Consumption-based emissions and global decarbonization in 2020

Summary of the abstract

Based on the World Energy Outlook New Policies and 450ppm scenarios the paper investigates the past and future development of EU28's consumption based emissions. To this end two models need to be combined, a dynamic macro-econometric system of national input-output models with a detailed representation of the energy industry linked via bilateral trade and a multi-regional input-output accounting system. The former model is used for projecting the economic development, associated energy use and emissions of about 60 countries for the two scenarios. The latter model is used to combine input-output data with bilateral trade data in such a way that it is possible to allocate territorial emissions along global production chains to final consumption. After an increase until the late 2000's, EU28 consumption-based emissions are expected to decrease over the next decades; more so if countries outside the EU decrease their emissions as well (450ppm versus New Policies scenario).

Abstract

Based on the World Energy Outlook (WEO 2013) New Policies and 450ppm scenarios the paper investigates the past and future development of EU28's consumption based emissions. To this end two models need to be combined, a dynamic macro-econometric system of national input-output models with a detailed representation of the energy industry linked via bilateral trade and a multi-regional input-output accounting system.

In recent years several multi-regional input-output (MRIO) databases have been published that allow a reallocation of territorial emissions along global production chains to final consumers (EORA Lenzen et al., 2013; EXIOBASE Tukker et al., 2013; GRAM Wiebe et al., 2012; GTAP e.g. Peters et al., 2011; OECD-ICIO Nakano et al., 2009; and WIOD Timmer et al., 2012). However, these databases only cover the past years and do not (yet) include estimations of the future development of consumption-based emissions. This is due to the complexity and data intensity of the systems, which include several million data points.

A decomposition analysis of past consumption-based emissions shows, that the main factors influencing consumption-based emissions are the development of final demand and emission intensities, while changes in the production structure do not seem to have a significant impact. This however can also be explained by the fact that production structures do not change quickly. In contrast, trade structures can change quickly and have a significant impact on the allocation of consumption-based emissions around the globe. Therefore, when projecting consumption-based emissions special attention is paid to projecting final demand, emission intensities and trade structures, while the production structure (in real terms) is assumed to remain constant. One exception are energy inputs into production processes that change depending on energy mix, which is crucial for the determination of the emission intensity.

The approach followed in this paper is to project economic development (final demand and production) on the industry level using country-specific dynamic input-output models (based on

data from OECD IOT, 2013) for about 60 countries. These models are linked via bilateral trade (based on data from OECD BTDIxE, 2013), with future trade relations being determined based on time trends and relative prices. The energy industry is represented by detailed energy balances (IEA, 2012a,b,c) and emissions are calculated from energy use using constant emission factors. This projects the entire database that is used to construct a MRIO system for the past into the future, thus enabling us to fill in the data points in the MRIO system for the year 2020.

After an increase until the late 2000's, EU28 consumption-based emissions are expected to decrease over the next decades. While in the New Policies scenario the decrease is mainly due to decreasing territorial emissions in the EU28, in the 450ppm scenario, embedded emissions in imports also decrease. The increase in consumption-based emissions over the past years can be attributed to large increase in final demand, especially in the new member countries. However, the impact of the increasing final demand can almost be offset by decreasing emission intensities along global production chains. For the coming decade even stronger improvements in emission intensity are expected, so that the only slightly increase in final demand can be more than offset by the decreasing emission intensity.

The final demand for goods and services from the textiles, construction and motor vehicles industry have the highest absolute amount of carbon embedded in imports, followed by food products, beverages and tobacco and machinery & equipment (ranking according to results in 2010, the same industries are ranked among the top 5 in the other years as well). The consumption-based emissions can be traced back along the production-chains to identify in which countries and industries emissions occur. One major finding for 2010 for example is that more than 50% of carbon emissions embedded in EU28 final demand emitted in China can be traced back to the Chinese electricity industry. Looking at Chinese emissions embedded in European consumption from the perspective of the final demand industries, we find that the European final demand for goods and services from six industries (Textiles, textile products, leather and footwear, Machinery & equipment, Office, accounting & computing machinery, Manufacturing nec; recycling (include Furniture), Construction, Motor vehicles, trailers & semi-trailers) induce 50% of carbon emissions embedded in EU28 final demand emitted in China. Generally, the electricity industry is a major emitter along production chains for all products, but for construction, food products etc., coke and petroleum products as well as chemicals, the share of emissions associated with electricity generation along global production chains in total embedded emissions is smaller.

Regarding the projected future development, the differences in mitigation efforts between the EU countries and the non-EU countries in the NPS and 450ppm scenario have some impact on the share of emissions embedded in imports in total emissions embedded in EU final demand: in the NPS, territorial emissions are projected to account for 61% of embedded emissions. In the 450ppm scenario this share is one percentage point higher (62%). One general conclusion is that the overall decrease of about -10% in the NPS in consumption-based emissions is only due to decreasing emissions within the EU, while in the 450ppm scenario, imported embedded emissions decrease as well, resulting in an additional decrease of EU consumption-based emissions of -5%.

Emissions embedded in imports are about one thirds of total emissions embedded in EU final demand in 2010. This share is expected to further grow until 2020. Thus, mitigation efforts outside the EU have a significant impact on total emissions embedded in European final consumption.

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