# Mapping Aluminium Trade in Three Dimensions: Challenges

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# Overview

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# Introduction

- **Objective**: Mapping aluminium content of trade considering three dimensions:
  - Linkages to other material cycles
  - Time
  - Stages

- Focus on specific **challenges/particularities** when working with trade data using aluminium and three different fields of application as examples:
  1. **Schoer et al. 2013:** Eurostat Guide to Compilation of EW-MFA data, linked to
  2. **Schoer, Dittrich, Weinzettel, et al 2017:** Eurostat documentation on estimation of raw material equivalents of EU imports
  3. **Liu & Müller:** Trade-Linked Multi-Level MFA

# Aluminium in Trade Classifications I

## Extraction and first proccessing

| HS 2017 (Comtrade) | SITC Rev. 1 | CN 8 (Comext) |
|---|---|---|
| **HS-2606** Aluminium ores and concentrates<br><br>**HS-281810** Aluminium oxide; artificial corundum<br><br>**HS-28120** Aluminium oxide; other than artificial corundum<br><br>**HS-28230** Aluminium hydroxide | **S1-2833** Bauxite and concentrates of aluminium<br><br>**S1-51365** Aluminium oxide and hydroxide | **CN-2606** Aluminium ores and concentrates<br><br>**CN-28182** Aluminium oxide (excl. Artificial corundum)<br><br>**CN-281830** Aluminium hydroxide |

- Aluminium content of traded ores is unknown
- Coupled metal ores unknown (in case of Al: Ga, V)

# Aluminium in Trade Classifications II

## Intermediate and final products

| HS 2017 (Comtrade) | SITC Rev. 1 | CN 8 (Comext) |
|---|---|---|
| **HS Chapter 76**: 35 categories for products of Aluminium<br><br>e.g. powders and flakes (non-lamellar/lamellar), bars, rods and profiles (not alloyed, alloyed, hollow, other) , wire (exceeding 7mm, other), foil (backed/not backe, rolled, other), tubes, pipes, household articles, reservoirs etc. | **6841** Aluminium and aluminium alloys, unwrought<br>**6842** Aluminium and aluminium alloys, worked<br>**68421** Bars,rods,angles,shapes and wire of aluminium<br>**68422** Plates,sheets and strip of aluminium<br>**68423** Aluminium foil<br>**68424** Aluminium powders and flakes<br>**68425** Tubes,pipes & blanks,hollow bars of aluminium<br>**68426** Tube and pipe fittings of aluminium<br>**69213** Tanks,etc.for storage or manuf.use of aluminium<br>**69222** Casks,drums,etc.used for transport of aluminium<br>**69313** Wire,cables,ropes etc.not insulated,aluminium<br>**69343** Expanded metal of aluminium<br>**69723** Domestic utensils of aluminium<br>**69895** Articles of aluminium,n.e.s. | **CN Chapter 76:** appr. 100 categories for products of Aluminium<br><br>e.g. foil ((not) backed/(not) rolled/(not) further worked/thickness less than 0,2 mm/more than 0,021 mm/less than 0,021 mm/self adhesive/stamping foils/weight of foils/ excl. Christmas tree decorating material) |

- Aluminium content of products is unknown

# Aluminium in Trade Classifications III

## End of life: waste and scrap

| HS 2017 (Comtrade) | SITC Rev. 1 | CN 8 (Comext) |
|---|---|---|
| **H4-7602** Aluminium waste and scrap<br><br>**H4-262040** Slag, ash and residues containing mainly aluminium | **S1-28404** Aluminum waste and scrap | **76020011** Turnings, shavings, chips, milling waste etc. of aluminium; waste of coloured or bonded sheets...<br><br>**76020019** Waste of Aluminium, incl. faulty workpieces<br><br>**76020090** Scrap of Aluminium<br><br>**26204000** Slag, ash and residues containing mainly Aluminium |

- No distinction of primary and EOL scrap
- No distinction of further metals/materials in waste
- No consideration of waste with a value of zero

# Aluminium in Trade Classifications IV

## Time dimension

| HS 2017 (Comtrade) | SITC Rev. 1 | CN 8 (Comext) |
|---|---|---|
| Update of the classification every 5 years | Data available since 1962, current version: SITC Rev. 4 | Annual update of the classification |

- For longer time series, outdated classifications (e.g. SITC Rev. 1) with less detail have to be used to ensure consistency
- New codes are added with each update of the classification, other codes are deleted: if data is converted to other formats, conversion keys have to be updated annually/every five years

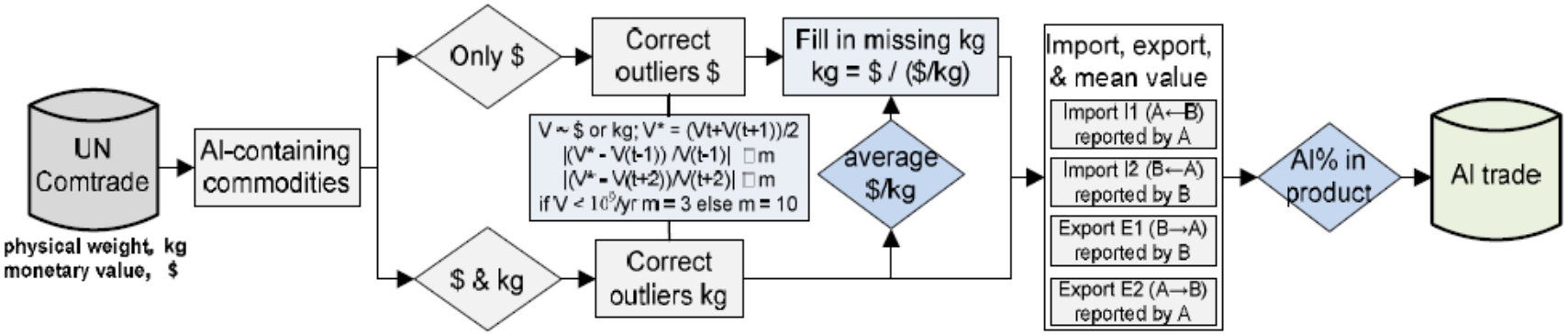
# Further challenges of working with trade data

- Missing physical and/or monetary values
- Asymmetries between imports and exports of partner countries
- Price adjustments can be necessary to account for different price reporting (CIF vs. FOB prices)
- Confidential values

# Dealing with unsufficient trade data

## Liu & Müller 2013

- Use of Comtrade SITC Rev. 1 data to ensure consistency over time
- Use of monetary and physical values and average prices to estimate missing values
- Mean value if import and export of partner countries differ




## Schoer, Dittrich, Weinzettel et al. 2017

- Use of Comext CN8 trade data (EU-intra and extra trade), converted to NACE Rev. 2 (182 industries); conversion key updated annually by SSG/ifeu on behalf of EUROSTAT
- Price correction approach (CIF/FOB) using physical trade relations including correction of outliers
- (For checking) Comparison with other data sources (Prodcom, USGS, SBS)
- All in all: high data quality for the EU

# Estimating the metal content of traded bauxite

**Table S4.** Bauxite ore grade of different countries and the world average.

| Countries | Bauxite ore grade | Countries | Bauxite ore grade |
|---|---|---|---|
| Australia | 0.42 | Bosnia and Herzegovina | 0.50 |
| Brazil | 0.46 | Montenegro | 0.57 |
| China | 0.54 | Iran | 0.47 |
| Domin. Republic | 0.44 | Hungary | 0.50 |
| Ghana | 0.50 | Azerbaijan | 0.44 |
| Greece | 0.53 | Russia | 0.42 |
| Guinea | 0.49 | Kazakhstan | 0.42 |
| Guyana | 0.50 | Crotia | 0.49 |
| India | 0.47 | France | 0.47 |

## Liu & Müller 2013

- literature review of bauxite ore grades of different countries

## Schoer et al. 2012 – MFA-guide 2013

- Use price for metal content calculation
- Use of conversion factors to estimate gross ore based on 160 mining reports *if national data* is not available
- for coupled ores, identification of the main metal and allocation of gross ore to coupled ores using value as criterion

| | Gross ore / metal content | Gross ore / concentrate |
|---|---|---|
| A.2.1 Iron | 43.32 | 81.93 |
| A.2.2.1 Copper | 1.04 | 3.33 |
| A.2.2.2 Nickel | 1.83 | 23.45 |
| A.2.2.3 Lead | 11.86 | 16.52 |
| A.2.2.4 Zinc | 8.34 | 14.50 |
| A.2.2.5 Tin | 0.24 | 0.33 |
| A.2.2.6.1 Gold | 0.00021 | 0.06630 |
| A.2.2.7 Aluminium | 18.98 | 67.55 |

# Allocating Aluminium to final products

## Liu & Müller 2013

- Estimation of the aluminium content of 126 SITC Rev. 1 final products based on extensive literature research

| Use categories | SITC1 | Commodity name | Al% | Uncertainty |
|---|---|---|---|---|
| Building & Construction (B&C) | S1-6912 | Fin, structural parts & structures of aluminum | 90.0% | low |
| | S1-72505 | Electric space heating equipment etc. | 3.0% | high |
| | S1-8121 | Central heating apparatus and parts | 2.0% | high |
| | S1-81242 | Lamps & lighting fittings & parts thereof | 2.0% | high |
| | S1-7115 | Internal combustion engines, not for aircraft | 25.0% | high |
| | S1-7294 | Automotive electrical equipment | 5.0% | high |
| | S1-7321 | Passenger motor cars, other than buses | 5.1% * | low |
| | S1-7326 | Chassis with engs. Mntd. For vehicles of 732.1 | 1.0% | high |
| | S1-7328 | Bodies & parts motor vehicles ex motorcycles | 10.0% | high |
| | S1-7114 | Aircraft incl. jet propulsion engines | 3.0% | medium |
| | S1-7341 | Aircraft, heavier than air | 70.0% | medium |
| | S1-73491 | Airships & balloons | 50.0% | high |
| | S1-73492 | Parts of aircraft,airships,etc. | 70.0% | medium |
| | S1-7113 | Steam engines and steam turbines | 2.0% | high |
| | S1-7311 | Railway locomotives steam and tenders | 1.0% | medium |
| | S1-7312 | Electric railway locomotives, not self generat. | 1.0% | medium |

# Allocating Aluminium to final products

## Schoer, Dittrich, Weinzettel, et al. 2017

- Domestic extraction and imports of Aluminium according to EW-MFA data are allocated to 182 industries based on monetary interlinkages according to detailed input-output tables (based on National Accounts)
- Imports according to Comext are assumed to be produced with the same amount of raw materials as domestic products with adjustments for recycled content and the energy mix
- >> results industry specific (assumption of homogeneous products), no disaggregation to product level

| Eurostat, Raw Material Consumption Bauxite and other aluminium in the EU, 2013 (in 1000 t) | | |
|---|---|---|
| | | |
| CPA08/INDIC_ENV | Raw material consumption | RMC of Households |
| Total CPA products | 49.222,66 | 26.459,524 |
| Fabricated metal products, except machinery and equipment | 1.564,671 | 370,47 |
| Computer, electronic and optical products | 2.136,24 | 971,542 |
| Electrical equipment | 2.199,535 | 1.198,819 |
| Machinery and equipment n.e.c. | 2.651,967 | 102,927 |
| Motor vehicles, trailers and semi-trailers | 4.068,178 | 2.668,524 |
| Other transport equipment | 692,402 | 68,213 |
| Furniture and other manufactured goods | 2.145,285 | 1.469,784 |
| Repair and installation services of machinery and equipment | 860,103 | 44,391 |
| Electricity, gas, steam and air conditioning | 706,266 | 709,61 |

# Estimating the recycled content of Aluminium

## Schoer, Dittrich et al. 2017

- Use of USGS data on primary and secondary Aluminium production
- Estimation of the share of secondary to total production of Aluminium for major producing countries vs. EU countries to estimate differences in recycled content for correcting exports and imports:

| | 2012 | 2013 | 2014 |
|---|---|---|---|
| Finland | 1,00 | 1,00 | 1,00 |
| France | 0,35 | 0,34 | 0,34 |
| Germany | 0,61 | 0,55 | 0,55 |
| Greece | 0,00 | 0,00 | 0,00 |
| Hungary | 1,00 | 1,00 | 1,00 |
| Ireland | NA | NA | NA |
| Italy | 0,90 | 1,00 | 1,00 |
| Spain | 0,37 | 0,00 | 0,00 |
| Sweden | 0,19 | 0,19 | 0,19 |
| United Kingdom | 0,83 | 0,88 | 0,88 |
| EU28 | 0,58 | 0,58 | 0,58 |

## Liu & Müller 2013

- Use of USGS data on primary production, use of other data sources for secondary production
- Yield ratios & losses along the life cycle estimated using transfer coefficients from industry statistics/estimates
- Scrap generation rates by product category estimated using the GARC model

# Conclusion and recommendation

„Ideal“:

- No outliers, no missing information
- information on primary and secondary metal(s) content in each of the statistic categories
- for some products, more differentiation needed (electric cars vs. conventional cars, ore grades)

How to move forward with the existing data?

- develop common guidelines on how to cope with data gaps
- create lists of materials for traded products