Improving timeliness of statistics on air emissions with a consumption perspective

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Abstract

Statistics Sweden produces official statistics on greenhouse gas and other air emissions with a consumption perspective using simplified single-country national accounts compatible (SNAC) environmentally extended input output analysis. In the current production, yearly data are produced with a lag-time of almost 23 months between the most recent reference year and the publication date. We are currently investigating the possibility of producing the statistics with a lag-time of only six months or so. The aim of the work presented in this paper is to survey data availability and assess potential methods to achieve this timeliness improvement.

Air emissions accounts, foreign trade data (in goods and services separately) GDP and production values *for Sweden* are all already produced with a suitable degree of sectoral detail (about 50 industry or product groups) with less than 5 months lag-time. Other macroeconomic aggregates are also available for Sweden in this timeframe, though without industrial/productwise detail. Nor are data on gross output or intermediate use available in this timeframe.

FIGARO and EXIOBASE are the most interesting multiregional input-output databases for now casting the international economy outside of Sweden. EXIOBASE also includes data for relevant environmental extensions. For the purpose at hand, the IMF's World Economic Outlook and the World Bank's World Development Inicators have also been investigated. Though there exist many potential sources for emissions data for the international economy, each potential source is lacking either in system boundary (territorial vs. economic production), geographic coverage (e.g. only European Union Member States) or production time.

The initial survey has also revealed a number of methods that can be applied to available data to achieve the necessary balancing for input-output tables.

Going forward, it is proposed to implement a method to now cast for the Swedish data used in Statistics Sweden's method based on the exisiting Statistics Sweden data presented in the paper. For environmental effects arising from Sweden's imports one method based on EXIOBASE and one method based on FIGARO is proposed.

Introduction and aim

Statistics Sweden has published and updated statistics on the environmental pressures from Swedish consumption yearly since 2019. The data for the statistics are produced using a method based in input-output analysis known as a simplified single-country national account compatible (SNAC) model (see e.g. Tukker et al., 2018). According to such a model, the environmental pressures due to Swedish consumption arising from production in the Swedish economy are modelled using an environmentally-extended single region input-output (EE SRIO) model using input-output tables and environmental pressures from Swedish production all produced in-house at Statistics Sweden. The environmental pressures due to Sweden's imports are calculated using a separate environmentally extended multi-regional input-output (EE MRIO) database in combination with trade data for Sweden and input-output tables for Sweden. For this calculation, Statistics Sweden currently uses the EE MRIO database EXIOBASE, in-house data on Swedish trade and in-house single-region input-output tables.

The method applied is advantageous compared to an EE SRIO method applying the domestic technology assumption (DTA) because environmental pressures arising due to Swedish imports are calculated using *actual data* for the economic structure and production-perspective environmental pressures of Sweden's trading partners from EXIOBASE. The method applied is advantageous compared an EE MRIO method for Sweden because Sweden has a relatively small economy and the in-house data the method applies (input-output tables, production-perspective environmental pressures and trade data) are more accurate that those from an EE MRIO. More detailed descriptions of the method applied can be found in Brown et al. (2021) and Palm et al. (2019).

Statistics Sweden currently publishes updates for the statistics yearly every autumn. The time series for the statistics starts in 2008 and goes up to two years before the year of publication. Thus in the autumn of 2021, the statistics will cover a time series from 2008 to 2019. One reason for this time lag is the time lag involved in producing the statistics that are used as input data for environmental pressures from consumption.

In light of this, the purpose of the work presented here is to survey and analyse potential data sources and methods to improve the timeliness of the statistical updates, in particular with a view to publishing statistics with a lag time of less than a year, i.e. publishing statistics in the autumn of 2022 for a time series finishing in 2021.

Method

The review and analysis was divided into work focussing on the global MRIO-based data required for the Statistics Sweden's simplified SNAC method and the SRIO-based data used.

A key part of the analysis for the MRIO-related work was a comparison of the MRIO databases EXIOBASE and FIGARO. EXIOBASE was included in the analysis because it is a well-known MRIO database produced as a result of European-funded research projects, including separate data for all European Union Member States, as well as having been produced specifically with a view to perform environmental analyses. It is also the MRIO that is currently used by Statistics Sweden in the simplified SNAC method used to produce official statistics. FIGARO was chosen for the comparison because it

represents an interesting new MRIO that was first published in May 2021. Data and documentation for EXIOBASE and FIGARO and their respective source data were reviewed covering:

- Source data for:
    - Macroeconomic main aggregates, e.g. value added, GDP (expenditure approach, production approach)
    - Industry-level data, especially production values
    - Trade data
    - Environmental extensions
- Data processing steps
- Timeliness of source data

The review of EXIOBASE and FIGARO was followed up with a review of other potential sources for input data for MRIO now casting in particular for macroeconomic aggregates and environmental extensions. An extended analysis of international bilateral trade data beyond the Swedish trade data produced at Statistics Sweden was excluded however. This was because including these data in the now casting was judged to be beyond the scope of the work being carried out.

The work focussing on SRIO-data for Sweden reviewed internal sources at Statistics Sweden covering the same areas as listed above for the MRIO-data.

A review of potential methods for balancing input-output matrices was carried out in light of the needs of the now casting method proposed.

Finally, potential methods for achieving the intended timeliness improvement for Statistics Sweden's production were proposed in light of the findings of the earlier analysis and review of sources and methods.

Results

Single-region input-output tables for Sweden

Detailed data required for the construction of input-output tables is not available from Statistics Sweden's National Accounts until about 18 months after the final reference period. Thus in June of 2021 data with a high level of industry and product detail about supply, intermediate and final uses and output became available with 2019 as the latest reference year. These are the basis for Statistics Sweden's official input-output tables[1].

Meanwhile, preliminary data for main aggregates such as value added with about 30 industry groups[2] and final use[3] are available a few months after the final reference period. An index of production value

[1] Statistics Sweden's Input-output tables for Sweden: https://www.scb.se/en/finding-statistics/statistics-by-subject-area/national-accounts/national-accounts/national-accounts-quarterly-and-annual-estimates/pong/tables-and-graphs/tables/input-output-tables-productproduct/

[2] GDP production approach (ESA2010) by industrial classfication SNI 2007. Quarter 1980K1 - 2021K2: https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__NR__NR0103__NR0103A/NR0103ENS2010T06Kv/

[3] GDP: expenditure approach (ESA2010) by type of use. Quarter 1980K1 - 2021K2: https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__NR__NR0103__NR0103A/NR0103ENS2010T01Kv/

with over 50 industry groups is also produced quarterly, with a lag time of less than 2 months[4]. Trade data with detailed information about products and exporting countries are also available with a lag-time of a few months[5,6].

The environmental accounts group at Statistics Sweden also produces preliminary air emissions accounts with a lag time of less than five months[7]. Thus data for reference year 2020 were published in May 2021. The preliminary year is simply the sum of the quarterly air emissions accounts produced at Statistics Sweden. Emissions from stationary sources are based on quarterly energy surveys. Emissions from mobile sources likewise. Industrial processes and product use are based on legally-mandated environmental reports or emissions inventories related to the the European emissions-trading scheme and compiled by Swedish Environmental Protection Agency. Emissions from agriculture are imputed from the previous year.

Sweden's National Institute for Economic Research publishes quarterly forecasts of macroeconomic aggregates for Sweden and the world[8]. The most recent forecast presents data up to 2030. Sweden's official national accounts are of course a key starting point for the forecasts. For the forecasts relating economies outside of Sweden, data from other countries' statistical offices are used as well as those from the IMF and the OECD. From these data forecasts are produced collaboratively between different area experts, with coordination focussing on ensuring consistency in the forecasts between each area[9].

Multi-regional input-output tables

In order to understand the potential for improving timeliness at the same time as maintaining a high standard from other quality perspectives, the production methods and input data for each data source identified has been reviewed and presented below.

EXIOBASE

EXIOBASE is a multi-regional environmentally-extended input output database produced in successive international research collaborations, most recently the DESIRE project[10,11]. The database covers 44 countries (all 27 EU member states, plus 17 other large economies) and 5 rest of world regions, classified according to 163 industry groups or 200 product groups. It includes over 1000 different stressors and covers a time period from 1995 up to and including 2022 (future years being a forecast. EXIOBASE is a research product based on high-quality data sources. It has been updated multiple times with a view to extending the time series. Stadler et al. 2015 give a full account of the sources and methods used for the entire time series for the initial version of EXIOBASE 3. More recent years in the time series produced through these updates tend to depend more on modelled data (as opposed to real reported data) than earlier years. Table 1 summarizes the final years for real data used as input for EXIOBASE. As shown in the table, the final year for real data for technical coefficients was 2011. Initial technical coefficients for subsequent years have been produced by trend extrapolation since this period. Macroeconomic data for EXIOBASE's now- and forecasting is taken from the IMF's World Economic

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[4] Statistics Sweden's Production value index: https://www.scb.se/en/finding-statistics/statistics-by-subject-area/business-activities/general-statistics/production-value-index/

[5] Trade in services. Exports and imports by item. Quarter 1982K1 - 2021K2: https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__HA__HA0202/HA0202TjanstHKvN/

[6] Imports of goods from all countries by commodity group CN 2,4,6,8-level and trading partner, confidential data excluded, not adjusted for non response. Month 1995M01 - 2021M06: https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__HA__HA0201__HA0201B/ImpTotalKNMan/

[7] Air emissions by industry SNI 2007 (NACE) and subject. Quarter 2008K1 - 2021K1: https://www.statistikdatabasen.scb.se/pxweb/en/ssd/START__MI__MI1301__MI1301B/MiljoUtslappAmneSNIK/

[8] Prognosdatabasen - välj tabell: http://prognos.konj.se/PxWeb/pxweb/sv/SenastePrognosen/

[9] Så gör vi prognoser - Konjunkturinstitutet: https://www.konj.se/var-verksamhet/sa-gor-vi-prognoser.html

[10] DESIRE project - http://fp7desire.eu/

[11] EXIOBASE 3 – Zenodo: https://doi.org/10.5281/zenodo.4588235

Outlook[12]. Air emissions data are also calculated from the real data by extrapolation of calculated trends in stressor intensity (see also Stadler et al. 2015). The method used to adjust EDGAR data using a territorial principle to a residency principle is not clearly described in available EXIOBASE documentation.

The complilation of the final database entails several steps of adjustment, in particular in compiling trade information and for balancing the technical coefficient matrices with macroeconomic data. Earlier versions of EXIOBASE used a quadratic programming approach for balancing matrices, which in the most recent version has been replaced with a cross entropy approach[13].

Table 1: Final years for input data for EXIOBASE[14]

EXIOBASE input data category	Final year for real data	Source for most recent years in the time series
Macroeconomic data	2019	World Bank
Industry data	2015 – 2019 dependant on source	Countries' own National Accounts data, FAOSTAT[15] and IEA energy balances[16]
Bilateral trade data	2018	BACI database[17]
Technical coefficients	2011	National Statistical Offices
CO2 emissions from combustion	2019	EDGAR[18]
Other GHG emissions	2017	PRIMAST database

The research team responsible for EXIOBASE update it with a rolling release cycle and it has been updated at least once a year for the past few years. Each update is announced through a Google group.

FIGARO

FIGARO is an economic multiregional input output database that was developed by Eurostat in collaboration with the Joint Research Centre of the European Commission (Rémond-Tiedrez, I., & Rueda-Cantuche, J. M., 2019). The database covers the world economy as subdivided into 46 regions in total – 27 EU Member States, 18 other major national economies and one rest-of-the-world region. The database contains input-ouput tables and supply and use tables, industry by industry or product by product. The temporal coverage is from 2010 through 2019.

The data contained in the database is produced according to two main methods. Which one is used depends on the region covered. For the 27 EU Member States, the United States and the United Kingdom, data are calculated from the following sources:

- National supply and use tables reported to Eurostat annually as part of the ESA2010 transmission programme. Input output tables for the United States are based on official country data reclassified by Eurostat from NAICS to NACE and CPA.

[12] World Economic Outlook – Frequently Asked Questions: https://www.imf.org/external/pubs/ft/weo/faq.htm#q1g

[13] EXIOBASE 3 – Zenodo: https://doi.org/10.5281/zenodo.4588235

[14] EXIOBASE 3 – Zenodo: https://doi.org/10.5281/zenodo.4588235

[15] FAOSTAT – http://www.fao.org/faostat/en/#home

[16] World Energy Balances – Analysis – IEA: https://www.iea.org/reports/world-energy-balances-overview

[17] BACI database: http://www.cepii.fr/cepii/en/bdd_modele/presentation.asp?id=37

[18] EDGAR - The Emissions Database for Global Atmospheric Research – https://edgar.jrc.ec.europa.eu/dataset_ghg60

- Trade data for goods (EU COMEXT data[19], UN Comtrade[20]) and services (using the international trade in services statistics[21] as a starting point)

According to ESA 2010, the submission of supply and use tables by Member States to Eurostat is planned for December every year, with the final reference year submitted being three years before the year of submission. Thus in December of 2020, Member States submitted supply and use tables up to and including the reference year 2017. Accordingly, the current version of the FIGARO tables features real data for a time series between 2010 and 2017 with a product x product and industry x industry classification of 64 x 64. FIGARO tables for 2018 and 2019 data are then now-casted based on available macroeconomic data – output, trade data, value added by industry, final use and taxes less subsidies on products[22]. Since the macroeconomic data are classified only according to 21 industry and product groupings, the input-output tables for these now-casted years are also presented with this lower level of detail. All tables in the dataset are balanced according to a generalized RAS-balancing method (GRAS - Rémond-Tiedrez, I., & Rueda-Cantuche, J. M., 2019).

The second major method used in the compilation of the FIGARO tables is for the 16 major economies and the rest-of-world region that is not covered by the method presented above. Data here are taken from the OECD inter-country input-output tables[23]. These data are produced from the OECD's STructural ANalaysis (STAN) database[24]. STAN is in turn based on OECD member countries' national accounts data, though also include estimates covering gaps in the data. The OECD-ICIO tables only cover a time series from 2005 to 2015. Therefore for the purposes of FIGARO, data for years after 2015 are also now-casted. Documentation of the now-casting of these years is less clear than for the EU27 nations plus the US and the UK above (Rémond-Tiedrez, I., & Rueda-Cantuche, J. M., 2019). Between 2010 and 2017, data for countries covered by the OECD-ICIO in FIGARO are presented with a for 30 product/industry groupings. For 2018 and 2019 they are presented for 17 product/industry groupings. This difference may arise for the same reason as the difference in level of detail for the datasets for the EU27 nations (and the USA and the UK), namely that the macroeconomic data used for the nowcast are on a lower level of detail.

After publication of the initial FIGARO tables in the early summer of 2021, Eurostat intends to update them yearly. The FIGARO project itself is running up until 2023 and aims to develop the current production further, for example with new indicators relevant for global value chain analyses and the compilation of extended supply and use tables.

Other sources of global economic data

World Bank

The World Bank's World Development Indicators database is already used as a data source in the production and updates for EXIOBASE. It includes amongst others data macroeconomic data for 266 countries and regions[25]. The World Bank does not compile the statistics for each country itself, rather collects them from national statistical agencies, central banks as well as other international organisations. Data are presented per calendar year, and updates for the economic data are published about 6 months after the end of the final year for which data are presented in the update[26]. Hence for

[19]Focus on Comext - International trade in goods – Eurostat: https://ec.europa.eu/eurostat/web/international-trade-in-goods/data/
[20] UN Comtrade International Trade Statistics Database: https://comtrade.un.org/

[21] International trade in services statistics - OECD: https://www.oecd.org/sdd/its/international-trade-in-services-statistics.htm

[22] FIGARO methodology May 2021: https://ec.europa.eu/eurostat/documents/51957/12767369/Figaro-methodology.pdf/487255c9-903a-0cb7-f5e2-73f37e35f196?t=1620750704022

[23] OECD Inter-country input-output tables: https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm

[24] STAN STructural ANalysis Database - OECD: https://www.oecd.org/sti/ind/stanstructuralanalysisdatabase.htm

[25] WDI - Home (worldbank.org): https://datatopics.worldbank.org/world-development-indicators/

[26] WDI - Sources and Methods (worldbank.org): https://datatopics.worldbank.org/world-development-indicators/sources-and-methods.html

reference period 2020, the World Bank published economic data on the 1st July 2021[27,28]. Accordingly, new data from this source are therefore available to facilitate the more timely production of statistics. These data are notably more recent that the most recent World Bank data included in the EXIOBASE updates.

IMF

The IMF's World Economic Outlook dataset[29] contains several macroeconomic indicators, and even includes projections beyond the recent past and present some years into the future. The WEO is published twice a year, in April and October[30]. A bottom-up approach is applied for the projection where country teams make country level projections using global assumptions on commodity prices and interest rates which are then aggregated with other country level projections and iterated to achieve consistency between all countries.

Global Air emissions data

Emissions inventories submitted by signatories of the UNFCCC have a lead-time of about 16 months, i.e. Sweden submitted a time series for territorial greenhouse gas emissions ending in 2019 in April of 2021. Therefore this is not a useful source of data for improving timeliness. Further the data is classified according to the UNFCCC's Common Reporting Format that would be need to be reclassified according to the national and environmental accounts perspective to be compatible for input-output modelling. The European Commission's EDGAR database is likewise not sufficiently timely[31]. The IEA's estimates of carbon dioxide emissions from fuel combustion are likewise not sufficiently timely to be of use[32].

One further source of greenhouse gas emissions data for recent time periods is the IMF's Quarterly greenhouse gas air emissions accounts from their dashboard of climate change indicators[33]. The data are produced with a lead time of three months, so that emissions data up to and including 2020 Q4 were made available on their website at the end of March 2021. The dataset is however limited to only 23 countries, all of which in Europe and omits for example Sweden and the Netherlands. Furthermore, data for the latest period in the time series, 2020 Q4 only covers four nations – Norway, the United Kingdom, France and Spain. The data are presented for three separate economic sectors and households. The data themselves are based on extrapolations of SEEA air emissions accounts, and where these are not available on UNFCCC emissions inventories. Quarterly patterns are derived from real value added for industry and on real household consumption for households.

Eurostat publishes air emissions accounts reported by member states in accordance with the SEEA Central Framework and Regulation 691/2011[34]. These data offer the advantage of being produced according to NACE classification. However their publication has a lag time of over 18 months so they are not directly of use for the desired timeliness improvement. Clearly they also provide only partial coverage of the global emissions required for the purposes of MRIO-based calculations.

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[27] Data Updates and Errata – World Bank Data Help Desk: https://datahelpdesk.worldbank.org/knowledgebase/articles/906522-data-updates-and-errata

[28] WDI - Economy (worldbank.org): https://datatopics.worldbank.org/world-development-indicators/themes/economy.html#about-the-data

[29] World Economic Outlook - Frequently Asked Questions (imf.org): https://www.imf.org/external/pubs/ft/weo/faq.htm#q1g

[30] World Economic Outlook (imf.org): https://www.imf.org/en/Publications/WEO

[31] EDGAR - The Emissions Database for Global Atmospheric Research – https://edgar.jrc.ec.europa.eu/dataset_ghg60

[32] CO2 Emissions from Fuel Combustion Highlights - Data product – IEA:
https://www.iea.org/data-and-statistics/data-product/co2-emissions-from-fuel-combustion-highlights

[33] Quarterly greenhouse gas (GHG) air emissions accounts | Climate Change Indicators Dashboard (imf.org):
https://climatedata.imf.org/datasets/543872e1d86c49e3a3bdf38f2b758f92_0/about

[34] Eurostat – Air emissions accounts: https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ac_ainah_r2&lang=en

Balancing methods for input-output tables

The need to balance input-output tables arises because matrices of intermediate use (and thus technical coefficients) established from a variety of sources are not exactly coherent with the macroeconomic data that constitute row and column sums. The survey revealed a number of methods in use for balancing input-output tables.

A central method in the literature is the RAS method. The basic method as exemplified by Trinh and Phong (2013) and the European Commission (2013) involves iteratively adjusting row and column sums respectively to equal the actual row and column sums with sufficient iterations to converge to the actual row and column sums. One desirable feature of this approach is that zero elements in the initial input matrix remain zero in the balanced one. This basic method has been expanded upon in multiple ways to fulfil many methodological purposes, as documented by Lenzen et al. (2009). An example of this is the generalised RAS (GRAS) which facilitates the balancing of a matrix with both positive and negative elements. Another version is the modified RAS (MRAS) which has been developed to handle situations where some elements in the matrix to be determined are fixed from the outset (Lenzen et al., 2009). A further variant, the TRAS has been developed to deal with a situation where a matrix consisting of partially-aggregated elements of the matrix to be determined is known (Lenzen et al., 2009). The compilation of FIGARO data involves the application of a GRAS method (Rémond-Tiedrez, I., & Rueda-Cantuche, J. M., 2019).

Stanger (2014) argues that balancing methods should aim to take into account the different degrees of uncertainty associated with each element of input data. This consideration is taken up by Stadler et al. (2015) in arguing for the constrained optimisation method used for balancing for EXIOBASE 3 instead of a RAS method. The EXIOBASE method uses 11 constraints in total, for example that the product output of the supply table equals the product output of the use table and that final demand for households should equal final demand in the macroeconomic data. Balanced values in the matrix system are derived from initial values by iteration aiming for the minimisation of an objective function dependent on the sum of the square of the differences between the initial and subsequent values of each matrix element.

Proposals for implementation

Single regional input-output tables for Sweden

The survey has shown that there is good availability in the current statistics production at Statistics Sweden to support a now-casting of the environmentally-extended single region input output table for Sweden for the year T-1 year (T is the year of production). The procedure can build upon the following already existing input data for this time period:

- Production value index with over 50 industry groups for the year
- Value added with approx. 30 industry groups (this is benchmarked to the production value index above)
- Final demand for Sweden by type of use
- Air emissions accounts with 32 industry groups
- Bilateral trade data for Sweden (goods and services)

All the data listed above can be used as is currently produced for the proposed now-casting, although reclassification to the industry and product classification and levels of detail will be necessary to match those used in Statistics Sweden's current model for calculating greenhouse gas emissions with a

consumption perspective. The survey showed that data in other areas require the application of more complex procedures. Firstly, Sweden's imports according to the national accounts NACE classification need to be modelled. It is proposed that the imports are now casted for the year T-1 from the equivalent data for the year T-2 and benchmarked to the trade data that is available for the year T-1. Final uses are further only available for the year T-1 without industry classification. Nor are the matrices of intermediate use (for domestic and imported goods) available. It is proposed therefore that for the now-casting initial estimates for the year T-1 are equal to the values for T-2. Arrival at final values for matrices of intermediate use and for final uses with the desired industry classification will be calculated using a balancing procedure making use of the data already produced for production values and total final use (without classification). It is initially proposed to apply a basic RAS balance method and to evaluate the need for more advanced methods based on the outcome of this initial method.

Multi-regional input-output tables for Sweden's imports

In light of the available data and methods, two potential methods for now-casted data for the year T-1 will be considered for multi-regional input-output tables from Sweden going forward.

The first is to use the existing now-casted data in EXIOBASE, version 3.8.1. This is considered viable in light of the fact that EXIOBASE is a comprehensive MRIO, including the necessary environmental extensions, a high degree of product- and industry-wise detail that is based on statistical sources of high quality in the international context and compiled and now-casted with well-documented methods. Recent years also show that it is regularly updated, even if not according to an institutional mandate. Since Statistics Sweden already uses EXIOBASE no extra resources are required to apply this either.

The second proposed method for this part of the analysis is to start from the FIGARO database. FIGARO is interesting to apply for the method because it can claim to use institutional data to a greater extent than EXIOBASE, having it all the way up to 2017 for all data for the EU27, US and UK and up to 2015 for other countries and regions. However, certain data are still lacking. FIGARO is not published with environmental extensions. To which end even if using FIGARO for monetary input output data, EXIOBASE data for greenhouse gas and other emissions may be used initially in light of advantages it has in terms of temporal and geographic coverage compared to say Eurostat's air emissions accounts and in temporal coverage and classification compared to the UNFCCC data. FIGARO further lacks data for T-1, which in the case of production in 2021 is of course reference year 2020. A resource efficient way of handling this is simply to impute greenhouse gas intensities with a consumption perspective calculated using FIGARO for 2020 to the year 2021. This is simple according to the simplified SNAC method used by Statistics Sweden. Notably according to the simplified SNAC method, the environmental impacts arising due to Swedish imports for T-1 would still vary compared to T-2 in light of the change in the absolute value of imports per product group and the change in regional distribution of imports for each product group for Sweden (see Palm et al. 2019 for a more detailed explantion of this). The alternative of now casting the MRIO for T-1 from FIGARO T-2 tables is not ruled out. The now casting of EXIOBASE shows that there are data and methods available to do it. Nevertheless, it is recognised that it is a resource intensive process that is of lower priority at this stage of methodological development at Statistics Sweden compared to others mentioned here.

In moving forward with producing provisional time series for greenhouse gas emissions with a consumption perspective for Sweden, it is further desirable to apply procedures to illustrate the validity of the methods proposed. In particular, it is interesting to apply the proposed now-casting procedures for reference years for which final data is already available, e.g. producing a now cast of data for say reference year 2017 using data from 2016, and comparing the results from the 2017 now casted data with those based on real data for 2017.

Final reflection and questions for the London Group

We are pleased to share the interim results of this project with the London Group and hope that the material presented contributes to knowledge development in national statistical institutes on the production of statistics using multi-regional input-output analysis techniques. This not least in light of the growing policy interest in measures related to environmental pressures arising from imports, in particular the proposed carbon border adjustment in Europe. There is also a need in Sweden for internationally harmonised methods for evaluating and comparing the environmental pressures arising from exported products.

Going forward it is interesting to hear the views of the London group on the work presented, in particular in relation to the following areas:

- Experiences that members have had with using the data and methods referred to, and data and methods that have not been included in the survey
- Reflections on barriers and drivers for the production of statistics on environmental pressures from a consumption perspective in your country
- Relevance on the relevance of statistics on environmental pressures from a consumption perspective for policy makers in respective countries

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