Development of a System of Indicators for a Resource efficient Europe

D5.1 Inception report

Authors:
Konstantin Stadler (NTNU)
Richard Wood (NTNU)
Tatyana Bulavskaya (TNO)
Olga Ivanova (TNO)
Jeroen Kuenen (TNO)
Nina Eisenmenger (SEC)
Michaela Theurl (SEC)
Stefan Giljum (SERI)
Stephan Lutter (SERI)
Arkaitz Usubiaga (WI)
José Acosta Fernández (WI)
Arnold Tukker (TNO)

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About DESIRE

DESIRE is a FP7 project that will develop and apply an optimal set of indicators to monitor European progress towards resource-efficiency. The project runs from September 2012 to February 2016. We propose a combination of time series of environmentally extended input output data (EE IO) and the DPSIR framework to construct the indicator set. Only this approach will use a single data set that allows for consistent construction of resource efficiency indicators capturing the EU, country, sector and product group level, and the production and consumption perspective including impacts outside the EU. The project will:

- Improve data availability, particularly by creating EE IO time series and now-casted data
- Improve calculation methods for indicators that currently still lack scientific robustness, most notably in the field of biodiversity/ecosystem services and critical materials. We further will develop novel reference indicators for economic success.
- Explicitly address the problem of indicator proliferation and limits in available data that have a 'statistical stamp'. Via scientific analysis we will select the smallest set of indicators giving mutually independent information, and show which shortcuts in (statistical) data inventory can be made without significant loss of quality.

The project comprises further Interactive policy analysis, indicator concept development via 'brokerage' activities, Management, and Conclusions and implementation including a hand over of data and indicators to the EU's Group of Four of EEA, Eurostat, DG ENV and DG JRC.

Partners are:

1. The Netherlands Organisation for Applied Scientific Research (TNO), Delft, Netherlands
2. Wuppertal Institute (WI), Wuppertal, Germany
3. Alpen Adria University - Institute of Social Ecology (UNI-KLU), Vienna, Austria
4. Institute of Environmental Sciences, University of Leiden (UL-CML), Leiden, Netherlands
5. Sustainable Europe Research Institute (SERI), Vienna, Austria
6. Norwegian University of Technology (NTNU), Trondheim, Norway
7. Radboud University (RU), Nijmegen, Netherlands
8. Fundação da Faculdade de Ciências da Universidade de Lisboa (FFCUL), Lisbon, Portugal

For more information contact the co-ordinator at: arnold.tukker@tno.nl

Executive Summary

Work package 5 (WP5) aims to compile an Environmentally-Extended Multi-Regional Input–Output database (EEMRIO) time series and calculate 'macro resource indicators' based on this database. In order to do so, the following tasks have to be accomplished:

1. Specify EE IO related 'macro resource' indicators including tentative natural targets/constraints
2. Systematically use and expand Multi-regional Environmentally Extended Input-Output data to time series as a basis for indicator calculation.
3. Create now-casted EE IO data
4. Calculate EE IO based 'macro resource' indicators

This inception document describes the work foreseen for each of these tasks and provides background information about the chosen framework. In addition, if give information concerning the classification of the EE IO and the underlying Supply Use tables. EE IO tables will be compiled for 49 countries/regions (EU28, 16 major economies and 5 Rest of the World regions). The document closes with a time table specifying mile stones within this work package

1 Introduction

Environmentally-Extended Multi-Regional Input–Output tables (EEMRIO) describe the global supply chain as well as pressures connected to the system in the form of environmental accounts. Therewith it is possible to allocate environmental pressures occurring during the production phase to the consumer of the products and services (Peters and Hertwich 2006; Peters and Hertwich 2008; Wiedmann 2009) This forms the basis for the calculation of various footprint indicators (land, water, carbon, materials, ets.). For the indicators that can be quite easily calculated with an EEMRIO database we will use as shorthand the term "macro-resource indicators". The main goal of work package 5 (WP5) is to compile a now casted EEMRIO time series and specify/calculate macro-resource indicators.

1.1 Backgrounds on EE SUT and IOT

Multi-regional input-output (MRIO) analysis has come a long way in the last decade (Tukker and Dietzenbacher 2013). Whilst MRIO at the global scale started with exploration in the early 2000's (Munksgaard and Pedersen 2001; Lenzen, Pade, and Munksgaard 2004), the use of it for addressing issues of carbon leakage related to limiting greenhouse gas emissions (Hertwich and Peters 2009; Peters 2008; Davis and Caldeira 2010) has advanced it's development significantly. Now a considerable number of environmental issues congruent with "footprint" approaches use MRIO in order to fully account for life-cycle impacts of consumption (Lenzen et al. 2012; Ewing et al. 2012; T. Wiedmann et al. 2011; Daniels, Lenzen, and Kenway 2011; Tukker and Dietzenbacher 2013).

The input-output framework as exemplified by the European System of Accounts (ESA95) consists of three types of table: supply and use tables (SUT) and symmetric input-output tables (IOT) (EUROSTAT 2011; United Nations Statistical Division 2004; United Nations Statistical Division 1999).

The supply table shows the supply of goods and services, both domestic and imported, by product and type of supplier in basic prices, while the use table shows the use of goods and services by product and type of use in purchase prices, i.e. as intermediate consumption by industries, final use (consumption, gross capital formation) and exports. The use table also contains the components of the value

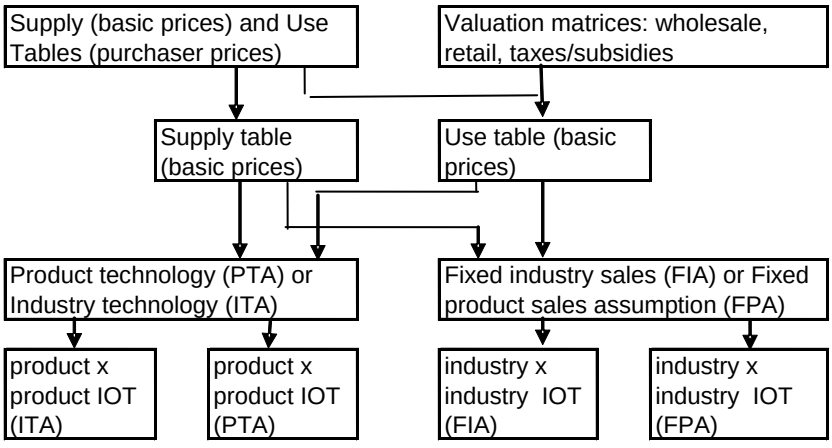


Figure 1.1: Simplified input-output framework (modified from Rueda-Cantuche et al., 2007)

added by industry, i.e. compensation of employees, other taxes less subsidies on production and gross operating surplus. The use table can be converted to basic prices with the help of valuation matrices reflecting retail, wholesale and taxes/subsidies per product used per industry. If necessary, the SUT can be broken down into a domestic and import (use) and an export (supply) part.

	Products	Industries			
Products		Use	Final use	Exports	*Use of products*
Industries	Make / Supply				*Output of industries*
	Imports cif	Value added			
	Supply of products	*Input of industries*			
		Extensions: - Primary Natural Resource input - Emissions output - etc.			

Figure 1.2: Schematic SUT with environmental extensions

Most analytical applications and models used (e.g. CGE) are based on IOTs rather than SUT (for an exception see e.g. Raa and Rueda-Cantuche 2007). Using various assumptions about technology, IOTs can be derived from the SUT in basic prices. The tables can be of a product by product type or an industry by industry type (see figure 1.1). Box 1.1 gives an example of how IOT can be constructed from SUT (for further information we refer to Miller and Blair 2009; EUROSTAT 2011; T. ten Raa and Rueda-Cantuche 2003; T. T. Raa and Manuel Rueda-Cantuche 2007).

SUT and IOT can be expanded with satellite accounts to indicate pressures such as an industry's resource inputs from and emission outputs to the environment (see figure 1.2.)

Box 1.1: Mathematical formulation of the industry technology assumption (Model B)

Adapted from *Eurostat Manual of Supply, Use and Input-Output Tables*

In the case of the industry technology, the transformation matrix is:

$T = (diag(g))^{-1} V$

Hence intermediates, value added and environmental extensions of the product-by-product input-output table are:

$S = UT$

$S^W = WT$

$S^R = RT$

Input coefficient matrices can be derived from those by dividing the columns by the total domestic output of products.

$A = S(diag(q-m))^{-1} = U(diag(g))^{-1} V(diag(q-m))^{-1}$

$A^W = S^W (diag(q-m))^{-1} = W(diag(g))^{-1} V(diag(q-m))^{-1}$

$A^R = S^R(diag(q-m))^{-1} = R(diag(g))^{-1} V(diag(q-m))^{-1}$

Note that Fig. 1.2 shows an EE SUT for a single country. This leads to the problem of how to deal with imports and exports. In some cases, apparent decoupling of CO_2 emissions or primary material use from GDP growth is in fact the result of the relocation of material and energy-intensive production to other countries (Giljum et al. 2008; T. Wiedmann et al. 2008; Weinzettel et al. 2013). Practitioners have sought to resolve this problem by using a multi-regional approach, in which different country EE SUT or EE IOT are linked via trade to a multi-regional SUT or IOT with environmental extensions (MR EE SUT or MR EE IOT). Figure 1.3 visualizes an MR EE SUT.

		Industries				$Y_{*,A}$	$Y_{*,B}$	$Y_{*,C}$	$Y_{*,D}$	q
Products		$Z_{A,A}$	$Z_{A,B}$	$Z_{A,C}$	$Z_{A,D}$	$Y_{A,A}$	$Y_{A,B}$	$Y_{A,C}$	$Y_{A,D}$	q_A
		$Z_{B,A}$	$Z_{B,B}$	$Z_{B,C}$	$Z_{B,D}$	$Y_{B,A}$	$Y_{B,B}$	$Y_{B,C}$	$Y_{B,D}$	q_D
		$Z_{C,A}$	$Z_{C,B}$	$Z_{C,C}$	$Z_{C,D}$	$Y_{C,A}$	$Y_{C,B}$	$Y_{C,C}$	$Y_{C,D}$	q_C
		$Z_{D,A}$	$Z_{D,B}$	$Z_{D,C}$	$Z_{D,D}$	$Y_{D,A}$	$Y_{D,B}$	$Y_{D,C}$	$Y_{D,D}$	q_D
W		W_A	W_B	W_C	W_D					
g		g_A	g_B	g_C	g_D					
C & L		$Capital_A$	C_B	C_C	C_D					
		$Labor_A$	L_B	L_C	L_D					
Environ Ext		$NAMEA_A$	$NAMEA_B$	$NAMEA_C$	$NAMEA_D$					
		$Agric_A$	$Agric_B$	$Agric_C$	$Agric_D$					
		$Energy_A$	$Energy_B$	$Energy_C$	$Energy_D$					
		$Metal_A$	$Metal_B$	$Metal_C$	$Metal_D$					
		$Mineral_A$	$Mineral_B$	$Mineral_C$	$Mineral_D$					
		$Land_A$	$Land_B$	$Land_C$	$Land_D$					

Figure 1.3: Example of a MR EE SUT for 4 countries

1.2 Classification

EE SUT and IOT in DESIRE will be based on the framework developed in the CREEA project.

1.2.1 Products and Industries

We will follow the product/industry classification developed in CREEA (EXIOBASE 2.0 – see Appendix 4.1 and 4.2), which includes 200 products and 163 industries.
All sectors present in the standardized Eurostat tables (EUROSTAT 2011)are also present in the EXIOBASE database. In addition, details have been added to sectors of particular importance to SEEA. The following are categories of industries for which additional details are provided in EXIOBASE:

- Agriculture and food
- Mining and raw materials
- Energy intensive metals production
- Electricity
- Transport
- Re-processing of secondary material
- Waste

Furthermore, significant extra detail is provided on energy products in a first step to harmonizing MRIO work with the IEA energy balances.

1.2.2 Countries

The geographic focus in this project will be the country level of the EU, with adequate description of non-EU countries to be undertaken so that reasonable estimates of resource efficiencies under consideration of embodied resource use of imports and exports can be incorporated. Thereby we follow the structure given by the CREEA/EXIOBASE 2.0 database (SUT and IOT for EU27 and 16 major economies plus 5 Rest of the World (RoW) regions). Nevertheless, recently Croatia (Hrvatska) joined the European Union. In CREEA Croatia was included in the RoW – Europe region. DESIRE will include Croatia in the list of specifically described countries. This results into a list of 44 countries (EU 28 + 16 major economies) and 5 RoW regions for DESIRE (see Appendix 4.3)

1.2.3 Extensions

DESIRE will include most of the environmental extensions covered in the CREEA project. Further detail about data sources and classification are given in section 2.2.2 (Task 5.2b - Macro-resource accounts). In the case of the material extensions time series for both used and unused extraction will be provided. However, it has to be noted that values for unused extraction are calculated on the basis of the values for used extraction, which are multiplied with unused factors (tonne unused material per tonne of used material). For all the years relevant for the DESIRE project the same factors per material category will be used.

2 Workflow

The core of WP5 is to compile time series of an Environmentally-Extended Multi-Regional Input–Output database and calculate 'macro resource indicators' based on this database. In order to do so, four main tasks have to be accomplished. The following section addresses the work plan for each task and provides further information about data sources and handling.

2.1 Task 5.1: Specify existing and improved EE IO related 'macro resource' indicators and potential targets/constraints

The first task in WP5 is to refine and specify the indicator set to be calculated. This will be based on the outcome of WP4, which gives the context and policy requirements for indicators across the project. A preliminary list of promising indicators to measure resource use and efficiency is shown in table MR1. In the work done so far by the team of WP4, the focus was on indicators that measure/give information on resource use, resource efficiency and environmental impacts. A further column in table MR1 gives information on the available disaggregation level within a specific resource category.

Resources (and their subsequent use) are divided into seven categories: energy, material, water, land, carbon (greenhouse gas emissions), wastes and other emissions and are reported in absolute values. As given so far, resource efficiency is clearly related to GDP or economic values per resource use, whereas environmental impacts relate a specific resource use to the natural stock of the resources that are extracted. Additionally to the areas covered so far, indicators should also address socio-economic issues and ecosystem services.

Socio-economic issues in relation to energy, material and water use address scarcity, prices, import dependency, access, competition, etc. Socio-economic issues related to land use affect access, competition, profitability, etc. and involve emission trading, carbon leakage, carbon tax, etc. in relation to carbon emissions. Wastes accumulating in the socio-economic system are addressed by trade, prices, societal costs, etc.

Indicators on ecosystem services address the quality aspect of ecosystem services and mineral stocks such as: landscape heterogeneity, NPP_{LC}, loss of bioproductivity, biodiversity, resilience, fragmentation, habitat change (energy) or ecosystem impacts related to radiation (nuclear energy). NPP_{LC}, loss of bioproductivity, biodiversity, and habitat change related to the use of biotic materials and metal/unused extraction and overburden and exergy/entropy related to abiotic material use are also indicators for the quality of ecosystem services. Further examples of indicators that inform on the quality aspects of ecosystems in relation to land use are landscape heterogeneity, NPP_{LC}, loss of bioproductivity, biodiversity, resilience, fragmentation, habitat change and climate change or global warming related to carbon.

Table MR1: Preliminary indicator list on resource use and resource efficiency (outcome of WP4)

	Resource efficiency	**Resource use**	**Environmental impacts**	**Disaggregation**
Energy	GDP / []	TPES GIEC	DE fossil fuels / stocks Bioenergy / area Etc.	Coal, Oil, Gas, unconventional Renewables (biomass, biogas, wind, water, solar, PV, etc.) Nuclear
Material	GDP / DMC GDP / RMC	DMC RMC	HANPP DE / min. stocks	Biotic Biomass Abiotic Fossil fuels Metals Non-metallic Minerals
Water	GDP / water appropriation	Water appropriation Water footprint	Water exploitation index	Blue and green water Agricultural and industrial
Land	GDP / land use	Land use Land footprint	Used land / total Artificial land / total	Cropland Grassland Forest land Wetland Settlements and other land
Carbon	GDP / C emissions	C emissions – territorial and global Carbon footprint	C emissions / C concentration	
Wastes	GDP / wastes	Waste accumulation		
Emissions	GDP / emissions	Other emissions to land, air, soil		

The specification of the EE IO related "macro resource indicators" into headline, dashboard, general and contextual indicators will be based on a detailed indicator list available from the upcoming final WP4 report. The definition of indicators in WP5 will further involve product and economy wide perspectives, drivers of demand (households, government etc.) and tentative constraints related to resource use and emissions.

2.2 Task 5.2: Data inventory and compilation: EE IO time series

The EXIOPOL (base year 2000) and CREEA (base year 2007) projects provide EEMRIO databases focusing on emissions and resource use for single years. They cover over 50 energy carriers, 28 emission types, 48 types of resources, three land types and three types of water extraction (Tukker et al. 2009; Tukker et al. 2013). In addition, the CREEA database also includes physical supply and use tables so that waste and recycling efforts are captured. Taking this as a starting point, DESIRE will calculate a time series of resource efficiency indicators by incorporating temporal data into the EEIO framework. This task can be divided into (a) Task 5.2a – Monetary SUTs and (b) Task 5.2b - Macro-resource accounts.

2.2.1 Task 5.2a – Monetary SUTs

Here we follow a **strict top down** approach. Macro economic variables (GDP, industry output/gross value added per broad category) are available from the United Nations Statistics Division (UNSD) - National Accounts Statistics: Main Aggregates and Detailed Tables. These tables provide a complete and consistent set of time series from 1970 onwards of main national accounts aggregates for more than 200 countries/regions (http://unstats.un.org/unsd/snaama/dnlList.asp). The tables are available in current USD and constant USD for 2005 (converted from data in constant prices in national currency using the annual period-average market exchange rate of the base year for all years and adjusted with price-adjusted rates of exchange in case of considerable distortion, exports and imports f.o.b.). The main aggregates are:

- Final consumption expenditure
- Household consumption expenditure (including Non-profit institutions serving households)
- General government final consumption expenditure
- Gross capital formation
- Gross fixed capital formation (including Acquisitions less disposals of valuables)
- Changes in inventories
- Exports of goods and services
- Imports of goods and services
- Gross Domestic Product (GDP)
- Agriculture, hunting, forestry, fishing (ISIC A-B)
- Mining, Manufacturing, Utilities (ISIC C-E)
- Manufacturing (ISIC D)
- Construction (ISIC F)
- Wholesale, retail trade, restaurants and hotels (ISIC G-H)
- Transport, storage and communication (ISIC I)
- Other Activities (ISIC J-P)
- Total Value Added

The first task will be to assure the consistency of the macro economic data, especially in regard to imports and exports. Next steps include converting the data into constant Euros and aggregating the Rest of the World (RoW) regions. This data set will provide constraints for all following balancing routines. Based on this data, we plan to assemble three time series, each incorporating more detail. We use SUT as the basic building

blocks for the database. Using SUTs as basis for building up an IO framework accommodates both flexibility of modelling in terms of both products as well as industries; whilst keeping tractability of data - which is usually collected for supply and use of products, by industries or activities. As such, modelling and data inventory can be kept separate.

2.2.1.1 First time series

For the first time series, industry and product output aggregates provided by the UN will be disaggregated based on the CREEA results. This industry/product output time series will then be used to update the CREEA tables for the whole time series. We expect this time series to be available at the end of this year. As the following time series follow the same structure and classification, all work packages depending on the results of WP5 can use this time series as a starting point.

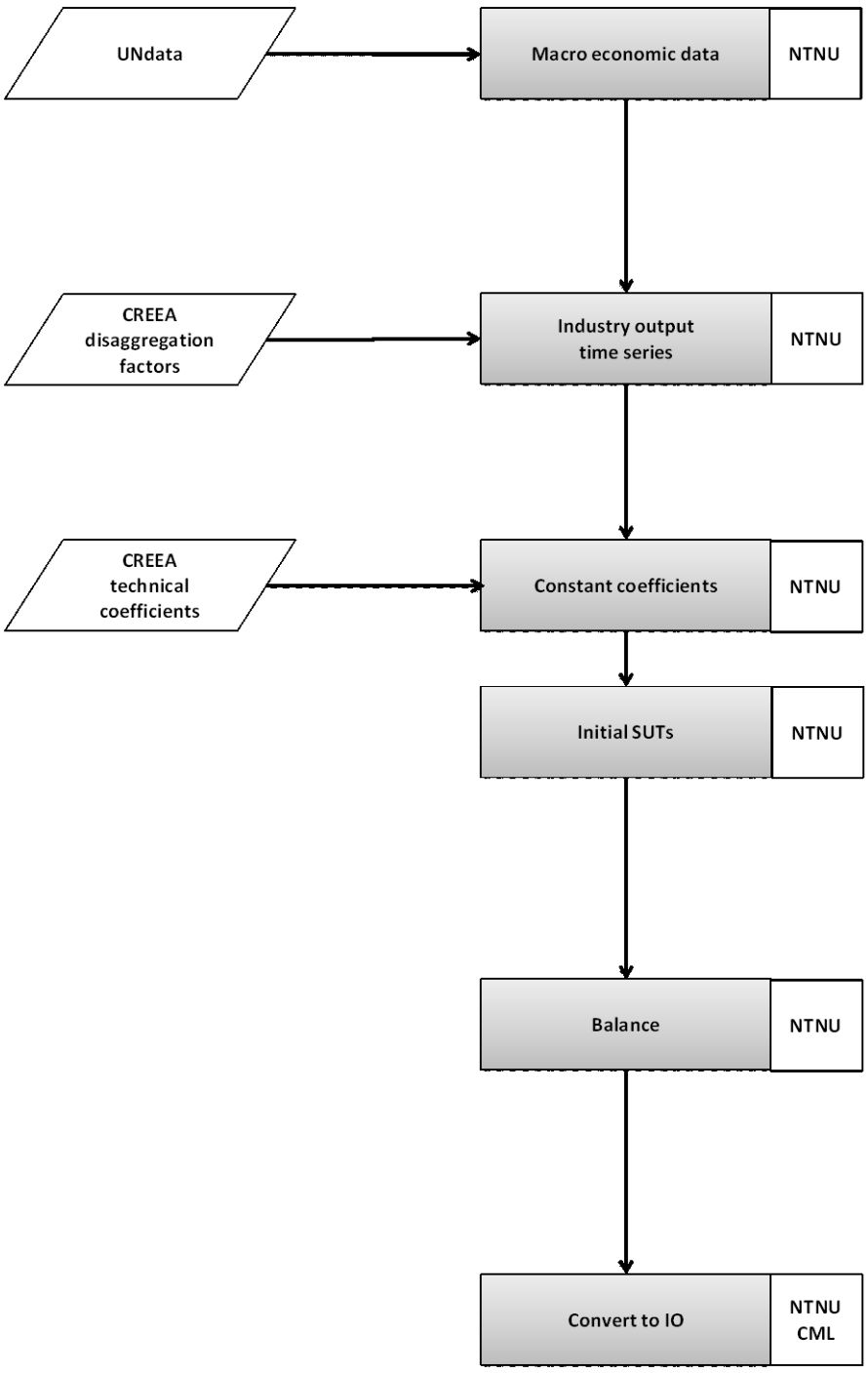


Figure 2.1: Flow chart first time series

2.2.1.2 Second time series

In the second time series, industry/product output will be disaggregated with data provided by auxiliary data sources: FAOstat, IEA, SERI - material flow, ... following the approach described in CREEA (Deliverable 7.2. - section 4.2). CREEA tables will be updated in with this data as in the first time series.

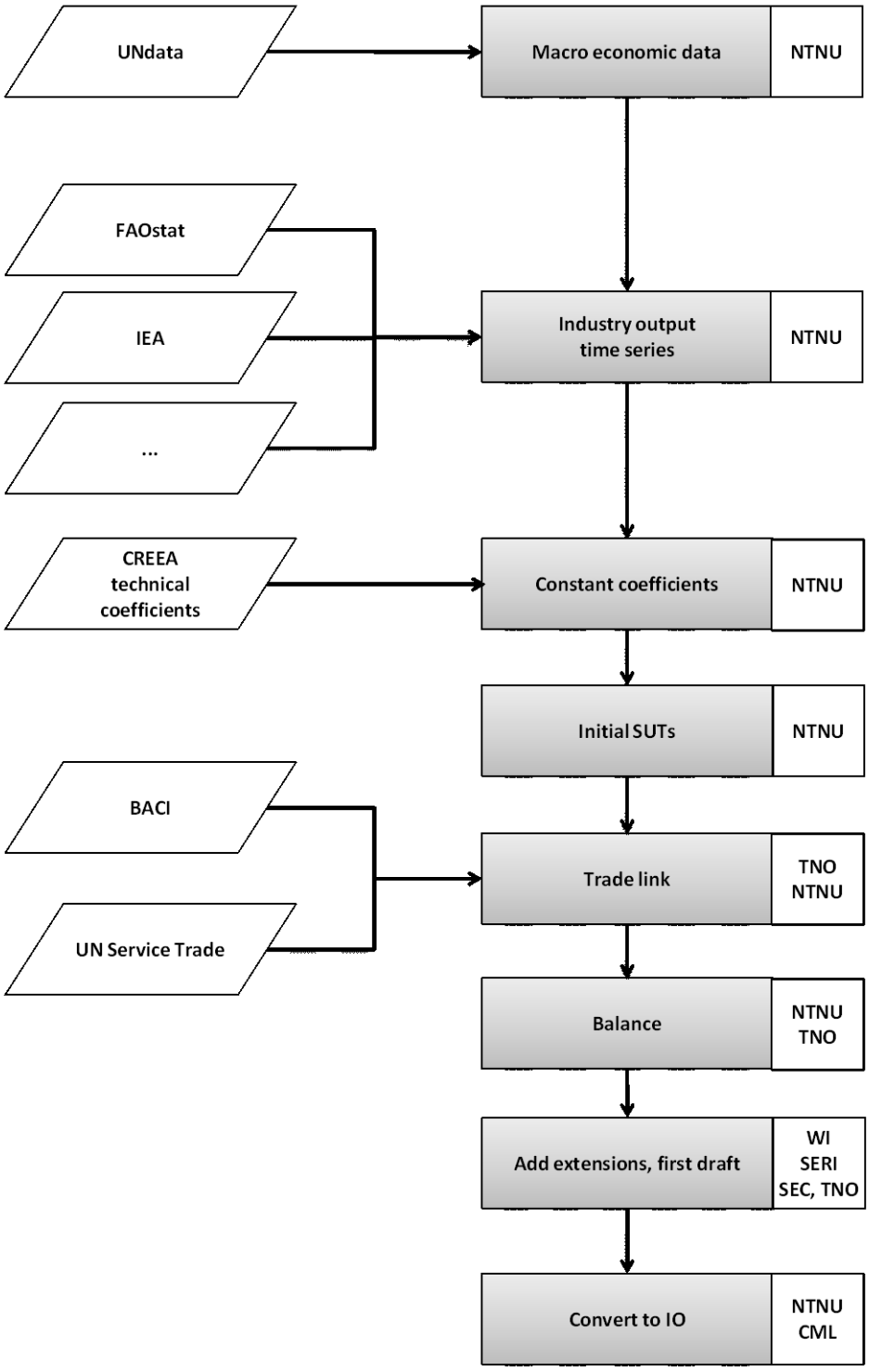


Figure 2.2: Flow chart second time series

2.2.1.3 Third time series

In the third and final time series we incorporate information about structural change within the economy.

We will start by performing structural decomposition analysis (SDA) in order to analyse the drivers of changes in consumption of materials over time. In most SDA studies a time period of 3-10 years are considered. Eurostat provides input-output tables on annual basis for some countries with 5-years intervals. These tables will be used for SDA of EU countries. OECD STAN database provides input-output tables averaged over 5-year periods (at the moment mid-1990s, early-2000s and mid-2000s are available), which will be basis for SDA analysis of non-EU countries. The SDA results will give us an overview of sectors where structure has changed the most from 1995 onwards and whether similar changes occurred in different countries.

The main difference between the third time series and the previous versions is the use of time-varying technical coefficients. Based on the time-series of Eurostat SUTs, which published both in current and previous year prices, we can estimate year-to-year changes in each technical coefficient for EU countries. Using the mapping between the DESIRE sectors/products and 60 NACE classification groups used by Eurostat, the coefficient time series in required classification will be created. National Statistical Offices of non-EU countries typically do not provide complete time series of SUTs. For a few exception countries, e.g. Canada, Australia, the same procedure as for EU countries will be applied. For the rest of the countries, coefficient time series will be created using inter- and extrapolation of the existing data points. The main efforts here will be put into the key sectors and materials identified by SDA.

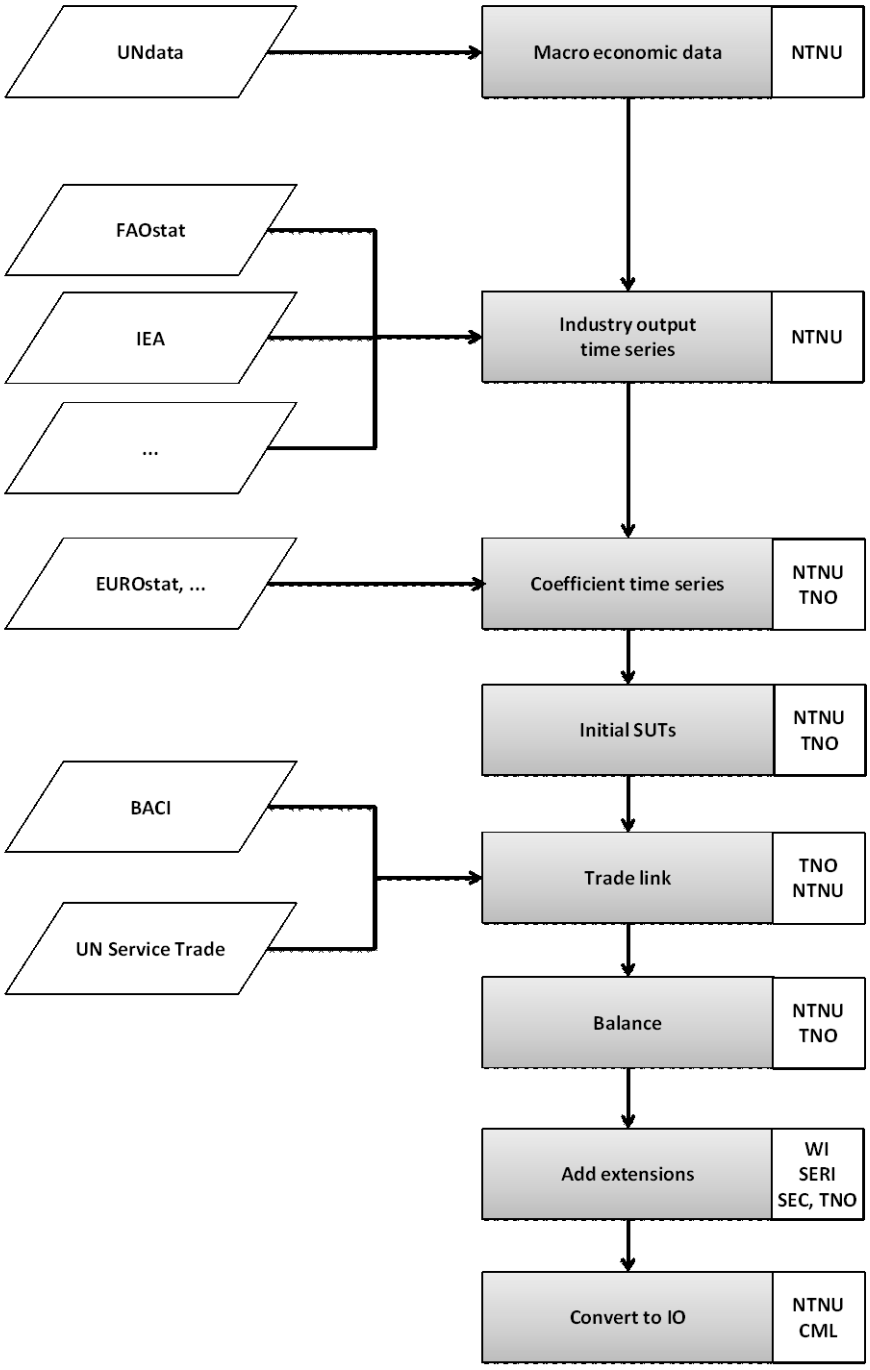


Figure 2.3: Flow chart third/final time series

For all MRSUTs we use the procedures developed for CREEA to convert the SUT system into an EE IO system (product by product and industry by industry).

2.2.2 Task 5.2b - Macro-resource accounts

2.2.2.1 Materials

For the compilation of the material extensions for the EXIOBASE model set up and compiled in the EXIOPOL and CREEA projects, the main data source for the environmental extensions of "material extraction" was SERI's Global Material Flow Database ("Global Material Flow Database. 2013 Version" 2013; "Technical Report on the Compilation of the Material Flow Database for www.materialflows.net." 2013). It is intended to also apply this data base as the main source in DESIRE.

The SERI MFA database is one of the most comprehensive global MFA databases currently available and encompasses more than 300 different types of materials and more than 200 countries. For the use in EXIOBASE the data for the year 2000 (EXIOPOL) and 2007 (CREEA) were aggregated according to the EXIOBASE material extension classification. The material extensions in the EXIOBASE encompass the following categories (23 material extraction categories are related to biomass, 10 are extractions of metal ores, 9 categories of industrial and construction materials are distinguished, as well 6 categories of fossil fuels):

Code	Extension	Code	Extension
DEU_1.1.1	Rice	DEU_2.1	Iron ores
DEU_1.1.2	Wheat	DEU_2.2.1	Bauxite and aluminium ores
DEU_1.1.3	Other cereals	DEU_2.2.2	Copper ores
DEU_1.1.4	Roots and tubers	DEU_2.2.3	Lead ores
DEU_1.1.5	Sugar crops	DEU_2.2.4	Nickel ores
DEU_1.1.6	Pulses	DEU_2.2.5	Tin ores
DEU_1.1.7	Nuts	DEU_2.2.6	Uranium and thorium ores
DEU_1.1.8	Oil crops	DEU_2.2.7	Zinc ores
DEU_1.1.9	Vegetables	DEU_2.2.8	Precious metal ores
DEU_1.1.10	Fruits	DEU_2.2.9	Other metal ores
DEU_1.1.11	Fibres	DEU_2.3	Chemical and fertilizer minerals
DEU_1.1.12	Other crops	DEU_2.4	Clays and kaolin
DEU_1.2.1	Straw	DEU_2.5	Limestone, gypsum, chalk, dolomite
DEU_1.2.2	Other crop residues	DEU_2.6	Salt
DEU_1.3.1	Fodder crops	DEU_2.7	Slate
DEU_1.3.2	Biomass harvested from grasslands	DEU_2.8	Other industrial minerals
DEU_1.4.1	Grazing	DEU_2.9	Building stones
DEU_1.5.1	Timber	DEU_2.10	Gravel and sand
DEU_1.5.2	Other extractions	DEU_2.11	Other construction minerals
DEU_1.6.1	Marine fish	DEU_3.1	Hard coal
DEU_1.6.2	Inland water fish	DEU_3.2	Lignite/brown coal
DEU_1.6.3	Other aquatic animals	DEU_3.3	Crude oil
DEU_1.6.4	Hunting	DEU_3.4	Natural gas
		DEU_3.5	Natural gas liquids
		DEU_3.6	Peat for energy use

In the case of the material extensions time series for both used and unused extraction will be provided. However, it has to be noted that values for unused extraction are calculated on the basis of the values for used extraction, which are multiplied with unused factors (tonne unused material per tonne of used material). For all the years relevant for the DESIRE project the same factors per material category will be used.

The SERI MFA database currently covers the time period 1980-2009. It is constantly updated and revised as well as kept up to date with ongoing developments of MFA accounting standards. Due to data availability and quality requirements the most recent year in the database is t-3. Consequently, currently the update to the year 2010 is being finalised, already using resources from DESIRE WP 5. Hence, the time period foreseen in the DESIRE DoW (1995-2011) shall be feasible to produce, however, only in a two stage process: 1995-2010 will be available in autumn 2013. Due to the publishing dates of the original data sources especially of the metal and mineral data, which then have to be adjusted to MFA standards, it is estimated that the update to the year 2011 will not be finalised before autumn 2014.
Summarising, we estimate that by October 2013 a first draft data set for material extensions in the EXIOBASE format for the years 1995-2010 will be compiled, with a quality-checked version available by the end of 2013. Further, in October 2014 the dataset 1995-2011, with a final data set in December 2014.

2.2.2.2 Water

For the compilation of the water use/consumption extensions for the EXIOBASE set up and compiled in the EXIOPOL and CREEA projects, the main data sources used were the Water Footprint data set (Mekonnen and Hoekstra 2011) for agricultural water consumption and the WaterGAP model (Flörke et al. 2013) for industrial water use/consumption. These databases are currently among the most comprehensive global databases with the Water Footprint data encompassing a vast amount of agricultural categories and the WaterGAP data set covering a large number of livestock categories as well as manufacturing sectors – the latter being an area where special requirements of an MRIO system meet the general poor data coverage situation.
The water use/consumption extensions in the EXIOBASE encompass the following categories (see table on next page). They include 13 categories for water consumption in agricultural activities for both green and blue water, 12 categories of blue water consumption in live stock production, 7 blue water consumption categories in aggregated manufacturing sectors and 2 related to electricity production. For the 7 manufacturing and the 2 electricity production sectors, also data on withdrawal of blue water are provided.
For the use in the EXIOBASE the data for the years 2000 (EXIOPOL) and 2007 (CREEA) were aggregated or disaggregated according to the EXIOBASE water extension classification and allocated to the different sectors and products. With regard to disaggregation, in CREEA, the physical output data generated in the PSUTs were taken to allocate the water use in the 7 aggregated manufacturing sectors to the detailed EXIOBASE manufacturing sectors (the same for the electricity sectors). As this detailed physical production data set is – at least so far – only available for the year 2007, it will need to be discussed, how the allocation of aggregated water data to products will be done in the time series envisaged in DESIRE.

Code	Extension
WCB_1.1	Water Consumption Blue - Agriculture - rice
WCB_1.2	Water Consumption Blue - Agriculture - wheat
WCB_1.3	Water Consumption Blue - Agriculture - other cereals
WCB_1.4	Water Consumption Blue - Agriculture - roots and tubers
WCB_1.5	Water Consumption Blue - Agriculture - sugar crops
WCB_1.6	Water Consumption Blue - Agriculture - pulses
WCB_1.7	Water Consumption Blue - Agriculture - nuts
WCB_1.8	Water Consumption Blue - Agriculture - oil crops
WCB_1.9	Water Consumption Blue - Agriculture - vegetables
WCB_1.10	Water Consumption Blue - Agriculture - fruits
WCB_1.11	Water Consumption Blue - Agriculture - fibres
WCB_1.12	Water Consumption Blue - Agriculture - other crops
WCB_1.13	Water Consumption Blue - Agriculture - fodder crops
WCG_1.1	Water Consumption Green - Agriculture - rice
WCG_1.2	Water Consumption Green - Agriculture - wheat
WCG_1.3	Water Consumption Green - Agriculture - other cereals
WCG_1.4	Water Consumption Green - Agriculture - roots and tubers
WCG_1.5	Water Consumption Green - Agriculture - sugar crops
WCG_1.6	Water Consumption Green - Agriculture - pulses
WCG_1.7	Water Consumption Green - Agriculture - nuts
WCG_1.8	Water Consumption Green - Agriculture - oil crops
WCG_1.9	Water Consumption Green - Agriculture - vegetables
WCG_1.10	Water Consumption Green - Agriculture - fruits
WCG_1.11	Water Consumption Green - Agriculture - fibres
WCG_1.12	Water Consumption Green - Agriculture - other crops
WCG_1.13	Water Consumption Green - Agriculture - fodder crops
WCB_1.14	Water Consumption Blue - Livestock - dairy cattle
WCB_1.15	Water Consumption Blue - Livestock - nondairy cattle
WCB_1.16	Water Consumption Blue - Livestock - pigs
WCB_1.17	Water Consumption Blue - Livestock - sheep
WCB_1.18	Water Consumption Blue - Livestock - goats
WCB_1.19	Water Consumption Blue - Livestock - buffaloes
WCB_1.20	Water Consumption Blue - Livestock - camels
WCB_1.21	Water Consumption Blue - Livestock - horses
WCB_1.22	Water Consumption Blue - Livestock - chicken
WCB_1.23	Water Consumption Blue - Livestock - turkeys
WCB_1.24	Water Consumption Blue - Livestock - ducks
WCB_1.25	Water Consumption Blue - Livestock - geese
WCB_2.1	Water Consumption Blue - Manufacturing - food products, beverages and tobacco
WCB_2.2	Water Consumption Blue - Manufacturing - textiles and textile products
WCB_2.3	Water Consumption Blue - Manufacturing - pulp, paper, publishing and printing
WCB_2.4	Water Consumption Blue - Manufacturing - chemicals, man-made fibres
WCB_2.5	Water Consumption Blue - Manufacturing - non-metallic, mineral products
WCB_2.6	Water Consumption Blue - Manufacturing - basic metals and fabrication of metals
WCB_2.7	Water Consumption Blue - Manufacturing - other manufacturing
WCB_3.1	Water Consumption Blue - Electricity - tower
WCB_3.2	Water Consumption Blue - Electricity - once-through
WCB_4	Water Consumption Blue - Domestic - domestic Water Consumption Blue
WWB_2.1	Water Withdrawal Blue - Manufacturing - food products, beverages and tobacco
WWB_2.2	Water Withdrawal Blue - Manufacturing - textiles and textile products
WWB_2.3	Water Withdrawal Blue - Manufacturing - pulp, paper, publishing and printing
WWB_2.4	Water Withdrawal Blue - Manufacturing - chemicals, man-made fibres
WWB_2.5	Water Withdrawal Blue - Manufacturing - non-metallic, mineral products
WWB_2.6	Water Withdrawal Blue - Manufacturing - basic metals and fabrication of metals
WWB_2.7	Water Withdrawal Blue - Manufacturing - other manufacturing
WWB_3.1	Water Withdrawal Blue - Electricity - tower
WWB_3.2	Water Withdrawal Blue - Electricity - once-through
WWB_4	Water Withdrawal Blue - Domestic - domestic Water Withdrawal Blue

The WaterGAP model currently covers a time period 1950-2010, with most data being available since 1990 and earlier years being estimated. So far, the University of Kassel provided the EXIOPOL/CREEA team with the data for the years 2000 and 2007. Negotiations for the provisions of the data for the missing years (1995-2010/2011) have just been started. Provided that the scientific collaboration will be extended, we estimate that a first data set (1995-2010) will be ready by the end of 2013; while we estimate that the update of the data set including the year 2011 will be available only by the end of 2014.
Regarding the Water Footprint data, we face a similar situation: currently published data cover the period 1996-2005 – however, as an average value, with the data provided for 2007 being upscaled in the course of the CREEA project with data on agricultural production for the year 2007 in comparison to the average production in 1996-2005. We aim at applying a similar approach for extending the data to the years 1995-2011. Hence, the data will be up- and downscaled from the available Water Footprint data set with agricultural production data. Given the ongoing scientific collaboration with the University of Twente in the course of the CREEA project the best suited procedure will be discussed and decided. We estimate that a first data set (1995-2011) for the Water Footprint data will be ready by the end of 2013. However, University Twente is planning to set up long term and annual Water Footprint calculations from next year onwards. Hence, we envisage coming up with a revised data set by the end of 2014.
Summarising, by October 2013 a first full draft data set regarding the water extensions for the years 1995-2010 will be compiled, with a quality-checked version available by the end of 2013. Further, in October 2014 the dataset 1995-2011 will be available, with a final data set in December 2014. The industrial water data set also to some extent depends on the willingness of scientific teams outside the consortium to collaborate with the DESIRE project; in the past, those other research teams were very interested in collaboration in earlier years. In the Water Footprint case, further collaboration is already agreed. The set up of the estimation methodology will be subject of the works in WP 5.

2.2.2.3 Energy

General overview

Two main tasks have to be accomplished here:

(I) converting the time series of IEA territorial data into residential principle
(II) Allocate energy flows within the DESIRE classification

Ad (I): IEA reports energy data use in the territory principle. These have to be converted into residential principle. Also some aggregation across the rest of world regions needs to be performed.

For Marine (+Fishing) and Air transport the same databases and functions as in CREEA can be utilized. In the case of marine transport, the model combines data on fleet by nationality of the owner and average fuel consumption and movement data by type of ship extracted from an IMO study. Besides, 2000 and 2007 which are already in the model, we will include a 4-5 more points in time and interpolate the rest. As for air transport, the model is fed with fleet and movement data from IATA and fuel consumption data from the EMEP/EEA emission inventory guidebook. As in the previous

case, we will generate 4-5 more points and interpolate the rest. Transport of ships and planes tends to be used for medium to long distances, so for many international transports they are the preferred choice of transport (almost all intercontinental transports are addressed by these two kinds of transports).

The importance of international road transport between non European countries is still unknown with precision. For EU countries, Eurostat reports the air emissions by residents abroad and non residents in the territory for a subset of countries. How this can be used for complementing a model-based approach will be determined in the next couple of month in cooperation with TNO.

The outcome of this task (a time series of IEA energy flows converted into residential principle) will be made available for all partners that hold an IEA license together with the underlying IEA source data. This ensures consistent data use within the project.

Ad (II): The first option here is to use the allocation procedure applied in CREEA by WI to generate ESUTs that follow the accounting rules of the SEEA Energy manual and Eurostat's draft manual on Physical Energy Flow Accounts. It should be pointed out though that this allocation will be relatively crude, since the main focus of WI's work is to capture as accurately as possible the territory to residence transformation, which is critical for the calculation not only of energy SUTs, but also for the emission accounts related to combustion.

Since the accounting principles followed by the SEEA Energy and the M-SUTs are not always compatible, it is likely that a different partner will also perform the allocation based on the routine generated to produce hybrid SUTs in CREEA.

The approach adopted for the energy accounts is the result of a long and complex discussion. The text above is just a summary of it. For more details on the different allocation procedures applied in CREEA we refer to Deliverable 4.2 and 6.1 of the CREEA project[1].

Time plan:

1) Check of auxiliary databases for the time line: **October 2013**
2) Correspondence table IEA – CREEA/DESIRE classification: **October 2013**
3) IEA energy flows in territorial and residential principle available for all partners: **April 2014** (the underlying original IEA energy flows should be shared with TNO and NTNU as soon as possible)
4) Draft E-SUTs based on WI's allocation procedure plus energy products disaggregated into DESIRE classification: **September 2014**
5) Final E-SUTs – to be discussed in the next meeting

[1] Section 5.4 contains a more detailed overview of how the approach applied by WI in CREEA could have been used in DESIRE in case more resources were available. This was the basis for the discussion that led to the adoption of the plan above

2.2.2.4 Emissions

Calculating the air emission accounts comprises a number of steps to be taken. In principle we will follow the same approach as in the CREEA project, using the TEAM model for calculating the air emissions and emission factors for the year 1995-2010/2011.
In the TEAM model several new technologies and associated emission factors will be introduced to be able to capture the technology trends going from 1995 to 2011. The IIASA GAINS model, which contains a bottom-up inventory for most regions, will play a big role in identifying the share of each of the technologies over time, but also several other data source will be used.
A potential problem is lack of data on the use of technologies, here assumptions will have to be made to fill gaps. This approach ensures a dataset which is consistent between countries and in time, has all relevant sectors, and has all the pollutants that were also covered in preceding projects EXIOPOL and CREEA.

Different steps that will be taken in the calculation of air emissions:

1. **Collection of activity data**

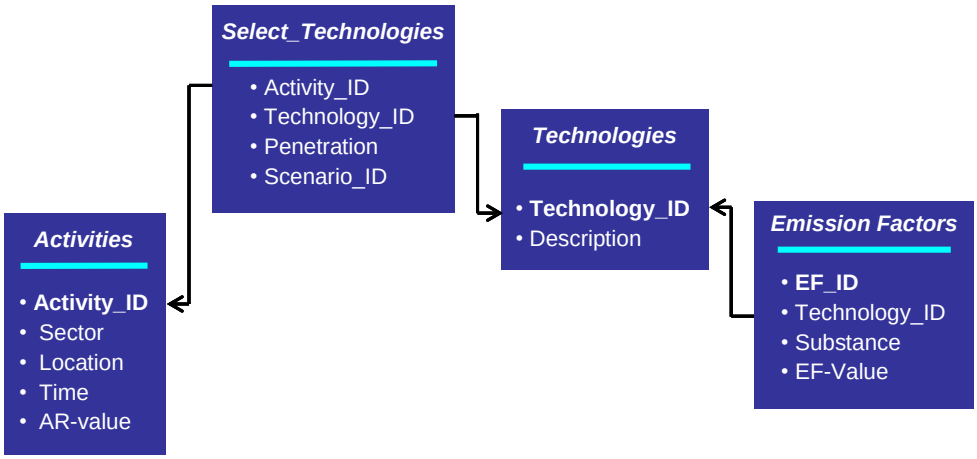
   This means collection of all activity variables which are needed for the calculation of the emission time series, for all the years requested. In this proposal we assume 1995-2010.
   a) Energy statistics: acquire the latest energy statistics from IEA and process the data, fairly straightforward but a lot of numbers
   b) Industrial sectors: manual collection of data (the production of cement; production of steel; production of paper; etc.). Data can also be taken from GAINS online for some sources.

   The industrial sectors activity data collection will not collect information for all the countries since many will be unavailable. We will aim to use consistent datasets as far as possible, such as USGS which has commodity production for various minerals/metals for the whole world. For the countries which are not available, production data will be estimated based on a distribution of the world total production of the commodity over the missing countries, using the relative GVA trend of each country.
   This data collection will to a large extent be done by other partners in the project, as they also need these physical data.

2. **Set-up of TEAM for modeling multiple years**

   The figure below shows the default set-up of the TNO Emission Assessment Model (TEAM). This model uses activities (collected in the previous step) and technologies with emission factors (available in the model to a certain extent). Methodologies for estimating air emissions are taken from the established sources which are also used in the emission inventory community, such as the IPCC Guidelines for National Greenhouse Gas Inventories and the EMEP/EEA Guidebook.
   A major task will be to further develop the technology side to include more technologies to be able to model trends in time (step 3, below).

As a default approach (only to be taken when no information is available),, we will ensure that an approach with default emission factors for each source and region is implemented, in this case for each year the same emission factor is selected. This will be used in cases where no information is available on the technology trend and for sources where this trends is expected to be small. In other cases, a more refined method will be elaborated in step 3 below.



3. Elaborating TEAM

This involves the introduction of new "technologies" in the TEAM model to better represent the trend in emissions, and introduce better and updated methodologies with respect to the ones we used in CREEA (using Guidebook and Guidelines default factors in many cases) where possible using TNO expert information or external literature sources.
Some specific improvements that we suggest based on availability of data and importance of sectors:

a. For road transport, we will use TREMOVE to disaggregate energy use data to vehicle categories/technologies and use LAT emission factors per technology – this should automatically give the trend in emissions and emission factors. For the non-European countries other sources can be used as we did in CREEA.
b. For many other sectors we will use IIASA GAINS for the shares of different technologies in various sectors, which is available to us for a number of substances. GAINS is in principle available for Europe, but recently it also became available online for China, India, and some other major countries. GAINS can also be the source for some of the activity variables when nothing else is available. These data are freely available online and can be directly used to further improve the TEAM model results.

For the remaining sectors/countries where no information was found yet, we will conduct a literature survey on trends in technologies and emission factors for the specific sectors and countries, in the time frame 1995-2010/2011. Amongst others, we could apply global emission inventories such as EDGAR to investigate the trend in some of the sectors in the past years. However, these data would only be used as scaling for specific cases and only if the quality of the data is good enough (expert judgment). In cases where we do not have any information, we could choose to keep

the emission factors constant in time, or assume a certain trend based on expert judgment (e.g. we can apply the same trend as a similar, neighbouring country).
Finally, for sources which do not contribute much to the total emissions, we propose not to use different emission factors, but stick to one emission factor applied for the whole time series. This implies that the trend in emissions will be the same as the trend in emission factors.

The final decision on how to exactly deal with all the gaps will be made later, when we have better information on how much data is missing and what are the possibilities for gapfilling.

4. Comparisons to other datasets & QA/QC

To check the time series, it is important to compare our estimates to other estimates from various global and regional scale emission inventories. This includes a comparison to the official data reported to UNFCCC/CLRTAP but also to other emission datasets. A recently published peer-reviewed article (Granier et al. 2011) compares a number of these emission estimates showing that especially for earlier years the difference between these datasets may be large (see list of global and regional emission inventories in table below). It is expected that the emissions we calculate are at least in the range of the other estimates.

Inventories providing global emissions of all species considered, i.e. CO, NO_x, BC and SO_2

ACCMIP	1980–2010	0.5×0.5	http://ether.ipsl.jussieu.fr/eccad ftp://ftp-ipcc.fz-juelich.de/pub/emissions/ http://www.iiasa.ac.at/web-apps/tnt/RcpDb Lamarque et al. 2010
MACCity	1980–2010	0.5×0.5	http://ether.ipsl.jussieu.fr/eccad
RCPs	2000–2010	0.5×0.5	http://ether.ipsl.jussieu.fr/eccad ftp://ftp-ipcc.fz-juelich.de/pub/emissions/ http://www.iiasa.ac.at/web-apps/tnt/RcpDb
EDGAR v3	1990, 1995 2000	1×1	http://edgar.jrc.ec.europa.eu Olivier et al. 2005
HYDE	1980, 1990	1×1	Van Aardenne et al. 2001 http://www.pbl.nl/en/themasites/hyde/index.html
RETRO	1980–2000	0.5×0.5	http://retro.enes.org/data_emissions.shtml
GAINS	1990–2010		http://gains.iiasa.ac.at/gains
Regional inventories			
EMEP	1980–2010	0.5×0.5	http://www.ceip.at/emission-data-webdab/emissions-used-in-emep-models/
TNO	2003–2007	0.125×0.0625	ftp://neptunus.tno.nl/TNO/MEP/EM/MACC/ Denier van de Gon et al. 2010
INERIS	1998–2007	0.1×0.1 and 0.5×0.5	http://cityzen-project.eu/
EPA	1980–2008	Not gridded	http://www.epa.gov/ttn/chief/trends/index.html
REAS	1980–2010	0.5×0.5	http://www.jamstec.go.jp/frcgc/research/p3/reas_h_a.html Ohara et al. 2007
ACCESS	2000 and 2006	0.5×0.5	http://www.cgrer.uiowa.edu/ACESS/acess_index.htm Streets et al. 2003; Zhang et al. 2009
Garg	1985–2005	Not gridded	Garg et al. 2006

5. Result

The emissions will be converted from emission reporting sectoral level (CRF/NFR, GAINS code, IEA flow/product for combustion, or some other level of detail) to EXIOBASE/DESIRE industries and products by using allocation matrices.
We will generate from the dataset emission factors by taking the ratio of emissions and activity use at the requested level of detail (all IEA product and flow combinations).

The final emission extension will consist of the following pollutants:

Code	Emission	Type
EM_AIR.1	CO2	air
EM_AIR.2	N2O	air
EM_AIR.3	CH4	air
EM_AIR.4	HFCs	air
EM_AIR.5	PFCs	air
EM_AIR.6	SF6	air
EM_AIR.7	NOX	air
EM_AIR.8	SOx	air
EM_AIR.9	NH3	air
EM_AIR.10	NMVOC	air
EM_AIR.11	CO	air
EM_AIR.12	CFCs	air
EM_AIR.13	HCFCs	air
EM_AIR.14	Pb	air
EM_AIR.15	Cd	air
EM_AIR.16	Hg	air
EM_AIR.17	As	air
EM_AIR.18	Cr	air
EM_AIR.19	Cu	air
EM_AIR.20	Ni	air
EM_AIR.21	Se	air
EM_AIR.22	Zn	air
EM_AIR.23	Aldrin	air
EM_AIR.24	Chlordane	air
EM_AIR.25	Chlordecone	air
EM_AIR.26	Dieldrin	air
EM_AIR.27	Endrin	air
EM_AIR.28	Heptachlor	air
EM_AIR.29	Hexabr.-biph.	air
EM_AIR.30	Mirex	air
EM_AIR.31	Toxaphene	air
EM_AIR.32	HCH	air
EM_AIR.33	DDT	air
EM_AIR.34	PCB	air
EM_AIR.35	dioxin	air
EM_AIR.36	PM10	air
EM_AIR.37	BaP	air
EM_AIR.38	Benzene	air
EM_AIR.39	1,3 Butadiene	air
EM_AIR.40	Formaldehyd	air
EM_AIR.41	PM2.5	air
EM_AIR.42	Furans	air
EM_AIR.43	Benzo-[a]-pyrene (PAHs)	air
EM_AIR.44	PBDEs	air

2.2.2.5 Land

The main source for the land use extensions in the EXIOBASE model compiled in the EXIOPOL and CREEA projects was the online data base of the FAO, FAOstat. The FAO database is the most comprehensive database with regard to agricultural production and all related physical flows. Thus, land use data and biomass extraction (part of MFA data) are consistently linked.

FAO land use data are compiled along 6 main categories of land use and land cover: cropland, grassland, forest land, wetland, settlements and other land. Data from the FAO database for primary crops such as rice, wheat, vegetables or fibres are allocated to the category "land use – Arable Land" within the CREEA project (Table L1). The item "Other crops" includes forestry plantations and fallow land was not defined as a CREEA category. Permanent meadows and pastures as well as forest land are allocated to one single category.

Table L1: CREEA land use classification and proposed additional categories (source: Annnex 7.2. Schütz and Klement 2013; CREEA Deliverable 7.2)

Land use occupation, 1 item [hectares/yr] (extensions); derived from FAOSTAT		
		IndustryTypeCode
L_0	Land use	
N.B. the following FAOSTAT categories allow for allocating land use to agricultural sectors		
L_1.1.	Land use-Arable Land - Rice	i01.a
L_1.2.	Land use-Arable Land - Wheat	i01.b
L_1.3.	Land use-Arable Land - Other cereals	i01.c
L_1.4.	Land use-Arable Land - Roots and tubers	i01.h
L_1.5.	Land use-Arable Land - Sugar crops	i01.f
L_1.6.	Land use-Arable Land - Pulses	i01.d
L_1.7.	Land use-Arable Land - Nuts	i01.d
L_1.8.	Land use-Arable Land - Oil crops	i01.e
L_1.9.	Land use-Arable Land - Vegetables	i01.d
L_1.10.	Land use-Arable Land - Fruits	i01.d
L_1.11.	Land use-Arable Land - Fibres	i01.g
L_1.12.	Land use-Arable Land - Other crops	i01.h
L_1.13.	Land use-Arable Land - Fodder crops	i01.h
L_2	Land use-Pasture - Permanent pasture	i01.h
L_3	Land use-Forest - Wood land	i02
additional categories by HSC/WI:		
L_1.14	Cropland - Fallow land	n.a.
L_4	Settlements	n.a.

All developed land, including transportation infrastructure and human settlements is allocated to the category "settlements". In the CREEA project two databases for built-up and related land were compared due to huge differences in data from different sources. 2011 Annex 1 Party GHG Inventory Submissions are used with first priority. Since national GHGE inventories are only available from 2003 to 2013, we have to find appropriate alternatives.

The DESIRE land use extensions will follow the CREEA classifications in Table L1. The final result is a data set encompassing information on:

- Country
- Extension label
- Industry codes
- Year
- Quantity
- Unit

Despite the high quality of FAO data, inconsistencies and data gaps still occur, in particular for fallow land and forage crops. In addition to FAOstat, other data and information will be taken from a broad range of specific sources based on the documentation done in the CREEA project (e.g Eurostat data) to fill data gaps. In the case of China, apart from the aggregated FAO data, national statistical data for Taiwan is used and than subtracted in order to get detailed land use data. Moreover, we will follow the methodology to adjust FAO data on cropland, permanent meadows and pastures according to the CREEA land data provision by Schütz and Klement (2012). In order to derive the resulting data set as environmental extension to CREEA, original FAO cropland data is refined by allocating surplus or missing cropland area to the categories of primary crops in relation to their individual shares of the sum or reported primary crops area.

Land use data is now available for the years 2000 (EXIOBASE) and 2007 (CREEA). The time series foreseen in the DoW (1995-2011) is feasible to produce and FAO final data for 2012 will be available by the end of October 2013. We are going to adapt established methodologies on land use categories in EXIOPOL and CREEA as far as practicable in deriving the time series.
To sum up, we estimate that by the end of November 2013 a first draft data set for land use extension in the CREEA format for the year 1995-2011 will be compiled. By May 2014 a quality check is completed, if necessary further data sources have been included as well. A final land use change matrix will be available in December 2014.

2.3 Task 5.3: Data inventory and compilation: now-casting

In this task we explore the options for now-casting the EEIO database. Now casting of the time series can be accomplished by updating/rebalancing the system using up to data macro economic constraints. These are readily available with a time lag of 1 to 2 years and the methods for updating will be developed in Task 5.2a. Incorporating further detail (modelled change in industry/product output, technical coefficients, extensions) will be planned based on the outcome of the third time series in Task 5.2.

The first step in doing so is to define the starting point for the now-casting. For that we screen the various data source utilized in DESIRE and check for the latest data available as well as the update interval.

Database	Latest datapoint *)	Time lag
UN SNA	2011	2 to 3 years
Eurostat ESA 95 IO tables	2009	3 to 4 year, country specific derogation rules can be applied
FAOstat	2012	1year
BACI	2011	1 year
UN service trade	2012	Few months
UNIDO	2010	2 to 3 years
ProdCom	2012	Few months
GHG Inventory Subm.	2012	1 year
IEA extended energy balances	2012	1 year, although the last point is sometimes incomplete or based on estimations

***) by October 2013**

For the compilation of the EEIO time series we follow a top down approach with UN SNA macro economic data as the main constrain (see section 2.2.1). Following that approach, the availability of the UN SNA macroeconomic data restricts the timeliness of the now-casting. In that sense we define 'now' for the now-casting as the year of the latest available UN SNA data.

In the next step, we will explore methods to model/update change in technical coefficients and environmental extensions based on the EE IO time series and available auxiliary data (change over time/correlation with value added or industry output change per sector). We expect further information about the important structural changes which should be captured by the now casting procedure from the structural decomposition analysis of available IO time series (as described in section 2.2.1.3)

2.4 Task 5.4: Calculation of EE IO based 'macro resource' indicators

The EE MRIO framework offers the unique possibility to investigate environmental impacts of products under full consideration of upstream resource use. These upstream resource requirements will be calculated over the longest time frame available, with basic interpretation and analysis of indicator results.

The now casted database (outcome of Task 5.2 and 5.3) will be analysed according to different dimensions. A comparative analysis of direct versus indirect (embodied) resource use will show to what extent countries are using foreign resources for satisfying domestic demand and whether changes in trends can be seen. In relation to the GDP these indicators will be used to calculate resource efficiency. A comparison of trends in resource productivity directly addresses current policy programmes. The underlying question is, whether improvement in resource productivity (decoupling) is still observed if upstream resource requirements are considered. This question is of particular interest if considered across all resources because substitutional effects or side-effects will get

visible. The now available final demand or final consumption perspectives then opens quite some area for further research that so far has only be discussed from the production perspective. One of the most prominent questions is for example, do we see a saturation of resource use in mature economies just as we see t for the direct resource use indicators (in total values and/or in per capital terms)? Or do we find more homogeneous resource use patterns across the European Countries as compared to patterns seen with the direct measurements? Task 5.4 will address these questions in the descriptive analysis. Methods for doing so have been developed within the EXIOPOL and CREEA project for single year snapshots of the global economy. Within Task 5.4, we will apply this methods to the indicators specified in Task 5.1 and calculate them over the whole time period.

3 Time plan

Date	Milestone
September 2013	Consistent macroeconomic time series
September 2013	**Deliverable 5.1** (Inception report)
October 2013	First material extension time series 1995-2010
October 2013	First water extension time series 1995-2010
October 2013	Correspondence list between IEA flows and products and EXIOBASE industries and products
November 2013	First land use extensions time series 1995-2011
December 2013	Revised material extension time series 1995-2010
December 2013	Revised water extension time series 1995-2010
December 2013	First time series (monetary)
April 2014	Energy SUTs in IEA format according to the residence principle
May 2014	Revised land use extension time series 1995-2011
May 2014	IEA (and FAO) data
May 2014	Final emission coefficient dataset
August 2014	Second time series
August 2014	**Deliverable 5.2** (Interim report on data processing creating EE IO time series and now-casted data)
September 2014	Draft energy SUTs based on the allocation applied by WI in CREEA
October 2014	First material extension time series 1995-2011
November 2014	Air emission accounts from combustion uses
December 2014	Revised material extension time series 1995-2011
December 2014	Revised water extension time series 1995-2011
February 2015	Complete EEIO time series (third version) with analysis, final report (**Deliverable 5.3**)

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5 Appendix

5.1 EXIOBASE 2.0 Product Classification

No	Name	Code1	Code2
1	Paddy rice	p01.a	C_PARI
2	Wheat	p01.b	C_WHEA
3	Cereal grains nec	p01.c	C_OCER
4	Vegetables, fruit, nuts	p01.d	C_FVEG
5	Oil seeds	p01.e	C_OILS
6	Sugar cane, sugar beet	p01.f	C_SUGB
7	Plant-based fibers	p01.g	C_FIBR
8	Crops nec	p01.h	C_OTCR
9	Cattle	p01.i	C_CATL
10	Pigs	p01.j	C_PIGS
11	Poultry	p01.k	C_PLTR
12	Meat animals nec	p01.l	C_OMEA
13	Animal products nec	p01.m	C_OANP
14	Raw milk	p01.n	C_MILK
15	Wool, silk-worm cocoons	p01.o	C_WOOL
16	Manure (conventional treatment)	p01.w.1	C_MANC
17	Manure (biogas treatment)	p01.w.2	C_MANB
18	Products of forestry, logging and related services (02)	p02	C_FORE
19	Fish and other fishing products; services incidental of fishing (05)	p05	C_FISH
20	Anthracite	p10.a	C_ANTH
21	Coking Coal	p10.b	C_COKC
22	Other Bituminous Coal	p10.c	C_OTBC
23	Sub-Bituminous Coal	p10.d	C_SUBC
24	Patent Fuel	p10.e	C_PATF
25	Lignite/Brown Coal	p10.f	C_LIBC
26	BKB/Peat Briquettes	p10.g	C_BKBP
27	Peat	p10.h	C_PEAT
28	Crude petroleum and services related to crude oil extraction, excluding surveying	p11.a	C_COIL
29	Natural gas and services related to natural gas extraction, excluding surveying	p11.b	C_GASE
30	Natural Gas Liquids	p11.b.1	C_GASL
31	Other Hydrocarbons	p11.c	C_OGPL
32	Uranium and thorium ores (12)	p12	C_ORAN
33	Iron ores	p13.1	C_IRON
34	Copper ores and concentrates	p13.20.11	C_COPO
35	Nickel ores and concentrates	p13.20.12	C_NIKO
36	Aluminium ores and concentrates	p13.20.13	C_ALUO
37	Precious metal ores and concentrates	p13.20.14	C_PREO
38	Lead, zinc and tin ores and concentrates	p13.20.15	C_LZTO
39	Other non-ferrous metal ores and concentrates	p13.20.16	C_ONFO
40	Stone	p14.1	C_STON

No	Name	Code1	Code2
41	Sand and clay	p14.2	C_SDCL
42	Chemical and fertilizer minerals, salt and other mining and quarrying products n.e.c.	p14.3	C_CHMF
43	Products of meat cattle	p15.a	C_PCAT
44	Products of meat pigs	p15.b	C_PPIG
45	Products of meat poultry	p15.c	C_PPLT
46	Meat products nec	p15.d	C_POME
47	products of Vegetable oils and fats	p15.e	C_VOIL
48	Dairy products	p15.f	C_DAIR
49	Processed rice	p15.g	C_RICE
50	Sugar	p15.h	C_SUGR
51	Food products nec	p15.i	C_OFOD
52	Beverages	p15.j	C_BEVR
53	Fish products	p15.k	C_FSHP
54	Tobacco products (16)	p16	C_TOBC
55	Textiles (17)	p17	C_TEXT
56	Wearing apparel; furs (18)	p18	C_GARM
57	Leather and leather products (19)	p19	C_LETH
58	Wood and products of wood and cork (except furniture); articles of straw and plaiting materials (20)	p20	C_WOOD
59	Wood material for treatment, Re-processing of secondary wood material into new wood material	p20.w	C_WOOW
60	Pulp	p21.1	C_PULP
61	Secondary paper for treatment, Re-processing of secondary paper into new pulp	p21.w.1	C_PAPR
62	Paper and paper products	p21.2	C_PAPE
63	Printed matter and recorded media (22)	p22	C_MDIA
64	Coke Oven Coke	p23.1.a	C_COKE
65	Gas Coke	p23.1.b	C_GCOK
66	Coal Tar	p23.1.c	C_COTA
67	Motor Gasoline	p23.20.a	C_MGSL
68	Aviation Gasoline	p23.20.b	C_AGSL
69	Gasoline Type Jet Fuel	p23.20.c	C_GJET
70	Kerosene Type Jet Fuel	p23.20.d	C_KJET
71	Kerosene	p23.20.e	C_KERO
72	Gas/Diesel Oil	p23.20.f	C_DOIL
73	Heavy Fuel Oil	p23.20.g	C_FOIL
74	Refinery Gas	p23.20.h	C_RGAS
75	Liquefied Petroleum Gases (LPG)	p23.20.i	C_LPGA
76	Refinery Feedstocks	p23.20.j	C_REFF
77	Ethane	p23.20.k	C_ETHA
78	Naphtha	p23.20.l	C_NAPT
79	White Spirit & SBP	p23.20.m	C_WHSP
80	Lubricants	p23.20.n	C_LUBR
81	Bitumen	p23.20.o	C_BITU
82	Paraffin Waxes	p23.20.p	C_PARW
83	Petroleum Coke	p23.20.q	C_PETC
84	Non-specified Petroleum Products	p23.20.r	C_NSPP
85	Nuclear fuel	p23.3	C_NUCF

No	Name	Code1	Code2
86	Plastics, basic	p24.a	C_PLAS
87	Secondary plastic for treatment, Re-processing of secondary plastic into new plastic	p24.a.w	C_PLAW
88	N-fertiliser	p24.b	C_NFER
89	P- and other fertiliser	p24.c	C_PFER
90	Chemicals nec	p24.d	C_CHEM
91	Charcoal	p24.e	C_CHAR
92	Additives/Blending Components	p24.f	C_ADDC
93	Biogasoline	p24.g	C_BIOG
94	Biodiesels	p24.h	C_BIOD
95	Other Liquid Biofuels	p24.i	C_OBIO
96	Rubber and plastic products (25)	p25	C_RUBP
97	Glass and glass products	p26.a	C_GLAS
98	Secondary glass for treatment, Re-processing of secondary glass into new glass	p26.w.1	C_GLAW
99	Ceramic goods	p26.b	C_CRMC
100	Bricks, tiles and construction products, in baked clay	p26.c	C_BRIK
101	Cement, lime and plaster	p26.d	C_CMNT
102	Ash for treatment, Re-processing of ash into clinker	p26.d.w	C_ASHW
103	Other non-metallic mineral products	p26.e	C_ONMM
104	Basic iron and steel and of ferro-alloys and first products thereof	p27.a	C_STEL
105	Secondary steel for treatment, Re-processing of secondary steel into new steel	p27.a.w	C_STEW
106	Precious metals	p27.41	C_PREM
107	Secondary precious metals for treatment, Re-processing of secondary precious metals into new preciuos metals	p27.41.w	C_PREW
108	Aluminium and aluminium products	p27.42	C_ALUM
109	Secondary aluminium for treatment, Re-processing of secondary aluminium into new aluminium	p27.42.w	C_ALUW
110	Lead, zinc and tin and products thereof	p27.43	C_LZTP
111	Secondary lead for treatment, Re-processing of secondary lead into new lead	p27.43.w	C_LZTW
112	Copper products	p27.44	C_COPP
113	Secondary copper for treatment, Re-processing of secondary copper into new copper	p27.44.w	C_COPW
114	Other non-ferrous metal products	p27.45	C_ONFM
115	Secondary other non-ferrous metals for treatment, Re-processing of secondary other non-ferrous metals into new other non-ferrous metals	p27.45.w	C_ONFW
116	Foundry work services	p27.5	C_METC
117	Fabricated metal products, except machinery and equipment (28)	p28	C_FABM
118	Machinery and equipment n.e.c. (29)	p29	C_MACH
119	Office machinery and computers (30)	p30	C_OFMA
120	Electrical machinery and apparatus n.e.c. (31)	p31	C_ELMA
121	Radio, television and communication equipment and apparatus (32)	p32	C_RATV
122	Medical, precision and optical instruments, watches and clocks (33)	p33	C_MEIN
123	Motor vehicles, trailers and semi-trailers (34)	p34	C_MOTO
124	Other transport equipment (35)	p35	C_OTRE
125	Furniture; other manufactured goods n.e.c. (36)	p36	C_FURN

No	Name	Code1	Code2
126	*Secondary raw materials*	*p37*	*C_RYMS*
127	Bottles for treatment, Recycling of bottles by direct reuse	p37.w.1	C_BOTW
128	Electricity by coal	p40.11.a	C_POWC
129	Electricity by gas	p40.11.b	C_POWG
130	Electricity by nuclear	p40.11.c	C_POWN
131	Electricity by hydro	p40.11.d	C_POWH
132	Electricity by wind	p40.11.e	C_POWW
133	Electricity by petroleum and other oil derivatives	p40.11.f	C_POWP
134	Electricity by biomass and waste	p40.11.g	C_POWB
135	Electricity by solar photovoltaic	p40.11.h	C_POWS
136	Electricity by solar thermal	p40.11.i	C_POWE
137	Electricity by tide, wave, ocean	p40.11.j	C_POWO
138	Electricity by Geothermal	p40.11.k	C_POWM
139	Electricity nec	p40.11.l	C_POWZ
140	Transmission services of electricity	p40.12	C_POWT
141	Distribution and trade services of electricity	p40.13	C_POWD
142	Coke oven gas	p40.2.a	C_COOG
143	Blast Furnace Gas	p40.2.b	C_MBFG
144	Oxygen Steel Furnace Gas	p40.2.c	C_MOSG
145	Gas Works Gas	p40.2.d	C_MGWG
146	Biogas	p40.2.e	C_MBIO
147	Distribution services of gaseous fuels through mains	p40.2.1	C_GASD
148	Steam and hot water supply services	p40.3	C_HWAT
149	Collected and purified water, distribution services of water (41)	p41	C_WATR
150	Construction work (45)	p45	C_CONS
151	Secondary construction material for treatment, Re-processing of secondary construction material into aggregates	p45.w	C_CONW
152	Sale, maintenance, repair of motor vehicles, motor vehicles parts, motorcycles, motor cycles parts and accessories	p50.a	C_TDMO
153	Retail trade services of motor fuel	p50.b	C_TDFU
154	Wholesale trade and commission trade services, except of motor vehicles and motorcycles (51)	p51	C_TDWH
155	Retail trade services, except of motor vehicles and motorcycles; repair services of personal and household goods (52)	p52	C_TDRT
156	Hotel and restaurant services (55)	p55	C_HORE
157	Railway transportation services	p60.1	C_TRAI
158	Other land transportation services	p60.2	C_TLND
159	Transportation services via pipelines	p60.3	C_TPIP
160	Sea and coastal water transportation services	p61.1	C_TWAS
161	Inland water transportation services	p61.2	C_TWAI
162	Air transport services (62)	p62	C_TAIR
163	Supporting and auxiliary transport services; travel agency services (63)	p63	C_TAUX
164	Post and telecommunication services (64)	p64	C_PTEL
165	Financial intermediation services, except insurance and pension funding services (65)	p65	C_FINT
166	Insurance and pension funding services, except	p66	C_FINS

No	Name	Code1	Code2
	compulsory social security services (66)		
167	Services auxiliary to financial intermediation (67)	p67	C_FAUX
168	Real estate services (70)	p70	C_REAL
169	Renting services of machinery and equipment without operator and of personal and household goods (71)	p71	C_MARE
170	Computer and related services (72)	p72	C_COMP
171	Research and development services (73)	p73	C_RESD
172	Other business services (74)	p74	C_OBUS
173	Public administration and defence services; compulsory social security services (75)	p75	C_PADF
174	Education services (80)	p80	C_EDUC
175	Health and social work services (85)	p85	C_HEAL
176	Food waste for treatment: incineration	*p90.1.a*	*C_INCF*
177	Paper waste for treatment: incineration	*p90.1.b*	*C_INCP*
178	Plastic waste for treatment: incineration	*p90.1.c*	*C_INCL*
179	Intert/metal waste for treatment: incineration	*p90.1.d*	*C_INCM*
180	Textiles waste for treatment: incineration	*p90.1.e*	*C_INCT*
181	Wood waste for treatment: incineration	*p90.1.f*	*C_INCW*
182	Oil/hazardous waste for treatment: incineration	*p90.1.g*	*C_INCO*
183	Food waste for treatment: biogasification and land application	*p90.2.a*	*C_BIOF*
184	Paper waste for treatment: biogasification and land application	*p90.2.b*	*C_BIOP*
185	Sewage sludge for treatment: biogasification and land application	*p90.2.c*	*C_BIOS*
186	Food waste for treatment: composting and land application	*p90.3.a*	*C_COMF*
187	Paper and wood waste for treatment: composting and land application	*p90.3.b*	*C_COMW*
188	Food waste for treatment: waste water treatment	*p90.4.a*	*C_WASF*
189	Other waste for treatment: waste water treatment	*p90.4.b*	*C_WASO*
190	Food waste for treatment: landfill	p90.5.a	C_LANF
191	Paper for treatment: landfill	p90.5.b	C_LANP
192	Plastic waste for treatment: landfill	p90.5.c	C_LANL
193	Inert/metal/hazardous waste for treatment: landfill	p90.5.d	C_LANI
194	Textiles waste for treatment: landfill	p90.5.e	C_LANT
195	Wood waste for treatment: landfill	p90.5.f	C_LANW
196	Membership organisation services n.e.c. (91)	p91	C_ORGA
197	Recreational, cultural and sporting services (92)	p92	C_RECR
198	Other services (93)	p93	C_OSER
199	Private households with employed persons (95)	p95	C_PRHH
200	Extra-territorial organizations and bodies	p99	C_EXTO

5.2 EXIOBASE 2.0 Industry Classification

No	EXIOBASE 2.0 Industry sectors	Code1	Code2
1	Cultivation of paddy rice	i01.a	A_PARI
2	Cultivation of wheat	i01.b	A_WHEA
3	Cultivation of cereal grains nec	i01.c	A_OCER
4	Cultivation of vegetables, fruit, nuts	i01.d	A_FVEG
5	Cultivation of oil seeds	i01.e	A_OILS
6	Cultivation of sugar cane, sugar beet	i01.f	A_SUGB
7	Cultivation of plant-based fibers	i01.g	A_FIBR
8	Cultivation of crops nec	i01.h	A_OTCR
9	Cattle farming	i01.i	A_CATL
10	Pigs farming	i01.j	A_PIGS
11	Poultry farming	i01.k	A_PLTR
12	Meat animals nec	i01.l	A_OMEA
13	Animal products nec	i01.m	A_OANP
14	Raw milk	i01.n	A_MILK
15	Wool, silk-worm cocoons	i01.o	A_WOOL
16	Manure treatment (conventional), storage and land application	i01.w.1	A_MANC
17	Manure treatment (biogas), storage and land application	i01.w.2	A_MANB
18	Forestry, logging and related service activities (02)	i02	A_FORE
19	Fishing, operating of fish hatcheries and fish farms; service activities incidental to fishing (05)	i05	A_FISH
20	Mining of coal and lignite; extraction of peat (10)	i10	A_COAL
21	Extraction of crude petroleum and services related to crude oil extraction, excluding surveying	i11.a	A_COIL
22	Extraction of natural gas and services related to natural gas extraction, excluding surveying	i11.b	A_GASE
23	Extraction, liquefaction, and regasification of other petroleum and gaseous materials	i11.c	A_OGPL
24	Mining of uranium and thorium ores (12)	i12	A_ORAN
25	Mining of iron ores	i13.1	A_IRON
26	Mining of copper ores and concentrates	i13.20.11	A_COPO
27	Mining of nickel ores and concentrates	i13.20.12	A_NIKO
28	Mining of aluminium ores and concentrates	i13.20.13	A_ALUO
29	Mining of precious metal ores and concentrates	i13.20.14	A_PREO
30	Mining of lead, zinc and tin ores and concentrates	i13.20.15	A_LZTO
31	Mining of other non-ferrous metal ores and concentrates	i13.20.16	A_ONFO
32	Quarrying of stone	i14.1	A_STON
33	Quarrying of sand and clay	i14.2	A_SDCL
34	Mining of chemical and fertilizer minerals, production of salt, other mining and quarrying n.e.c.	i14.3	A_CHMF
35	Processing of meat cattle	i15.a	A_PCAT
36	Processing of meat pigs	i15.b	A_PPIG
37	Processing of meat poultry	i15.c	A_PPLT
38	Production of meat products nec	i15.d	A_POME

No	EXIOBASE 2.0 Industry sectors	Code1	Code2
39	Processing vegetable oils and fats	i15.e	A_VOIL
40	Processing of dairy products	i15.f	A_DAIR
41	Processed rice	i15.g	A_RICE
42	Sugar refining	i15.h	A_SUGR
43	Processing of Food products nec	i15.i	A_OFOD
44	Manufacture of beverages	i15.j	A_BEVR
45	Manufacture of fish products	i15.k	A_FSHP
46	Manufacture of tobacco products (16)	i16	A_TOBC
47	Manufacture of textiles (17)	i17	A_TEXT
48	Manufacture of wearing apparel; dressing and dyeing of fur (18)	i18	A_GARM
49	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear (19)	i19	A_LETH
50	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (20)	i20	A_WOOD
51	Re-processing of secondary wood material into new wood material	i20.w	A_WOOW
52	Pulp	i21.1	A_PULP
53	Re-processing of secondary paper into new pulp	i21.w.1	A_PAPR
54	Paper	i21.2	A_PAPE
55	Publishing, printing and reproduction of recorded media (22)	i22	A_MDIA
56	Manufacture of coke oven products	i23.1	A_COKE
57	Petroleum Refinery	i23.2	A_REFN
58	Processing of nuclear fuel	i23.3	A_NUCF
59	Plastics, basic	i24.1	A_PLAS
60	Re-processing of secondary plastic into new plastic	i24.1.w	A_PLAW
61	N-fertiliser	i24.2	A_NFER
62	P- and other fertiliser	i24.3	A_PFER
63	Chemicals nec	i24.4	A_CHEM
64	Manufacture of rubber and plastic products (25)	i25	A_RUBP
65	Manufacture of glass and glass products	i26.a	A_GLAS
66	Re-processing of secondary glass into new glass	i26.w.1	A_GLAW
67	Manufacture of ceramic goods	i26.b	A_CRMC
68	Manufacture of bricks, tiles and construction products, in baked clay	i26.c	A_BRIK
69	Manufacture of cement, lime and plaster	i26.d	A_CMNT
70	Re-processing of ash into clinker	i26.d.w	A_ASHW
71	Manufacture of other non-metallic mineral products n.e.c.	i26.e	A_ONMM
72	Manufacture of basic iron and steel and of ferro-alloys and first products thereof	i27.a	A_STEL
73	Re-processing of secondary steel into new steel	i27.a.w	A_STEW
74	Precious metals production	i27.41	A_PREM
75	Re-processing of secondary preciuos metals into new preciuos metals	i27.41.w	A_PREW
76	Aluminium production	i27.42	A_ALUM
77	Re-processing of secondary aluminium into new aluminium	i27.42.w	A_ALUW
78	Lead, zinc and tin production	i27.43	A_LZTP

No	EXIOBASE 2.0 Industry sectors	Code1	Code2
79	Re-processing of secondary lead into new lead	i27.43.w	A_LZTW
80	Copper production	i27.44	A_COPP
81	Re-processing of secondary copper into new copper	i27.44.w	A_COPW
82	Other non-ferrous metal production	i27.45	A_ONFM
83	Re-processing of secondary other non-ferrous metals into new other non-ferrous metals	i27.45.w	A_ONFW
84	Casting of metals	i27.5	A_METC
85	Manufacture of fabricated metal products, except machinery and equipment (28)	i28	A_FABM
86	Manufacture of machinery and equipment n.e.c. (29)	i29	A_MACH
87	Manufacture of office machinery and computers (30)	i30	A_OFMA
88	Manufacture of electrical machinery and apparatus n.e.c. (31)	i31	A_ELMA
89	Manufacture of radio, television and communication equipment and apparatus (32)	i32	A_RATV
90	Manufacture of medical, precision and optical instruments, watches and clocks (33)	i33	A_MEIN
91	Manufacture of motor vehicles, trailers and semi-trailers (34)	i34	A_MOTO
92	Manufacture of other transport equipment (35)	i35	A_OTRE
93	Manufacture of furniture; manufacturing n.e.c. (36)	i36	A_FURN
94	*Recycling of waste and scrap*	*i37*	*A_RYMS*
95	Recycling of bottles by direct reuse	i37.w.1	A_BOTW
96	Production of electricity by coal	i40.11.a	A_POWC
97	Production of electricity by gas	i40.11.b	A_POWG
98	Production of electricity by nuclear	i40.11.c	A_POWN
99	Production of electricity by hydro	i40.11.d	A_POWH
100	Production of electricity by wind	i40.11.e	A_POWW
101	Production of electricity by petroleum and other oil derivatives	i40.11.f	A_POWP
102	Production of electricity by biomass and waste	i40.11.g	A_POWB
103	Production of electricity by solar photovoltaic	i40.11.h	A_POWS
104	Production of electricity by solar thermal	i40.11.i	A_POWE
105	Production of electricity by tide, wave, ocean	i40.11.j	A_POWO
106	Production of electricity by Geothermal	i40.11.k	A_POWM
107	Production of electricity nec	i40.11.l	A_POWZ
108	Transmission of electricity	i40.12	A_POWT
109	Distribution and trade of electricity	i40.13	A_POWD
110	Manufacture of gas; distribution of gaseous fuels through mains	i40.2	A_GASD
111	Steam and hot water supply	i40.3	A_HWAT
112	Collection, purification and distribution of water (41)	i41	A_WATR
113	Construction (45)	i45	A_CONS
114	Re-processing of secondary construction material into aggregates	i45.w	A_CONW
115	Sale, maintenance, repair of motor vehicles, motor vehicles parts, motorcycles, motor cycles parts and accessoiries	i50.a	A_TDMO
116	Retail sale of automotive fuel	i50.b	A_TDFU
117	Wholesale trade and commission trade, except of motor	i51	A_TDWH

No	EXIOBASE 2.0 Industry sectors	Code1	Code2
	vehicles and motorcycles (51)		
118	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods (52)	i52	A_TDRT
119	Hotels and restaurants (55)	i55	A_HORE
120	Transport via railways	i60.1	A_TRAI
121	Other land transport	i60.2	A_TLND
122	Transport via pipelines	i60.3	A_TPIP
123	Sea and coastal water transport	i61.1	A_TWAS
124	Inland water transport	i61.2	A_TWAI
124	Air transport (62)	i62	A_TAIR
126	Supporting and auxiliary transport activities; activities of travel agencies (63)	i63	A_TAUX
127	Post and telecommunications (64)	i64	A_PTEL
128	Financial intermediation, except insurance and pension funding (65)	i65	A_FINT
129	Insurance and pension funding, except compulsory social security (66)	i66	A_FINS
130	Activities auxiliary to financial intermediation (67)	i67	A_FAUX
131	Real estate activities (70)	i70	A_REAL
132	Renting of machinery and equipment without operator and of personal and household goods (71)	i71	A_MARE
133	Computer and related activities (72)	i72	A_COMP
134	Research and development (73)	i73	A_RESD
135	Other business activities (74)	i74	A_OBUS
136	Public administration and defence; compulsory social security (75)	i75	A_PADF
137	Education (80)	i80	A_EDUC
138	Health and social work (85)	i85	A_HEAL
139	Incineration of waste: Food	*i90.1.a*	*A_INCF*
140	Incineration of waste: Paper	*i90.1.b*	*A_INCP*
141	Incineration of waste: Plastic	*i90.1.c*	*A_INCL*
142	Incineration of waste: Metals and Inert materials	*i90.1.d*	*A_INCM*
143	Incineration of waste: Textiles	*i90.1.e*	*A_INCT*
144	Incineration of waste: Wood	*i90.1.f*	*A_INCW*
145	Incineration of waste: Oil/Hazardous waste	*i90.1.g*	*A_INCO*
146	Biogasification of food waste, incl. land application	*i90.3.a*	*A_BIOF*
147	Biogasification of paper, incl. land application	*i90.3.b*	*A_BIOP*
148	Biogasification of sewage sludge, incl. land application	*i90.3.c*	*A_BIOS*
149	Composting of food waste, incl. land application	*i90.4.a*	*A_COMF*
150	Composting of paper and wood, incl. land application	*i90.4.b*	*A_COMW*
151	Waste water treatment, food	*i90.5.a*	*A_WASF*
152	Waste water treatment, other	*i90.5.b*	*A_WASO*
153	Landfill of waste: Food	i90.6.a	A_LANF
154	Landfill of waste: Paper	i90.6.b	A_LANP
155	Landfill of waste: Plastic	i90.6.c	A_LANL
156	Landfill of waste: Inert/metal/hazardous	i90.6.d	A_LANI
157	Landfill of waste: Textiles	i90.6.e	A_LANT
158	Landfill of waste: Wood	i90.6.f	A_LANW
159	Activities of membership organisation n.e.c. (91)	i91	A_ORGA

No	EXIOBASE 2.0 Industry sectors	Code1	Code2
160	Recreational, cultural and sporting activities (92)	i92	A_RECR
161	Other service activities (93)	i93	A_OSER
162	Private households with employed persons (95)	i95	A_PRHH
163	Extra-territorial organizations and bodies	i99	A_EXTO

5.3 DESIRE country classification

Number	Country/Region	Code	EU member
1	Austria	AT	EU
2	Belgium	BE	EU
3	Bulgaria	BG	EU
4	Cyprus	CY	EU
5	Czech Republic	CZ	EU
6	Germany	DE	EU
7	Denmark	DK	EU
8	Estonia	EE	EU
9	Spain	ES	EU
10	Finland	FI	EU
11	France	FR	EU
12	Greece	GR	EU
13	Croatia	HR	EU
14	Hungary	HU	EU
15	Ireland	IE	EU
16	Italy	IT	EU
17	Lithuania	LT	EU
18	Luxembourg	LU	EU
19	Latvia	LV	EU
20	Malta	MT	EU
21	Netherlands	NL	EU
22	Poland	PL	EU
23	Portugal	PT	EU
24	Romania	RO	EU
25	Sweden	SE	EU
26	Slovenia	SI	EU
27	Slovakia	SK	EU
28	United Kingdom	GB	EU
29	United States	US	nonEU
30	Japan	JP	nonEU
31	China	CN	nonEU
32	Canada	CA	nonEU
33	South Korea	KR	nonEU
34	Brazil	BR	nonEU
35	India	IN	nonEU
36	Mexico	MX	nonEU
37	Russia	RU	nonEU
38	Australia	AU	nonEU
39	Switzerland	CH	nonEU
40	Turkey	TR	nonEU
41	Taiwan	TW	nonEU
42	Norway	NO	nonEU
43	Indonesia	ID	nonEU
44	South Africa	ZA	nonEU
45	RoW Asia and Pacific	WA	nonEU
46	RoW America	WL	nonEU
47	RoW Europe	WE	nonEU
48	RoW Africa	WF	nonEU
49	RoW Middle East	WM	nonEU

5.4 Energy accounts according to SEEA Energy - Detailed previous overview

Given the time constraints and data availability, we will invest time in bridging the energy balances properly, while the allocation of IEA energy flows to EXIOBASE industries and final use categories will be largely based on the existing allocation procedure generated in CREEA, i.e. we will use energy intensity coefficients generated in CREEA, rather than monetary and physical output volumes. Only if the necessary monetary and physical data is in place we MIGHT partially reproduce the routine generated in CREEA.

Thus, WI will produce comparable time series of physical energy accounts in SEEA format, i.e. three main matrices showing the energy inputs from natural resources, the energy flows within the economy and the residuals going back to the environment.

In principle, we will produce the energy accounts for the period 1995-201x. In any case, we will have to check the completeness of the data, especially for the period 1995-1999 and the years after 2010. It is possible that we might have to make assumptions when generating the balances of the RoW regions.

The following scheme shows the general procedure to be followed:

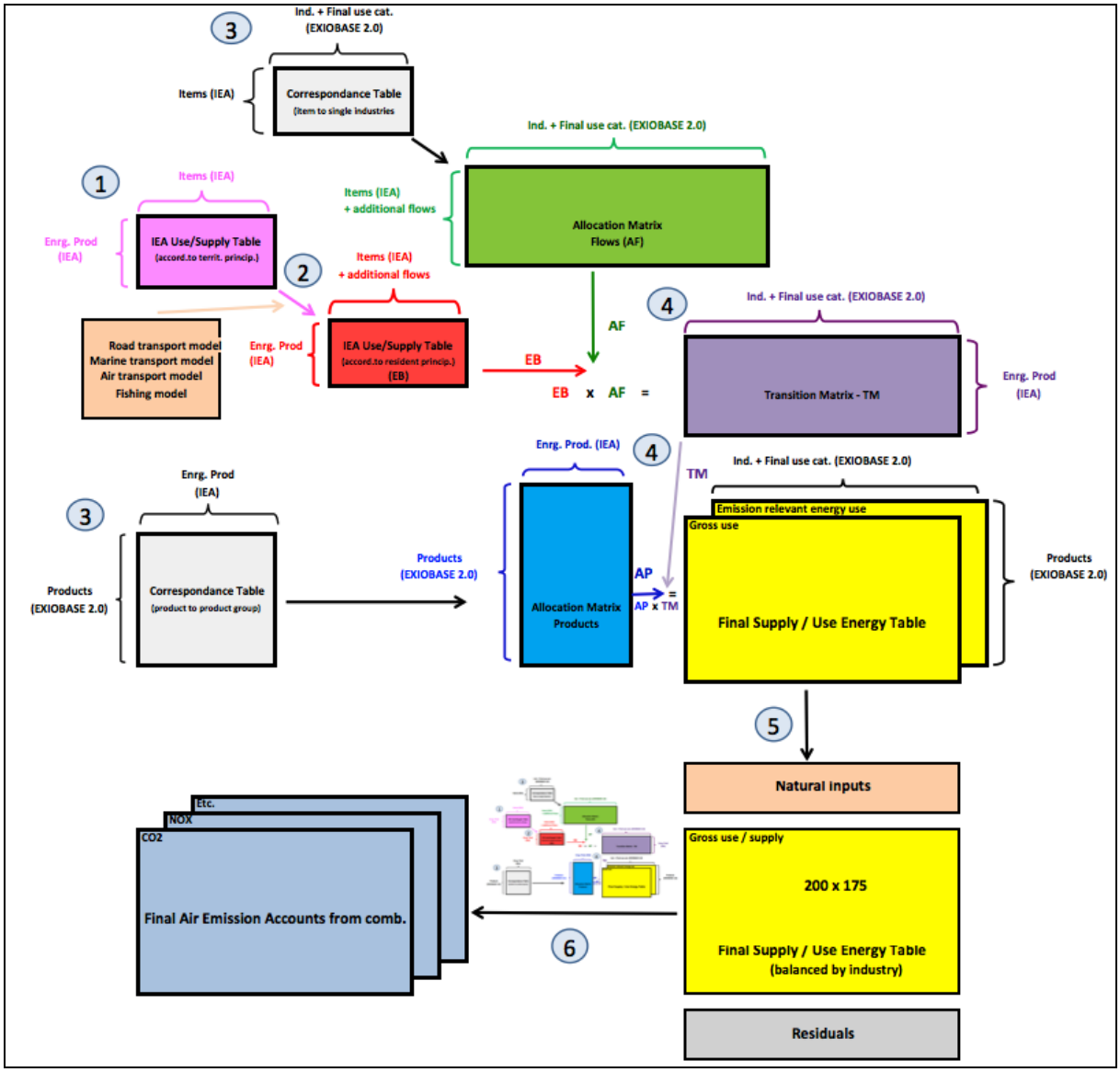

Figure 2.4: Flow chart: Estimating Energy SUT and Air Emission Accounts

Step 1: Generate the energy balances for the RoW regions, balance them according to the world totals and split the balances of all the countries into supply and use.

Step 2: Convert the energy SUTs to the territory principle. We will only generate data for a few years. The remaining years will be filled by linear regression and the like. The road transport model we generated in CREEA is very data intensive, thus, we will contact Olga to see whether the possibility of using GLADYSTE still exists. For the other models the same data sources as in CREEA will be used (e.g. Lloyds database, IATA database, EMEP/EEA guidebook, etc.)
To finish this step, we will probably need data from TNO on the share of trade related to entrepots by country and year so that we can remove it from the IEA export and import data.

Step 3: Correspondence tables. This should not take more than a few working days. We have the tables created in CREEA. In any case, we will check whether minor modifications are needed.

Step 4: Allocation of the energy flows to the DESIRE industries and final use categories. In CREEA we have generated an allocation matrix for each flow and country. This will be our first option in absence of the necessary physical and monetary data.
If the needed data were to be in place, we could run partially of the routine used in CREEA. For this we would need:

- The activity variables of all the industries both in monetary and physical terms at the DESIRE resolution,
- The activity variables of all agriculture- and food-related products at CPA 6-digit resolution,
- Processed LCI data both at CPA 6-digit resolution and DESIRE classification resolution,
- Processed MSUTs (by WI) to ensure that the allocations based on the monetary tables do not lead to inconsistencies in the final values.

It is very unlikely that we will get / generate all the information above, so we have to take shortcuts. Please note that this is not final, but a few bullet points to be born in mind:

- Whenever we do not have the necessary data, we will use the allocation matrices by flow generated in CREEA. Please note that this would mean assuming similar recycling/reuse rates as in 2007, same shares among the waste management options, etc.
- In case a few points are missing in a time series, we will estimate them using yearly variations in the GDP or other relevant indicators.
- If partners agree to supply the necessary physical output data, WI will provide the FAO and IEA data. Otherwise, we will only collect the IEA data and use the CREEA allocation matrices for agriculture and the remaining flows.
- The LCI data we have used in CREEA might need further refinement, although we do not have much time to invest on this.

- A considerable amount of time will have to be spent processing the M-SUTs so that we can do a smooth allocation based on monetary values. We will look at how to improve the approach we took in CREEA.

Step 5: Adding the matrices that show energy flows from and to the environment. The routine written in CREEA automatically allocates the energy flows from natural inputs and the residuals, so this task should not take very long once Step 4 is done.

Step 6: Generation of the air emission accounts from combustion uses. We ignore whether TNO is supposed to generate emission factors for every year or whether we will use the ones used in CREEA. In any case, the allocation for the air emission accounts resulting from the combustion of energy products is the same as in the case of the energy uses. In other words, this task can be carried out within a few days, once a completely balanced energy SUTs are generated.