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Innovative climate policy instruments to reduce consumption based emissions

Consumption-Based Emissions of Austria

Conventional greenhouse gas emission inventories record emissions released by the agents (e.g. industries or residents) within the geographical borders of a nation. This territorial emission accounting framework, known as Production-Based Accounting (PBA), is used by the UNFCCC. Studying emissions from a consumption-based accounting (CBA) perspective, also commonly referred to as Carbon Footprints (CF), provides a complementary perspective to PBA. Emission inventories using CBA record emissions induced by residents' consumption irrespective of where in the world those induced emissions take place. Since production and consumption occur very often in different geographical regions, these two distinct emission accounting frameworks tend to show different pictures on the amount of emission allocated to a nation.

Regarding CBA emissions, one could for example think of the emissions generated in the production of a car imported from China. But emissions might not only occur in China but throughout the supply chain, such as in countries exporting inputs to China. In case of CBA, all the emissions occurring along the production chain are attributed to the final consumer of the car.

In this summary, we explore consumption-based emissions for Austria by using a global model[i] which connects consumers in Austria and producers around the world, who use different technologies and a different energy mix in the production process. We explore Austria's emission from a CBA perspective for the following years: 1997, 2001, 2004, 2007 and 2011.

Before referring to CBA emissions, we briefly review Austria's territorial or PBA emissions. Territorial emissions have peaked in 2004/2005 and declined afterwards to stabilize at about 80 million tonnes of CO_2-equivalent (CO_2e) or 10 t CO_2e per capita (see Figure 1a and Table 1). As illustrated in Figure 1b, this progress seems to be the result of at least two important factors: i) the economic crises in 2009; and ii) important gains in emissions per unit of output, caused by replacements of fossil fuels by renewables and gains in energy efficiency.

When switching the focus to CBA emissions, empirical evidence reveals that GHG emissions are about 50% higher than production-based emissions (Figure 1a). Both CPA and PBA declined after peaking in 2004/2005.

Figure 1 a: Overview of CBA vs PBA GHG emissions for Austria

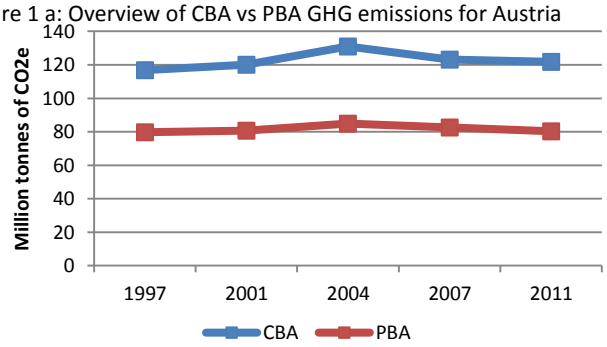
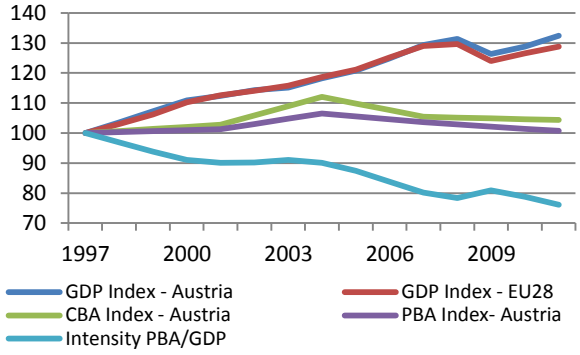


Figure 1b: Changes in Gross Domestic Product (GDP), PBA emissions, and GHG emission intensity (index 1997=100)



From a CBA stand point, Austria is responsible for about 121 million tonnes of CO_2e in the year 2011, which corresponds to 14.5 t CO_2e per capita. While the difference between CBA and PBA emissions is remarkable, this magnitude has been relatively stable over time.

Figure 2 shows the shares of the consumption-based emissions accounting across agents: households are the main agent inducing carbon emissions (54%), followed by firms' investments (21%) and government (8%). The remaining categories to complete the hundred percent of the CBA emission are household direct emissions (13%), such as fuel consumption in transport and in heating, and international transport (4%).

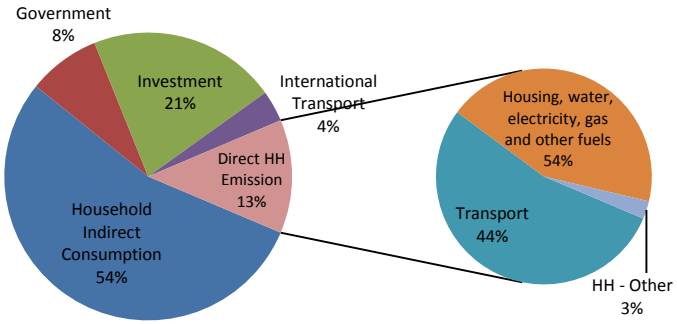


Figure 2: Breakdown of Austria's consumption based emissions across final demand categories for the year 2011 (in percentage).

These shares tend to be representative across the temporal scale too (see Table 1).

Table 1: Austria's GHG emission inventories from a CBA and PBA perspective (in million tonnes of CO2-e).
Note: The accounting principle followed here for PBA is the resident´s principle, while the UNFCCC balances follow the territorial principle, with a small divergence among the two for Austria.

Categories	1997	2001	2004	2007	2011
Household (direct consumption)	**17.66**	**18.88**	**18.59**	**16.96**	**15.57**
Domestic emissions due to Total Final Demand (TFD)	**96.79**	**96.56**	**107.38**	**101.35**	**102.07**
-Domestic emission due to HH final demand	59.52	61.62	69.10	64.93	66.32
-Domestic emission due to Gov. Final demand	10.32	9.68	12.67	11.20	9.90
-Domestic emission due to Inv. Demand	26.94	25.26	25.62	25.22	25.85
Imports of International Transport	**2.43**	**4.63**	**4.97**	**4.91**	**4.28**
CBA	**116.87**	**120.07**	**130.95**	**123.23**	**121.91**
PBA	**79.75**	**80.77**	**84.92**	**82.63**	**80.31**
CBA per capita (in tonnes)	**14.66**	**14.82**	**16.02**	**14.85**	**14.50**
PBA per capita (in tonnes)	**10.01**	**9.97**	**10.39**	**9.95**	**9.55**
Ratios	**1.47**	**1.49**	**1.54**	**1.49**	**1.52**

Regional emissions

An interesting aspect is the geographical location of emissions induced by Austrian final demand; this specially matters when the emissions triggered by Austria's consumption take place in countries which so far are not part of international climate agreements (e.g. non-Annex I countries). Results show that 38% of CBA emissions take place in non-EU countries, 34% in rest of EU-28 (i.e. EU-28 excluding Austria), and the remaining 28% occurred in the Austrian territory (see Figure 3).

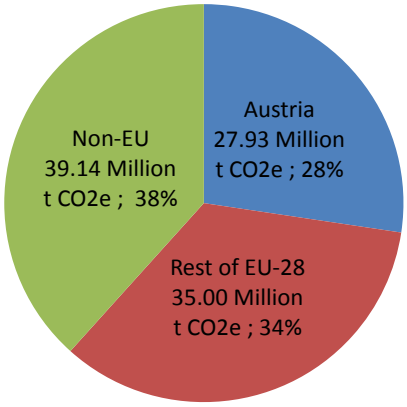


Figure 3: Emissions induced by Austria's final demand across regions (year 2011)
Note: Direct emissions from households and international transport are excluded from the base.

Findings illustrate that an important part of the emissions (38%) induced by Austrian consumption take place outside of the EU-28 geographical borders – mostly in China, Russia, United States, Kazakhstan and India – where climate commitments mostly have been weak. In order to reduce Austria's consumption-based emissions, it is therefore necessary to design policies that take into consideration these emissions that are not regulated under any climate agreement (as is largely the case for those emissions occurring outside the EU-28).

Figure 4 presents a regional breakdown of the top-15 sectors driving emissions from Austria's consumption. While there are sectors such as "Electricity" where most of the emissions occur within the EU-28, those from other sectors like "Electronic Equipment" are dominated by sources outside the EU-28.

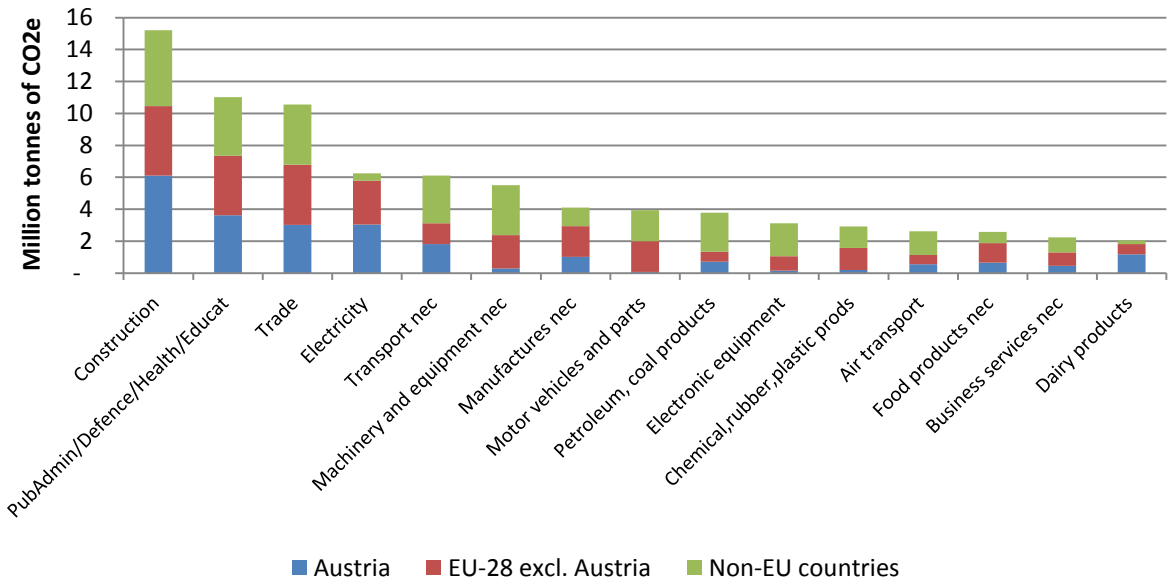


Figure 4. Regional disaggregation of the top-15 sectors driving GHG emissions from Austria's consumption (year 2011).

Inequality in emissions

As carbon footprints look at the CBA emission embedded in consumption, we examine carbon footprints based on the emissions embedded in the expenditure of residents grouped according to their level of income.

Figure 5 shows that in general the higher the income the more emissions are induced by consumption. This relation can be as much as a factor of two when comparing the lowest decile (the 10% of the population with lowest income) and the highest one.

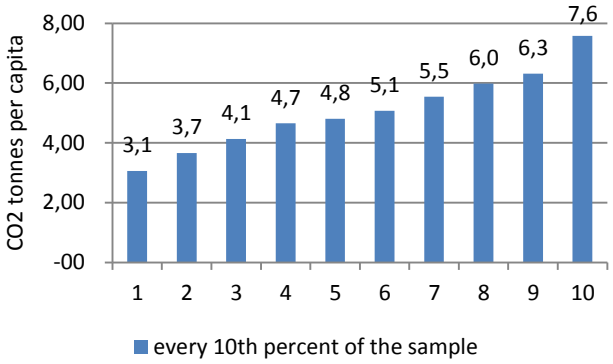


Figure 5: Average carbon footprint per capita for income deciles in Austria (year 2004).
Note: a) the average carbon footprint across income categories is 5.08 t CO_2
b) Figure 4 considers only CO_2 emissions in the final demand category "household".

Final remarks

The present analysis is oriented toward understanding Austria's emission profile from a consumption-based accounting perspective. This is particularly relevant due to the increasing spatial separation between production and consumption activities resulting from globalization, and the lack of a global climate agreement that is able to regulate emissions across countries. Findings reveal that the emissions needed to sustain Austria's consumption are about 50% larger than those reported by the conventional production-based accounting system.

Project team

The project team comprises of researchers from the Wegener Center for Climate and Global Change (University of Graz, project lead), the Sustainable Europe Research Institute (SERI) and the Environment Agency Austria (Umweltbundesamt GmbH). International project partners are from Bonn, Oslo and Manchester.

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[i] Munoz, P, Steininger, K.W. (2010), Austria´s CO_2 responsibility and the carbon content of its international trade, Ecological Economics, 69(10), 2003-2019.
Steininger, K.W., Lininger, C., Meyer, L.H., Munoz, P., Schinko, T. (2015), Multiple carbon accounting to support just and effective climate policies, *Nature Climate Change*, online Nov, 2015; doi: 10.1038/nclimate2867