL} + w_L c_{LL}) / w_L$

Employment: $me_L = (\sum_{i\in O} e_i c_{iL} + e_L c_{LL}) / e_L$

These multipliers estimate the economy-wide change in value added, labour income and employment required to accommodate a USD 1 increase in the company's gross output divided by the company's value added, labour income and employment coefficients defined above.

Coefficients for other indicators linked to the satellite systems (e.g., social and environmental) can be defined and the corresponding multipliers can be calculated analogously.

3.5. LEONTIEF STATIC IO QUANTITY MODEL FOR IMPACT MEASUREMENT

Multi-Regional Input-Output table (IO)

Input / Output →	country	A	A	B	B	Total (I)	Final Demand (II) A	Final Demand (II) B	OUTPUT (I+II)
country	sector	1	2	1	2				
A	1	10 €	5 €	15 €	5 €	35 €	20 €	5 €	60 €
A	2	3 €	10 €	8 €	9 €	30 €	15 €	5 €	50 €
B	1	4 €	4 €	20 €	12 €	40 €	5 €	10 €	55 €
B	2	8 €	3 €	5 €	24 €	40 €	5 €	20 €	65 €
Total intermediates		25 €	22 €	48 €	50 €	145 €	45 €	40 €	230 €
VA - wages and salaries		18 €	8 €	2 €	6 €	34 €			
VA - operating surplus		11 €	8 €	3 €	6 €	28 €			
VA - fixed capital dep.		4 €	6 €	1 €	2 €	11 €			
VA - taxes		4 €	6 €	1 €	2 €	12 €			
VA - Value Added total		35 €	28 €	7 €	15 €	85 €			
Production value (INPUT)		60 €	50 €	55 €	65 €	230 €			

Intermediate Inputs; Transaction matrix T; Final Demand Y; Output x = T+Y; Primary Inputs + Taxes; Gross = Value Added; =Output

Satelitte systems

	country	A	A	B	B
Category	sector / variable	1	2	1	2
Employment	Persons [FTE]	1.000	200	4.000	5.000
Emissions	CO2 [tons]	200	150	700	350

Input (technical) coefficients matrix (A)

	country	A	A	B	B
country	sector	1	2	1	2
A	1	0,17	0,10	0,27	0,08
A	2	0,05	0,20	0,15	0,14
B	1	0,07	0,08	0,36	0,18
B	2	0,13	0,06	0,09	0,37
Total intermediates		0,42	0,44	0,87	0,77
VA - wages		0,29	0,17	0,04	0,09
VA - operating surplus		0,18	0,17	0,05	0,09
VA - fixed capital dep.		0,06	0,11	0,01	0,02
VA - taxes		0,06	0,11	0,03	0,02
Value Added		0,58	0,56	0,13	0,23
Production value		1,00	1,00	1,00	1,00

Satelitte systems - coefficients per € of Output

	country	A	A	B	B
Category	sector / variable	1	2	1	2
Employment	[FTE]/€	17	4	73	77
Emissions	CO2 [tons]/€	3	3	13	5

Identity matrix (I)

	country	A	A	B	B
country	sector	1	2	1	2
A	1	1	0	0	0
A	2	0	1	0	0
B	1	0	0	1	0
B	2	0	0	0	1

IA matrix (I-A)

	country	A	A	B	B
country	sector	1	2	1	2
A	1	0,8333	-0,1000	-0,2727	-0,0769
A	2	-0,0500	0,8000	-0,1455	-0,1385
B	1	-0,0667	-0,0800	0,6364	-0,1846
B	2	-0,1333	-0,0600	-0,0909	0,6308

Inverse (I-A)-1

	country	A	A	B	B
country	sector	1	2	1	2
A	1	1,3401	0,2692	0,6968	0,4265
A	2	0,1902	1,3534	0,4557	0,4537
B	1	0,2627	0,2632	1,8337	0,6265
B	2	0,3392	0,2236	0,4549	1,8090
Output multipliers		2,1323	2,1093	3,4411	3,3156

X

Company's demand

Final Demand (II) A	Final Demand (II) B
20 €	5 €
15 €	5 €
5 €	10 €
5 €	20 €
45 €	40 €

=

OUTPUT
60 €
50 €
55 €
65 €
230 €

X

Coefficients

VA VA/OUT	EMPL EMP/OUT	CO2 CO2/OUT
1	17	3
1	4	3
0	73	13
0	77	5

=

Impact

VA €	EMPL FTE	CO2 ton
35 €	1.000	200
28 €	200	150
7 €	4.000	700
15 €	5.000	350
85 €	10.200	1.400

Induced effects
Consumption of employees

Figure 4: Leontief static IO quantity model for impact measurement

3.6. LIST OF FIGURES AND TABLES

Tables

Figures

3.7. LIST OF ACRONYMS AND ABBREVIATIONS

ADB-MRIO	Asian Development Bank: Multi-Regional Input-Output tables
AIIOTs	Asian International Input-Output Tables
CGE	Computable general equilibrium
CH_4	Methane
CO_2	Carbon dioxide
CSV	Comma-separated values
EEIO	Environmentally extended input-output
EIA	Economic impact analysis
FTE	Full-time equivalent
GHG	Greenhouse gas
GRI	Global Reporting Initiative
GTAP	Global Trade Analysis Project
HFCs	Hydrofluorocarbons
ICIO	Inter-country input-output
IIRC	International Integrated Reporting Framework
IMV	Impact measurement and valuation
IO	Input-output
ISIC	International Standard Industrial Classification of All Economic Activities
MRIO	Multi-regional input-output
N_2O	Nitrous oxide/laughing gas
NF_3	Nitrogen trifluoride
OECD	Organisation for Economic Co-operation and Development
PFCs	Perfluorocarbons
RoW	Rest of World
SASB	Sustainability Accounting Standards Board
SF_6	Sulphur hexafluoride
VBA	Value Balancing Alliance
WBCSD	World Business Council for Sustainable Development
XML	Extended markup language

3.8. GLOSSARY

Term	Definition	Source
Activity	Actions taken or work performed through which inputs, such as funds, technical assistance and other types of resources, are mobilised to produce specific outputs.	DAC/OECD (2010)
Capital	Stocks of value on which all organisations depend for their success that serve as inputs to their business models, and which are increased, decreased or transformed through the organisation's business activities and outputs. The capitals are categorised in this Framework as financial, manufactured, intellectual, human, social and relationship, and natural.	IIRC (2013)
Downstream	GHG emissions or removals associated with processes that occur in the life cycle of a product subsequent to the processes owned or controlled by the reporting company	GHG Protocol (2011)
Effects	Intended or unintended change directly or indirectly due to an intervention.	DAC/OECD (2010)
Environmentally extended input-output (EEIO) models	Traditional input-output (IO) tables summarise the exchanges between major sectors of an economy (Miller and Blair 2009). For example, output from the footwear manufacturing sector results in economic activity in associated sectors from cattle ranching to accounting services. Environmentally extended input-output models integrate information on the environmental impacts of each sector within IO tables (Kitzes 2013; Leontief 1970; Tukker et al. 2006).	Natural Capital Coalition (2016)
Greenhouse gases (GHG)	For the purposes of this standard, GHGs are the seven gases covered by the UNFCCC: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); sulphur hexafluoride (SF_6) and nitrogen triflouride (NF_3).	GHG Protocol (2015)
Impact	Positive and negative, primary and secondary, long-term effects produced by a development intervention, directly or indirectly, intended or unintended.	DAC/OECD (2010)
Impact management	No clear, authoritative definition exists.	IMP (2020)
Impact measurement	Measurement and management of the process of creating social and environmental impacts in order to maximise and optimise them.	IMP (2020)
Input	The financial, human and material resources used for a development intervention.	DAC/OECD (2010)

Measurement	In the Protocol, the process of determining the amounts, extent and condition of natural capital and associated ecosystem and/or abiotic services in physical terms.	Natural Capital Coalition (2016a)
Outcome	The likely or achieved short-term and medium-term effects of an intervention's outputs.	DAC/OECD (2010)
Output	The products, capital goods and services that result from a development intervention. May also include changes resulting from an intervention that are relevant for the achievement of outcomes.	DAC/OECD (2010)
Upstream	Cradle-to-gate: environmental aspects and potential environmental impacts throughout a product's life cycle from raw material acquisition (LCA addresses the environmental aspects and potential environmental impacts (e.g. use of resources and environmental consequences of releases) throughout a product's life cycle from raw-material acquisition through production, use, end-of-life treatment, recycling and final disposal (i.e. cradle-to-grave)).	ISO 14044 (2006)
Upstream	GHG emissions associated with processes that occur in the life cycle of a product prior to the processes owned, operated or controlled by the organisation implementing this PAS	PAS (2011)
Upstream	GHG emissions or removals associated with processes that occur in the life cycle of a product prior to the processes owned or controlled by the reporting company.	GHG Protocol (2011)
Valuation	The process of estimating a value for a particular good or service in a certain context in monetary terms.	TEEB (2010)

3.9. SOURCES

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3.10. ACKNOWLEDGEMENTS

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