Consumption and production indexes: options for contextualising EU GHG emissions data

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Should European consumption patterns change to reduce our greenhouse gas footprint? Reasons against it include potential negative impacts on consumer utility, employment and enterprise profitability in the affected sectors. Without the right price signals, it is also not entirely clear which products and services should be reconsidered by the final consumer. For example, Glass for Europe (2015) suggests that using glass for double glazing purposes creates GHG emission in the supply chain, but can lead to net overall improvements if the reduced emissions from indoor space heating are also considered. In theory, no climate-related changes in consumption patterns would be required if overall fuel use and chemical processes from production are "de-carbonised" enough to meet the EU's 80% GHG reduction target by 2050. But the potential damage from climate change and the stringency of the mitigation target are likely to require a combination of approaches by product suppliers and end users alike.

International conventions including the Paris Climate Agreement allocate national responsibilities on basis of territorial rather than consumption based emissions. National climate policies follow the same approach. In the absence of a unified international reporting system, there is considerable uncertainty around consumption based GHG accounting, especially when results are broken down by sector rather than by country, see van der Voet et al (2014). The uncertainty is caused by difficulties in matching sectoral classifications and emissions data for traded goods across countries, by fluctuating exchange rates, by complexities around intermediate good inputs in supply chains and by double counting of "upstream" emissions, e.g. fuel extraction and electricity generation. It is nevertheless important to improve our understanding of the link between consumption and emissions. According to recent research, despite a decline in EU's territorial, or production based, emissions between 1990 and 2010, total emissions, including those embodied in net imports, have actually increased, see Scott et al (2015).

Ongoing efforts to enhance consumption based statistics include the UK Government's publication of annual carbon footprint statistics first initiated in 2012 (see DEFRA 2012) and the European research project Carbon Cap[2]. Both initiatives rely on data intensive Multi-Region Input-Output models, with the more detailed databases only capable of providing snapshots in time. There is no official time-series of consumption-based GHG emissions for Europe that is broken down by detailed sectoral classification. While an acceptably robust worldwide database of emissions embodied in traded goods and services is being developed, it would be possible to produce less demanding statistics by placing EU's territorial GHG emissions in the context of production and consumption trends, disaggregated by sector. What follows is an illustration of the types of insights such contextualisation can provide.

Approach

The focus is on the top ten most GHG-intensive sectors covered by the EU Emissions Trading System (EU ETS) in the old Member States (EU15)[3]: the manufacturing of basic iron and steel and ferro-alloys, cement, two groups of basic inorganic chemicals, paper and paperboard, lime and plaster, hollow

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[2] http://www.carboncap.eu/

[3] The analysis is restricted to the EU15 in order to avoid "convergence" effects that were documented in relation to the new Member States joining the EU. Decreased energy intensity of production was observed in these Member States, see EEA (2012).

glass, sugar, bricks and tiles and flat glass. The EU ETS coverage allows some extent of GHG emissions data collection for a relatively disaggregated product classification, corresponding to level four of the European statistical classification NACE. As NACE was revised in 2006, the analysis covers the years between 2006 and 2012. Only direct emissions coming from burning fuel and chemical reactions within production facilities were included[4]. The trends in emissions data were recorded by using an index to compare changes to 2006 levels.

To place the GHG data in the context of material throughput, indexes of consumed product quantities, measured in kilograms or number of units were developed. These fall into the same NACE4 categories as the emissions data and were derived on basis of production, import and export statistics extracted from the Europroms database[i]. Here $"Apparent\ Consumption" = Production + Imports - Exports$.

Published data is far from perfect even for this simplified approach, see “Limitations” below. However, with triangulation, some interesting trends can be discerned even at the current stage of data readiness.

Illustration of emerging patterns

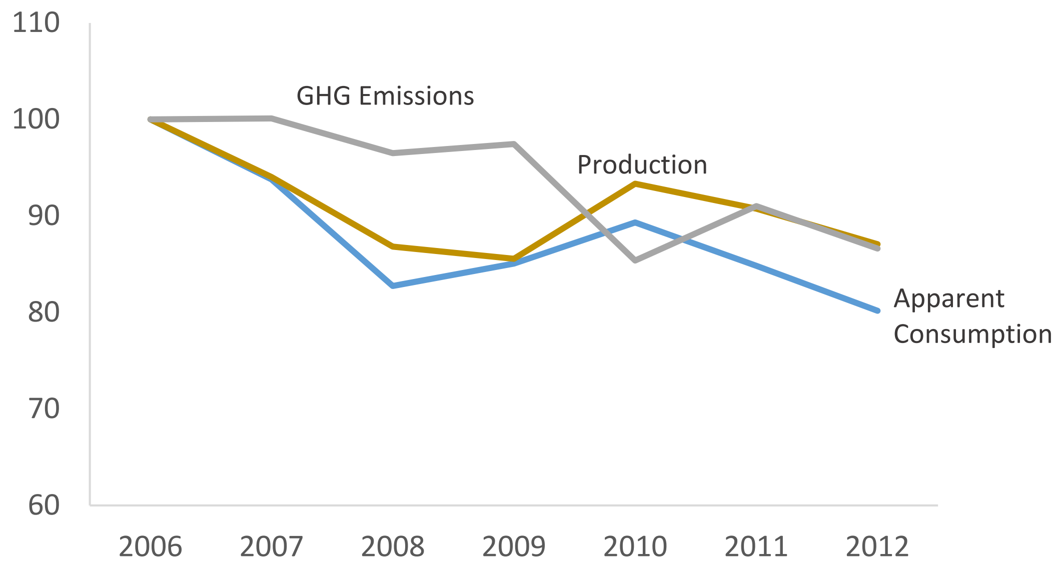
1. During 2006-2012 no distinctive structural shifts away from the product groups considered are observed except for graphic paper. This is in line with expectations for such as short time frame. However, some of the decreases in emissions recorded by the EU ETS may be short-lived and reversals are already observed as the economic recession is overcome[5], see Annex A.

[4] Indirect emissions from the use of electricity were not included as these are more easily targeted by adjacent policies such as the Renewable Energy target.

[5] The effect of the economic recession on EU’s GHG emissions are shown in the EEA (2012) decomposition analysis.

2. The consumption of graphic paper is decreasing[6], possibly due to the digitisation of information sharing, see Figure 1 below (the chart also covers other types of paper and paperboard due to industrial aggregation of data). This type of decline in emissions, production and consumption is likely to be sustained in the long term.

Figure 1. Paper and Paper Board: EU15 index of production and "apparent consumption" quantities, index of GHG emissions, 2006 base = 100



Sources: Production and "apparent consumption" calculated on basis of Production, Import and Export data from Europroms.

Emissions data from EC (2014).

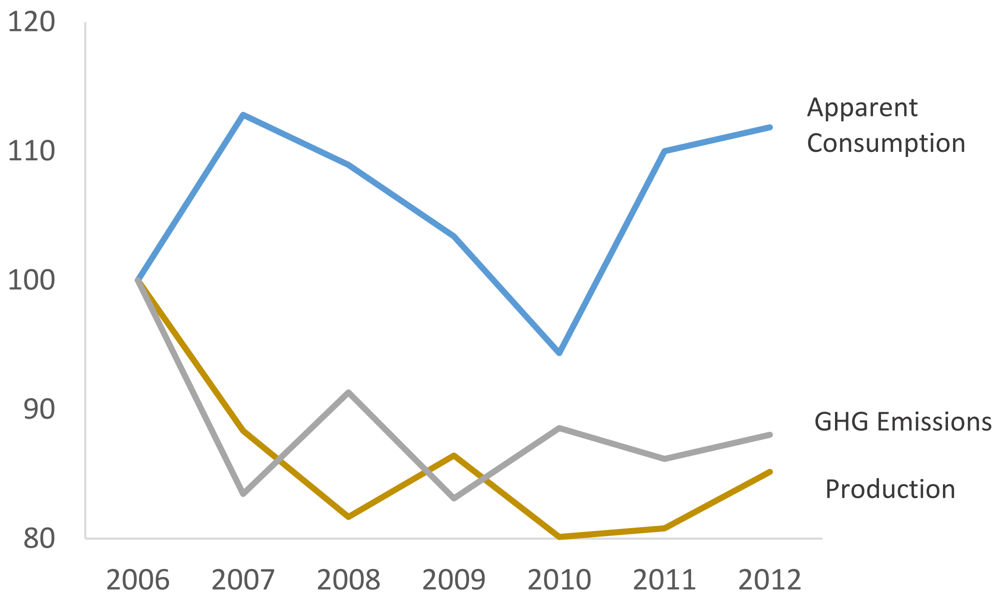
Notes: EU ETS coverage is not full. The emissions index only represents the trend for the installations where the statistical NACE4 category is reported. For paper and paperboard the total number of installations diverges from that reported in the Eurostat enterprise number statistics[ii].

The indexes in the chart above represent percentage point changes compared to a baseline level of 100. Where absolute baseline levels are low, apparently large percentage point changes can be associated with relatively small changes in total quantities. To see changes in total quantities, see Annexes A and B.

[6] See discussion on structural decline of graphic paper industry in http://www.cepi.org/node/17972

3. The production of sugar in the EU15 is decreasing and so are associated emissions. Consumption levels are however increasing, supplied in part by rising import levels allowed by the changing sugar import quota regulations, see EC (2014). It is not clear whether under a consumption-based GHG accounting method, emissions from the use of sugar would also be decreasing.

Figure 2. Sugar: EU15 index of production and "apparent consumption" quantities, index of GHG emissions, 2006 base = 100



Sources: Production and "apparent consumption" calculated on basis of Production, Import and Export data extracted from Europroms.

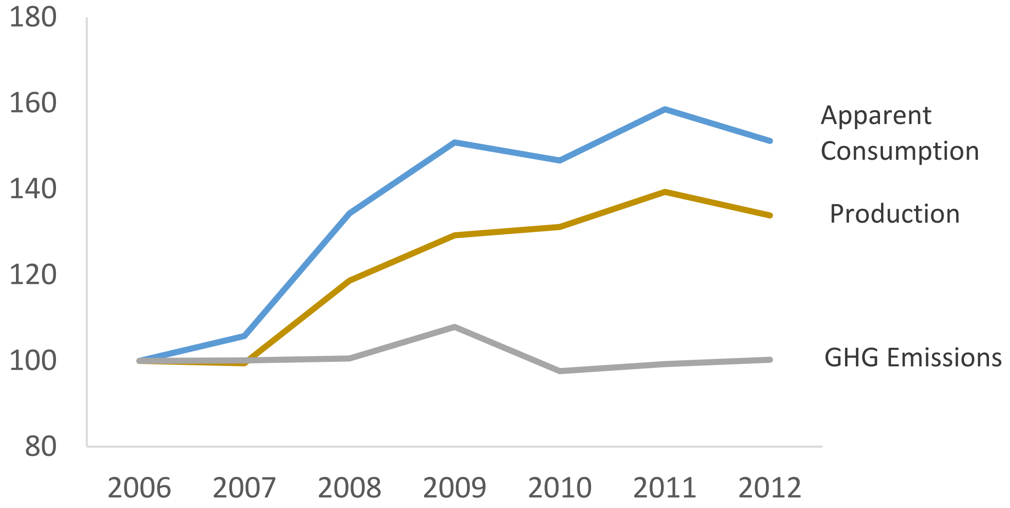
Emissions data from EC (2014).

Notes: The total number of installations covered by the EU ETS matches closely Eurostat enterprise number statistics, Eurostat (2016) and EU ETS emissions from the sector are well represented by the index above.

The indexes in the chart above represent percentage point changes compared to a baseline level of 100. Where absolute baseline levels are low, apparently large percentage point changes can be associated with relatively small changes in total quantities. To see changes in total quantities, see Annexes A and B.

4. Hollow glass consumption rates have increased considerably; this increase is primarily met through growing domestic production. Despite the rise in the number of glass containers manufactured, emissions from the sector are relatively stable. This is due to energy efficiency improvements and increased recycling rates see FEVE (2015) likely caused by the implementation of the Landfill Directive.

Figure 3. Hollow glass: EU15 quantity index of production "apparent consumption" and GHG emissions



Sources: Production and "apparent consumption" calculated on basis of Production, Import and Export data extracted from Europroms

Emissions data from the EC (2014).

Notes: EU ETS coverage of the hollow glass subsector is not full; enterprise numbers diverge with the Eurostat enterprise number statisticsii, but the pattern of the emissions index follows that for glass installations covered by the EU ETS and reported by the EEA[iii].

The indexes in the chart above represent percentage point changes compared to a baseline level of 100. Where absolute baseline levels are low, apparently large percentage point changes can be associated with relatively small changes in total quantities. To see changes in total quantities, see Annexes A and B.

Limitations

Limitations to the accuracy of the illustrations above include:

1. Estimating "Apparent Consumption" on basis of Production + Imports – Exports statistics is limited by the fact that inventory quantities are reported. This can lead to sharp fluctuations or negative consumption figures,[iv] the latter has not occurred for the EU15 aggregation used here.
2. Aggregation at NACE4 level was required in order to allow the matching of EU ETS GHG data to production and consumption statistics. However, this level of aggregation can mask conflicting trends and hides information at more detailed sectoral level for some categories. For example, the

NACE4 category “Other inorganic chemicals (2013)” includes 72 products ranging from chlorine to hydrogen peroxide to silver nitrate, all with varying emission and trade intensities.

3. Incomplete product classification data of EU ETS installations due to incidence of multiple goods being produced within the same facility leads to some sectors being covered only partially.
4. Production data does not fully match emissions data as not all installations in a product category are necessarily covered by the EU ETS. Enterprise number statistics can be inaccurate.[7] This makes it difficult to assess whether results are representative.

Conclusions

A Multi-Regional Input-Output database is essential for understanding the complexities of all the factors affecting embodied GHG emissions in European consumption, but is highly data intensive. A considerably simpler method of assessing whether a sector’s emissions fluctuations are in line with production and consumption trends can provide useful insights into the GHG intensity of production as well as demand and trade contexts of the respective sector. Such insights would help inform the general public and would support the evidence base for the design and evaluation of policies that target both sustainable production and consumption. To be viable across a wide range of products, this simplified approach would require improved granularity of GHG emissions data by sector, preferably at PRODCOM8 level.

[7] For example, the British Glass Manufacturers’ Confederation points out that Eurostat’s NACE4 category for flat glass shows more than 1000 enterprises instead of the 5 known in the UK; this is likely to be linked to glaziers registering in the wrong NACE category http://www.etg.uk.com/documentationmore.asp?subcat=651&category=427.

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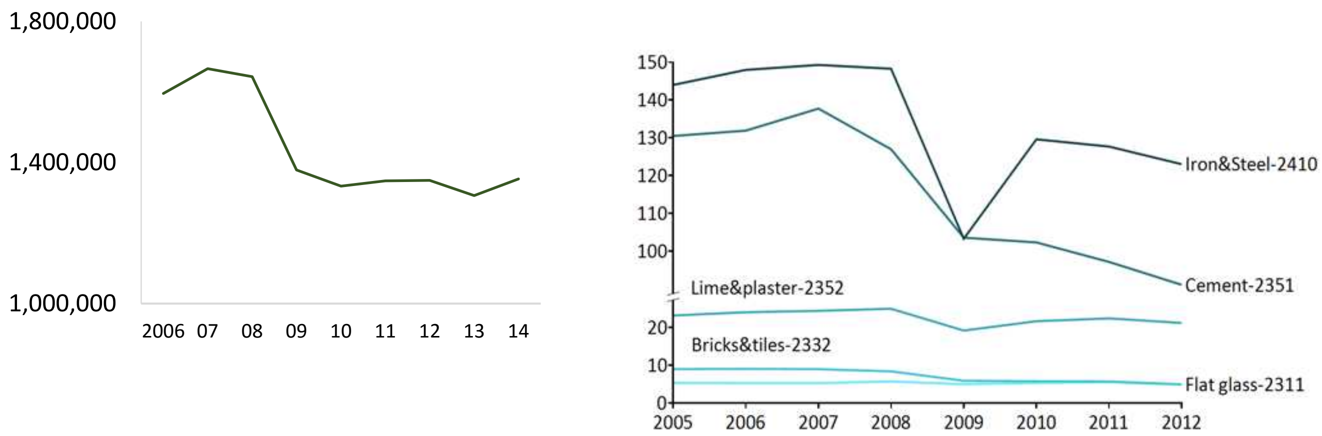
Annex A. Detailed illustrations for GHG intensive sectors supplying to the construction sector

Iron & steel, cement, lime, bricks and tiles & flat glass all supply the construction sector exclusively or in part.

No significant changes in imports as a proportion of total apparent consumption is observed for these sectors at the NACE4 level of aggregation, with the exception of the more complex iron and steel sector, see Figure A-2 below[1].

The fluctuations in emissions from these sectors follow in large those observed in the turnover of construction sector, affected significantly by the recession. Whereas the NACE4 EU ETS data published by the EC stops in 2012, additional data with a different sectoral classification from the EEA suggests that GHG emissions from ETS installations producing lime, cement clinker and ceramics have gone up between 2012 and 2014[2], in line with the resurgent demand for construction sector.

Figure A – 1. EU15 Construction Turnover on the left, in € million. On the right, EU 15 GHG emissions from EU ETS installations with NACE4 sector attribution, in million tonnes $CO2_e$.



Sources: Turnover statistics from Eurostat (2016).
Emissions data from EC 2014.

Notes: Four digit numbers following sector name represent NACE4 code.

[1] For iron and steel the rate of variability is so high, that the time period captured is insufficient for trend assessment.

[2] See http://www.eea.europa.eu/data-and-maps/data/data-viewers/emissions-trading-viewer

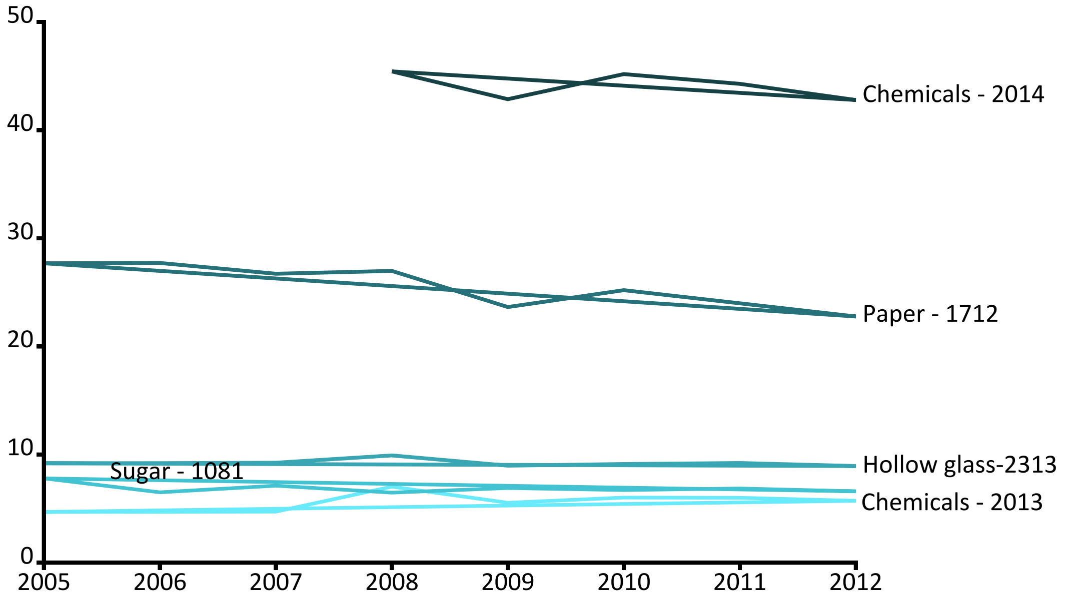
Figure A – 2. EU 15 Apparent Consumption and Imports of selected GHG intensive goods supplying to the construction sector

Source: Derived on basis production, exports and imports data from Europroms (2016)

Notes: Four digit numbers following sector name represent NACE4 code.

Annex B. Detailed illustrations for miscellaneous GHG intensive sectors

Figure B – 1. EU 15 GHG emissions from EU ETS installations with NACE4 sector attribution, in million tonnes $CO2_e$.



Sources: Emissions data from the European Commission EC (2014).

Notes: Four digit numbers following sector name represent NACE4 code.

The treatment of Other Inorganic Chemicals NACE category 2014 under the EU ETS was changed in 2008 when a number of installations were opted in by selected Member States.

Figure B – 2. EU 15 Apparent Consumption and Imports of selected goods

Source: Derived on basis production, exports and imports data from Europroms (2016).

Notes: Four digit numbers following sector name represent NACE4 code.

Trends in the chemical sectors 2013 and 2014 were not analysed in detail due to the complexity related to numerous products covered by these sectors. A more detailed classification of emissions data that is currently not available would be required for a meaningful analysis.