

SUPPORTING INFORMATION FOR:

Aguilar-Hernandez, G.A., Deetman, S., Rodrigues, J.F.D & Tukker, A. (2020.) Global distribution of material inflows to capital formation and its implications for a circularity transition. *Journal of Industrial Ecology.*



This supporting information provides the procedure to import from EXIOBASE v3.3.17, use main.py, to obtain Data\_S1.xls, Data\_S2.xls, Data\_S3.xls, and a comparison between results from EXIOBASE v3.3.17 and other material flow analysis (MFA) studies.



# Procedure

The following presents the procedure to import from EXIOBASE v3.3.17, use ***main.py***, obtain ***Data\_S1.xls***, ***Data\_S2.xls***, ***Data\_S3.xls,*** and creating the global map shown in Figure 2 from ‘Global distribution of material inflows to in-use stocks and its implication for a circularity transition’ paper.

## Import data

The dataset is stored as tab-delimited text file (txt.file) in the folder ***EXIOBASE\_3.3.17\_hsut\_2011***. In order to obtain EXIOBASE v3.3.17 txt.file, the following steps are implemented:

1. From ‘Data Download’ in EXIOBASE website (<http://www.exiobase.eu/>), download ‘EXIOBASE\_3.3.17\_hsut\_2011’
2. From folder ‘EXIOBASE\_3.3.17\_hsut\_2011’, open ‘MR\_HSUT\_2011\_v3\_3\_17\_extensions.xlsb’. This file contains spreadsheets with the accounts of: material inflows to in-use stock additions (‘stock\_add\_act’ and ‘stock\_add\_FD’), and stock additions from transport equipment (‘mach\_use\_waste\_act’ and ‘mach\_use\_waste\_fd’).
3. Copy each spreadsheet in a separate Excel file. Apply:
   1. Delete rows with sector codes leaving only country abbreviation and activity name as headers (usually correspond to rows 3 and 4 of the array).
   2. Save files as tab delimited files (.txt)
   3. Re-name files as follow: ‘stock\_add\_act’ = SA\_ACT ; ‘stock\_add\_FD’ = SA\_FD.txt; ‘mach\_use\_waste\_act’ = TR\_act; and ‘mach\_use\_waste\_fd’ = TR\_FD
4. For population:
   1. Download data from World Bank Statistics (2020) website (<https://data.worldbank.org/indicator/SP.POP.TOTL>)
   2. Copy dataset in Word Bank to EXIOBASE convertor (in ***wb\_to\_exio\_conv.xls***, from Aguilar-Hernandez et al. (2019))
   3. In ‘coverted\_data’ spreadsheed, copy and save array as tab-delimited text file (.txt), and re-name file as: population data = POP.txt
5. Save all files in folder as ***EXIOBASE\_3.3.17\_hsut\_2011***

## Use main.py, Data\_S1.xls, Data\_S2.xls, and Data\_S3.xls

Run ***main.py*** using Python 3.7.6, that retrieves:

1. ***Data\_S1.xls*** is a modified Excel file with all results from by using ***save\_result( )*** function
2. ***Data\_S2.xls*** combines data from ‘sa\_all\_tot’ ***Data\_S1.xls*** and income classification World Bank Statistics (2020). This file was uploaded to Tableau Public version 2019.4 Software (2019)
3. ***Data\_S3.xls*** brings the EXIOBASE classification combined with World Bank groups.

## Use country\_validation.py

Run ***country\_validation.py*** using Python 3.7.6 to retrieve the values of steel composition in Australia, Canada, France, Japan, United Kingdom, and United States, which are used for comparing results with other studies (see Table S2 below).

# Comparison between material inflow to in-use stocks data from EXIOBASE v3.3.17 and previous studies

Table S1 shows a comparison between data from EXIOBASE v3.3.17 and other sources of material flow accounts. This allows to demonstrate that the sum of inflows to in-use stocks in EXIOBASE v3.3.17 extensions is similar to those reported by previous studies.

Table S1. Comparison between material inflows to in-use stocks (or stock additions) of EXIOBASE v3.3.17 and other studies

|  |  |  |  |
| --- | --- | --- | --- |
| Source | EXIOBASE v3.3.17  (Merciai and Schmidt 2018; Schmidt and Merciai 2017)1 | MISO database (Wiedenhofer et al. 2019)2 | Haas et al. (2015) |
| Year reference | 2011 | 2011 | 2005 |
| Global stock additions (Gigatonnes) | 29.4 | 29.8 | 26.0 |

1 Value retrieved from Data\_S1

2 Value was calculated from data in supplementary material of Wiedenhofer et al. (2019)

Table S2 presents a comparison between the sectoral distribution of steel stock additions of 6 selected countries from EXIOBASE v3.3.17 and Muller et al. (2011). The values from EXIOBASE v3.3.17 for Australia, Canada, France, Japan, United Kingdom and United States are calculated by using the ***country\_validation.py*** function (see section 1.3.). The shares of steel stock additions in construction and transport sectors are significantly different between the two datasets, which requires further research on the application of multi-regional hybrid-units input-output tables (MT-HIOT) as explained in section 3.3, and further research in section 4.2 of the main text.

Table S2. Comparison between the shares of steel stock additions in construction and transport sectors from EXIOBASE v3.3.17 and Muller et al. (2011)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Source | EXIOBASE v3.3.17  (Merciai and Schmidt 2018; Schmidt and Merciai 2017)1 | | Muller et al. (2011)1 | |
| Year reference | 2011 | | 2005 | |
| Sector | Construction (%) | Transport (%) | Construction (%) | Transport (%) |
| Country: |  |  |  |  |
| Australia | 13 | 13 | 50 | 30 |
| Canada | 23 | 12 | 45 | 25 |
| France | 24 | 12 | 25 | 35 |
| Japan | 29 | 10 | 45 | 30 |
| United Kingdom | 5 | 14 | 33 | 27 |
| United States | 14 | 11 | 36 | 32 |

1 Values retrieved from *country\_validation.py*

2 Values were extracted from the graphs in supplementary material of Muller et al. (2011)

# References

Aguilar-Hernandez, G.A., C.P. Sigüenza-Sanchez, F. Donati, S. Merciai, J. Schmidt, J.F.D. Rodrigues, and A. Tukker. 2019. The circularity gap of nations: A multiregional analysis of waste generation, recovery, and stock depletion in 2011. *Resources, Conservation and Recycling* 151: 104452.

Haas, W., F. Krausmann, D. Wiedenhofer, and M. Heinz. 2015. How circular is the global economy?: An assessment of material flows, waste production, and recycling in the European union and the world in 2005. *Journal of Industrial Ecology* 19(5): 765–777.

Merciai, S. and J. Schmidt. 2018. Methodology for the Construction of Global Multi-Regional Hybrid Supply and Use Tables for the EXIOBASE v3 Database. *Journal of Industrial Ecology* 00(0): 1–16.

Müller, D.B., T. Wang, and B. Duval. 2011. Patterns of iron use in societal evolution. *Environmental Science and Technology* 45(1): 182–188.

Schmidt, J. and S. Merciai. 2017. *Physical/hybrid supply and use tables – methodological report. DESIRE deliverable*. http://fp7desire.eu/documents/category/3-public-deliverables.

Tableau. 2019. Tableau Public 2019.4. https://public.tableau.com/en-us/s/.

Wiedenhofer, D., T. Fishman, C. Lauk, W. Haas, and F. Krausmann. 2019. Integrating Material Stock Dynamics Into Economy-Wide Material Flow Accounting : Concepts , Modelling , and Global Application for 1900 – 2050. *Ecological Economics* 156: 121–133.

World-Bank. 2020. World Bank Open Data.