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Consumption- and production-based emissions: Updates for Austria

Stefan Nabernegg, Karl W. Steininger, Teresa Lackner

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Summary

This report presents updated emission data for Austria, disaggregated by source, sector and income groups. Using Multi-Regional Input-Output (MRIO) method, we calculate consumption-based emissions and allocate them to income groups based on household survey data for Austria. We emphasize that production-based and consumption-based accounting principles cannot be fully aligned within emission accounting scopes. Our calculations show that, since 2004, Austrian consumption-based emissions have continued to decline in parallel with production-based emissions, maintaining a rather consistent ratio of around 1.45 — meaning consumption-based emissions remain around 50% higher than production-based emissions. We show that relevant drivers of consumption-based emissions are not only private household consumption but also government consumption and firm investment. Mobility is identified as the largest contributor for private household emissions. In line with the findings of other studies on Austria, we observe significant disparities in emissions across income groups: the highest income decile emits four to nine times more than the lowest income decile, depending on whether emissions are accounted for on a household or per capita basis. Furthermore, the highest income percentile is likely to emit over 50 t CO_2eq per capita per year, although actual figures may be even higher due to data limitations.

1. Introduction

Effective climate policies at the global, national and local level require knowledge about existing emission sources. At the national and regional level, different accounting principles for emissions emerged (see e.g. Fong et al., 2021; Steininger et al., 2016). While production-based accounting (or territorial-based accounting) is mostly guiding official reporting processes of public authorities, consumption-based accounting emerged as most applied, complementing principle.

Production-based accounting attributes emissions to the geographic location where goods and services are produced. Thereby it provides insights into the emissions generated within a region's borders, reflecting the direct impact of domestic industries and energy consumption. In contrast, consumption-based accounting assigns emissions to the final demand of goods and services, regardless of where they are produced. Thereby it highlights the emissions associated with the consumption patterns of households and governments, including imports and exports.

At the same time, emission accounting on a regional or organizational level can be organized and reported at scope 1-3 level (Fong et al., 2021; Smith et al., 2004).

Scope 1 encompasses direct emissions from owned or controlled sources, such as fuel combustion in company vehicles and facilities. These emissions are directly attributable to the region or organization's operations. Scope 2 includes indirect emissions from the generation of used electricity, steam, heating, and cooling consumed by the region or organization, reflecting the emissions associated with energy use. Finally, Scope 3 accounts for all other indirect emissions that occur in the value chain of the organization or region, including both upstream and downstream activities, such as the production of purchased goods and services, waste disposal, and employee commuting.

Figure 1 relates the production- and consumption-based accounting approaches with the accounting in scopes. It shows the emissions included in production-based accounting (Scope 1) for **exports**; the embodied emissions included in consumption-based accounting (Scope 2 and 3) in **imports** for final demand of a region, as well as the emissions within a region included in both accounting approaches (Scope 1-3) that are triggered by **own final demand** of goods produced within the region.

Unlike production- and consumption-based approaches, Scope 2 and 3 emissions are also considered for a region's **exports**. The upstream emissions associated with exports overlap with the embodied emissions of imports in consumption-based accounting. For instance, consider an intermediate product exported from a region that is later used in the manufacture of a final product within that same region. In this case, the scope 2 and 3 emissions for the intermediate product are recorded in both the exports of this sector and the consumption-based accounts as embodied emissions.

Emission accounting using different scopes is particularly beneficial at smaller scales, such as for companies, organizations, or municipalities. This approach is often implemented through bottom-up product Life Cycle Assessments, which provide detailed insights into emissions associated with specific products and services.

In contrast, production- and consumption-based accounting is typically applied at a more aggregate level, utilizing the Multi-Regional Input-Output (MRIO) method to derive emission figures. This method relies on economic accounts, making it more suitable for

national-level assessments or for smaller regions when regional consumption data is available.

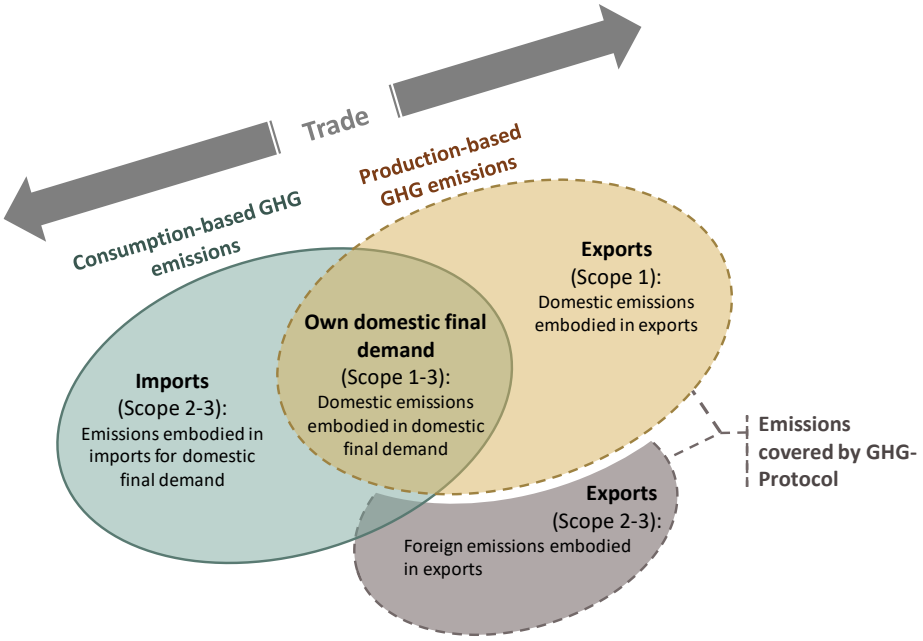


Figure 1: Relation and overlaps of emission accounting principles according to production-based and consumption-based accounting as well as scopes based on GHG-Protocol. Own elaboration based on Pichler and Steininger (2019).

To support policymakers at both the national and provincial levels in Austria, this report focuses on production- and consumption-based accounting. By examining both accounting methods, policymakers should be supported to assess the effectiveness of climate strategies and identify opportunities for reducing emissions at both the production and consumption levels.
This report updates the consumption-based accounts for Austria for the reference year 2014, following the methodology established by Steininger et al. (2018 GEC). Additionally, it presents an analysis of emission distribution across income groups, based on the work of Nabernegg (2021 GEP), as well as a breakdown of emissions across Austrian provinces, following the research conducted by Munoz et al. (2020 CleanerProd).

2. Method and Data

To derive consumption-based emissions we apply Multi-Regional Input-Output (MRIO) analysis with environmental extensions for greenhouse gas (GHG) emissions. This allows us to disaggregate the overall national emission number into sectors and agents of final demand. Furthermore, we can disaggregate the total emissions embodied in final demand of private households on a regional and income dimension.

2.1. Multi-Regional Input-Output analysis

Building on the approach of Muñoz and Steininger (2010) and Steininger et al. (2018), we conduct a Multi-Regional Input-Output (MRIO) analysis based on the Global Trade Analysis Project (GTAP) database in its most recent version V10 (Aguiar et al., 2019) with base year 2014. This allows us to distinguish import quantities and associated emissions along the

full international supply chain of sectoral domestic final demand. At the same time, the multi-regional approach requires sectoral economic and emission data for the considered regions. Providing such information, we use economic data from the GTAP V10. We develop the emission database in section 2.2 allowing us to calculate consumption-based GHG emissions of the Austrian economy on a sectoral level.

The MRIO model is specified in matrix notation as:

$$e^* = e\,\hat{x}^{-1}\,(I - Z\hat{x}^{-1})^{-1}\hat{y}$$

with:

e^*	Vector of emissions re-allocated on the basis of consumption-based accounting	$(1 \times n \cdot r)$
e	Vector of sectoral emissions allocated according to a production-based principle across countries	$(1 \times n \cdot r)$
$\hat{x}$	Diagonal matrix of sectoral outputs across nations	$(n \cdot r \times n \cdot r)$
I	Identity matrix	$(n \cdot r \times n \cdot r)$
Z	Matrix of intermediate inputs within and among regions	$(n \cdot r \times n \cdot r)$
$\hat{y}$	Diagonal matrix of sectoral final demands (total or disaggregated for private consumption, government consumption and firm investment) across countries	$(n \cdot r \times n \cdot r)$

The dimensions of each matrix or vector are given with n…sectors (65) and r…regions (121).
Thereby, we allocate all emissions along the supply chain to the region, sector and agent (household consumption, government consumption, firm investment) of final demand. We further decompose sectoral consumption-based emissions of Austria into regional sources. To determine the consumption-based emissions arising in region R we substitute $e\,\hat{x}^{-1}$ in the above specification by $e_R\widehat{x_R}^{-1}$, which includes only sectoral production-based emission intensities of the source region *R* (i.e., setting sectoral emissions in all other regions r which are not part of R in vector *e* to zero). In that way we first determine Austrian consumption-based emissions arising in Austria by defining R to include Austria only. Then, we determine Austrian consumption-based emissions arising each in other EU countries and the rest of the world by defining R as these respective regions. More details on the MRIO specifications can be found in Miller and Blair (2009) and Muñoz and Steininger (2010).

2.2.Emission data preparation

The GHG emission database used in the MRIO analysis is required on the same regional and sectoral resolution as the economic data. Since existing studies (Andrew & Peters, 2013; Peters et al., 2011; Steininger et al., 2018) indicate concerns about the reliability of GTAP GHG emissions data, we combine several sources in order to construct an emission data set for the year 2014, covering GTAP regions and sectors. This procedure aims at using the most reliable data for available countries and sectors and is established in five main steps. First, we collect industrial process emissions (CRF category 2) for each region, provided by UNFCCC (2021b, 2021a), as this type of emissions appear especially relevant for building materials such as steel and cement and are not included in the GTAP data base. It should be

noted that not total CRF 2 emissions are allocated but the most relevant ones (i.e., emissions associated with CRF categories 2A, 2B and 2C), such that the intersection of available data in the different regions is maximal. This "cut-off" ensures that the same process emissions are included across regions with different reporting standards (e.g., Annex-I and non-Annex I countries). The allocation of CRF 2 sectors to GTAP sectors for both Annex I and non-Annex I countries is given in Table 1.

Second, emissions for most European countries are based on national air emissions accounts (CO_2, CH_4, N_2O and F-GAS) available at Eurostat (2021), which follow the residential principle and are adjusted to the territorial principle as reported officially to UNFCCC by using the "bridging to territorial principle" data, provided by Eurostat (2021). It should be noted that data for F-GAS is taken from Eurostat (2017, tables 9-11) since it is no longer available from the online Eurostat database.

Third, emissions data for further large economies and relevant Austrian trading partners (i.e., Australia, Canada, USA, Russia, Japan, Kazakhstan, China, Brazil, Republic of Korea) is taken from UNFCCC (2021b, 2021a). We use total emissions of the category "Total GHG emissions without LULUCF", which is the analogous to the Eurostat emission data adjusted to territorial principle, to scale the sectoral structure by region from GTAP emissions data to match these total emissions.

Fourth, for the remaining regions, GTAP emissions data (Aguiar et al., 2019) are applied.

Finally, we check for unplausible deviations of the development of sectoral economic activity between the international GTAP database and the national Input-Output table provided by Statistics Austria (2015). We thus upscale the consumption-based emission value for the construction sector ("49 cns") by 12.5% as we find a decreased economic activity of this sector in the GTAP database (-5.2% compared to 2011), compared to an increased economic activity in the Statistics Austria data (+6.7% compared to 2011).

Table 1 Allocation of CRF 2 sector industrial process emissions to GTAP sectors.

GTAP sector		CRF sector Annex I countries	CRF sector non-Annex I countries
33	chm	2 B 1 - 2 B 7; 2 B 9 - 2 B 10	2B
35	rpp	2 B 8	
36	nmm	2A	2A
37	i_s	2 C 1, 2C2, 2C7	2C
38	nfm	2 C 3 - 2 C 6	

2.3.Household data and linking

We utilize data from the Austrian Household Budget Survey (HBS) conducted in 2014/15 (Statistik Austria, 2016a), which adheres to international standard reporting protocols. This survey provides comprehensive information on the income and private expenditure of a representative sample of 7,162 Austrian households. Household expenditure is categorized according to the international 'Classification of Individual Consumption Expenditures by Purpose' (COICOP), ensuring consistency and comparability in the analysis of consumption patterns.

For emission allocation to income groups, we first rank households using an expenditure proxy and then link sectoral consumption-based GHG emissions from the MRIO model to household consumption expenditures in COICOP categories.

Households can be ranked based on either income or expenditure, each serving different analytical purposes. Income ranking is commonly employed for general inequality assessments and the creation of indices such as the Gini or Atkinson index. However, it can be argued that expenditure provides a more accurate representation of lifetime income, in line with the Permanent Income Hypothesis. Temporary income fluctuations, such as those resulting from short-term unemployment, may place households in lower income brackets, despite their long-term financial situation aligning with a higher income group. In contrast, expenditure tends to be more stable over time, mitigating the effects of short-term income shocks. Therefore, for this analysis, we utilize household rankings based on expenditures, categorizing them into deciles or percentiles according to total household expenditure.

In a separate step, we map the calculated sectoral emissions associated with total household demand from the MRIO model to the consumption patterns of each household observed in the Austrian HBS in order to derive carbon footprints at the household level. To align the MRIO data given in the sectoral structure of GTAP, we first translate GTAP sectors into products by activity (CPC/CPA) based on GTAP (2022). Subsequently, we employ the Austrian bridging matrix for household consumption classified according to the COICOP system, as provided by Cai and Vandyck (2020). The resulting sectoral correspondence table and sector to COICOP table are provided in the appendix. In this process, we implicitly assume that any discrepancies between total household demand from GTAP and the HBS are distributed proportionally across households.

3. Austrian emissions over time and decomposition

3.1. Total emissions, emission sources and sectors

Looking at total Austrian numbers, we find that consumption-based emissions in 2014 amounted to 112.5 Mt CO_2eq. When compared to earlier studies that utilize a similar approach and data, we observe that consumption-based emissions increased until 2004 and subsequently declined (see Table 2). This trend aligns closely with the emissions reported under a production-based accounting framework. Notably, consumption-based emissions have consistently exceeded production-based emissions by approximately 42% to 51% since at least 1997, with a difference of 48% observed in 2014. This discrepancy arises because the emissions embodied in imports, which are included in consumption-based accounting, exceed those embodied in exports, which are accounted for in production-based emissions.

Allocating consumption-based emissions to the sectoral level accounts all domestic and international emissions along the supply chain which arise from final demand for this sector. We show that certain sectors exhibit significant production-based emissions, such as sectors Agriculture, forestry and fishing (A), Manufacturing (C), Electricity, gas, steam and air conditioning supply (D), and Transportation and storage (H). Among these, sectors Agriculture, forestry and fishing (A), Electricity, gas, steam and air conditioning supply (D), and Transportation and storage (H) demonstrate lower consumption-based emissions, while the manufacturing sector (C) shows higher consumption-based emissions. Additionally, sectors Construction (F), Wholesale and retail trade (G), and Accommodation

and food service activities (I) are also notable for their substantial consumption-based emissions. A detailed comparison of production-based versus consumption-based emissions by sector can be found in Figure 2. The sectoral aggregates are classified according to the ÖNACE-2008 system, with a corresponding table to GTAP sectors provided in the Appendix.

Table 2 Austrian annual GHG emissions.

	Years*					
	1997	**2001**	**2004**	**2007**	**2011**	**2014**
Production-based emissions [Mt CO_2eq] a)	82.1	84.1	91.0	87.0	82.1	76.3
Consumption-based emissions [Mt CO_2eq] b)	116.9	120.1	131.0	123.2	123.6	112.5
Relation (PBE/CBE)	1.42	1.43	1.44	1.42	1.51	1.48

Note: *Reported for those years with GTAP data available; CBE calculated from different sources. a) PBE data from UBA (Anderl et al. 2021); b) CBE data 1997-2011 from Steininger et al. (2018), 2014 own calculations.

The right panel of Figure 2 presents the total production-based and consumption-based emissions for Austria, disaggregated by regional components. This includes a distinction between direct household emissions and emissions from domestic production intended for domestic final consumption, which are covered by both accounting approaches (as illustrated by the overlapping area in Figure 1). To calculate total production-based emissions, it is necessary to include emissions from domestic production for export. Conversely, total consumption-based emissions must account for emissions embodied in imports, which are further categorized in Figure 2 by EU regions and non-EU regions.
For production-based emissions, we find that emissions associated with exports are nearly equivalent to those for domestic consumption. In terms of consumption-based emissions, upstream emissions are predominantly sourced from outside the EU, accounting for 44%, while emissions from Austria and other EU countries contribute approximately equal shares of 27% and 29%, respectively.

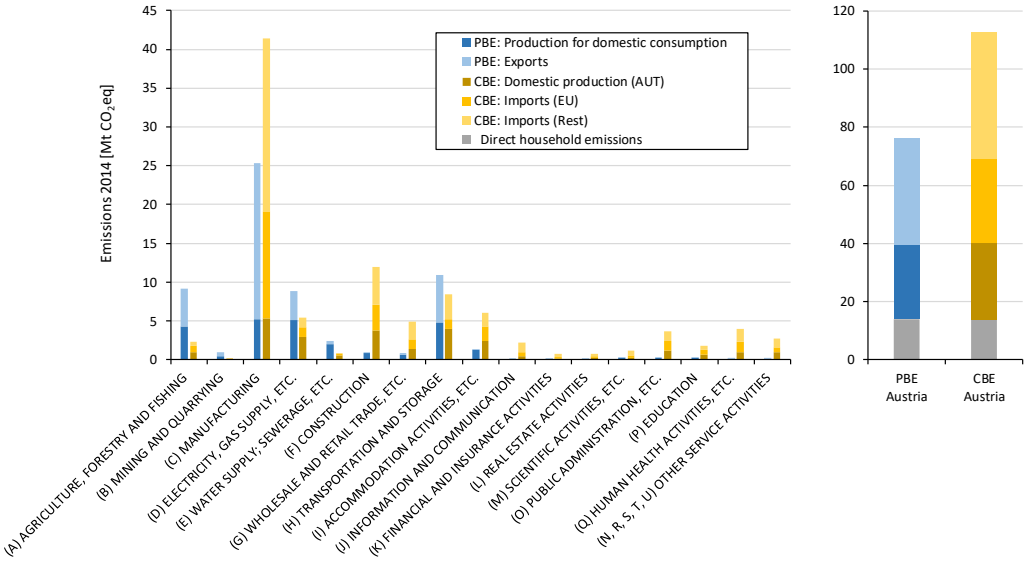


Figure 2: Production-based and consumption-based emissions for Austria in 2014 by ÖNACE sectors (left) and total (right).

In the consumption-based approach, when accounting for emissions towards final demand, we can further differentiate between private household consumption, public consumption, and investment demand from firms. As illustrated in Figure 3, private household consumption accounts for the largest share of emissions at 62%, while public consumption contributes a significant 11%, and investment by firms represents over a quarter (27%) of total consumption-based emissions. Additionally, private household emissions can be further disaggregated into specific consumption categories using the correspondence table between GTAP sectors and COICOP, which is provided in the Appendix. Figure 3 presents this disaggregation for broader consumption aggregates, highlighting that the primary driver of household consumption-based emissions is mobility, which accounts for 20%, followed by housing at 17% and nutrition at 9%.

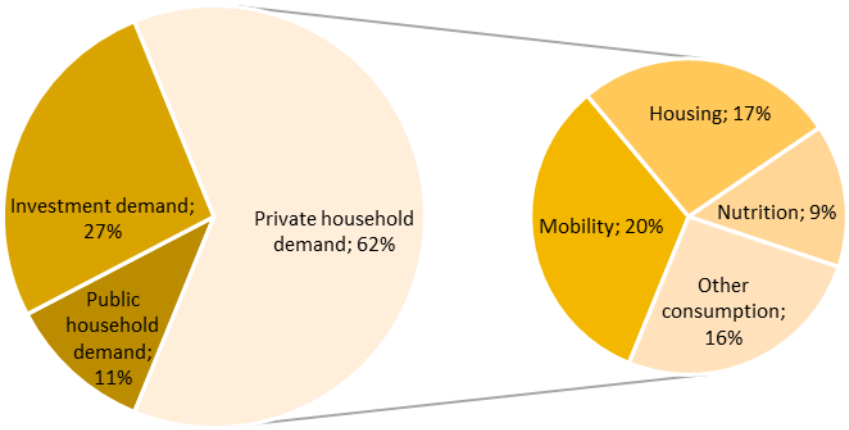


Figure 3: Decomposition of consumption-based emissions for Austria in 2014 to final demand categories and consumption categories of private household demand.

3.2.Emission distribution across income groups

Studies such as those conducted by Chakravarty et al. (2009) show that emissions are distributed unevenly within countries across households and individuals. This pattern is also evident in Austria, where income is the most significant factor influencing the distribution of emissions.

Figure 4a illustrates the distribution of consumption-based emissions per capita across income deciles in Austria (left axis). Emissions per capita steadily increase from 3 tonnes of CO_2eq per capita per year in the lowest income decile to 17 tonnes of CO_2eq per capita per year in the ninth decile. Notably, there is a significant increase in emissions for the highest income decile, reaching 28 t CO_2eq per capita per year. The figure also shows the absolute consumption-based emissions per year for each income group (right axis). This reveals that the lowest income group accounts for only 4% of total emissions, while the highest income group contributes 23%.

Panel b) of Figure 4 shows a comparison of our findings with those from other studies that employed similar methodologies for Austria. Theine et al. (2022) quantify emission

distributions in terms of emissions per household, emissions per equivalized household (which adjusts for household size and composition) and emissions per capita. Additionally, a Greenpeace study (Greenpeace, 2020) provides data on the distribution of emissions per household across income levels in Austria. The comparison shows that all the studies and indicators reveal an unequal distribution, with the highest income deciles emitting significantly more than the lowest. However, when accounting for emissions in terms of households (or household equivalents), the observed inequalities are lower than those indicated by per capita measures. Specifically, we estimate that the highest income decile emits around nine times more per capita than the lowest income decile, whereas Theine et al. (2022) report a ratio of 4:1 for emissions per household between the highest and lowest income deciles. Overall, our estimated distribution for emissions per capita across income deciles closely aligns with Theine et al.'s (2022) findings, although our analysis suggests a substantial increase in emissions for the highest income decile.

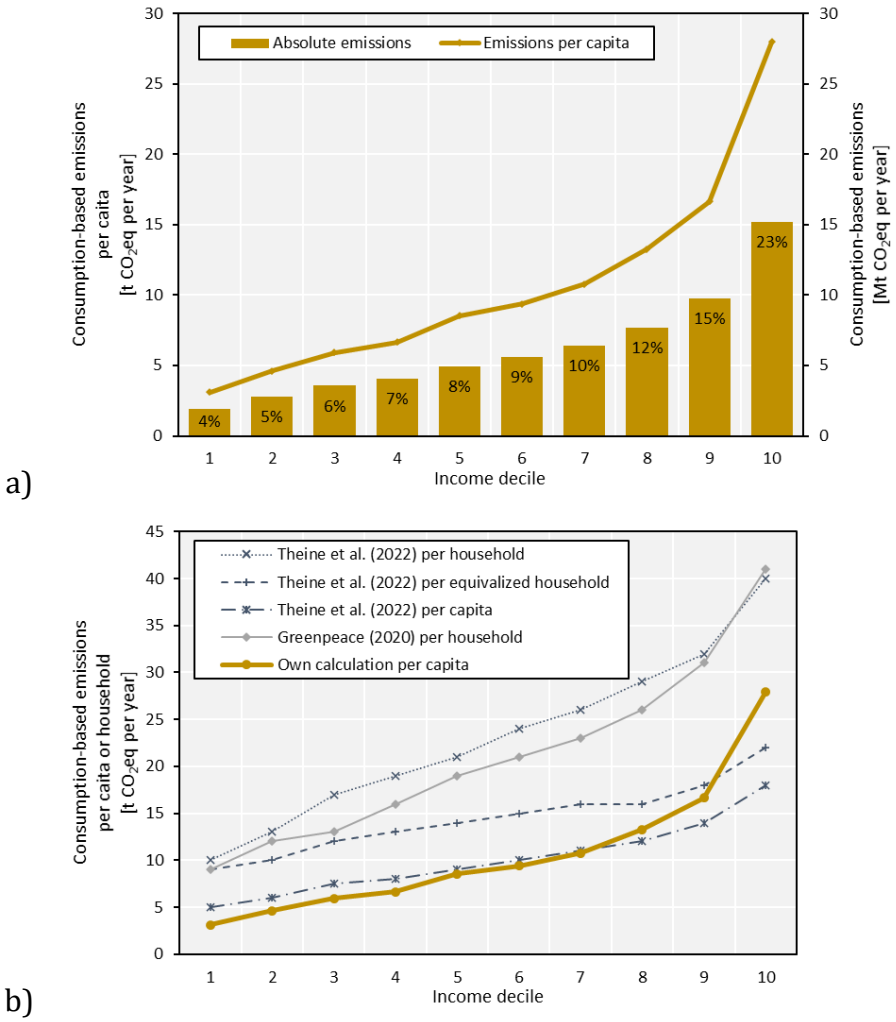


Figure 4: Distribution of consumption-based emissions across income deciles. Panel a) emissions per capita and absolute emissions per income decile. Panel b) comparison across studies and indicators.

We therefore present emission data with a finer percentile resolution (see Figure 5), which reveals an even more pronounced increase in emissions in the highest income groups. However, caution is warranted regarding the reliability of these results, since

disaggregating the data into percentiles based on the Austrian Household Budget Survey yields only 50–90 observations per percentile compared to 600–800 observations per decile, for results shown in Figure 4. Accepting this uncertainty, we find that the lowest percentile of the income distribution accounts for just 0.2% of total household emissions, whereas the highest percentile contributes 4.3% alone. Furthermore, emissions rise significantly within the highest income decile, surpassing 50 t CO_2eq per capita in the top percentile.

In addition to this sharp rise in emissions at the upper end of the income distribution, it is important to note that survey responses may be affected by underrepresentation and inaccurate reporting of income and consumption, particularly among households in the lowest and highest income brackets (Eckerstorfer et al., 2016). This could result in an even more pronounced inequality in emissions than is derived using survey data, as indicated also by Otto et al. (2019).

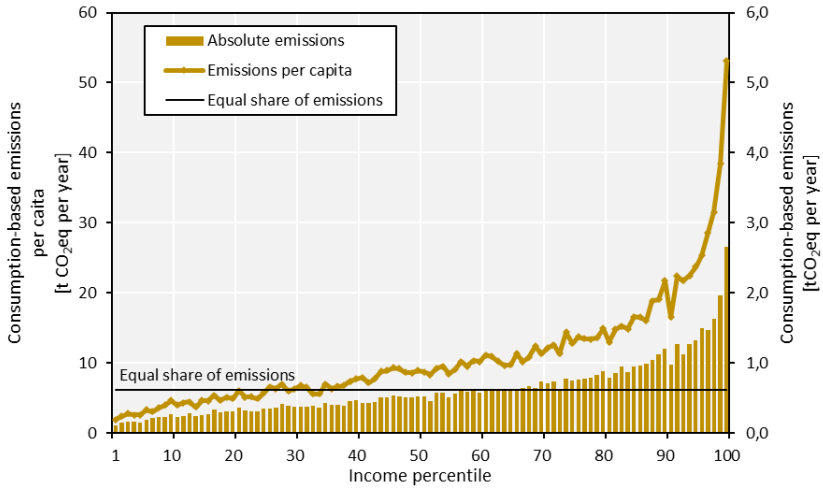


Figure 5: Distribution of consumption-based emissions across income percentiles in emissions per capita and absolute emissions per income percentile.

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Appendix A:

Table A.1 Regional structure of Austrian annual GHG emissions 2014.

Emissions components	**Emissions 2014 [Mt CO_2eq]**
Production-based emissions	*76.3*
Direct emissions	13.8
Domestic demand	25.9
Exports	36.6
Consumption-based emissions	*112.5*
Direct emissions	13.8
Domestic production for domestic demand	26.3
EU-imports for domestic demand	28.8
Non-EU-imports for domestic demand	43.6

Table A.2 Sectoral correspondence table ÖNACE-2008 to GTAP V10.

OENACE 2008 - Structure		**GTAP V10 sectors**		
Code	**Element**	**Nr**	**Abbr.**	**Sector**
A	AGRICULTURE, FORESTRY AND FISHING	1	pdr	Rice
		2	wht	Wheat
		3	gro	Maize (corn) etc
		4	v_f	Vegetables etc
		5	osd	Oil seeds and oleaginous fruit
		6	c_b	Sugar Crops
		7	pfb	Fibre crops
		8	ocr	Stimulant, spice and aromatic crops etc
		9	ctl	Bovine animals, live etc
		10	oap	Swine / pigs etc
		11	rmk	Raw mild
		12	wol	Raw animal materials used in textiles
		13	frs	Forestry and logging products
		14	fsh	Fishing and aquaculture etc
B	MINING AND QUARRYING	15	coa	Mining of coal and lignite
		16	oil	Extraction of crude petroleum etc
		17	gas	Extraction of natural gas etc
		18	oxt	Mining of metal ores etc
C	MANUFACTURING	19	cmt	Meat of cattle, fresh or chilled etc
		20	omt	Meat of pigs, fresh or chilled etc
		21	vol	Animal fats etc
		22	mil	Dairy products
		23	pcr	Rice, semi- or wholly milled, or husked
		24	sgr	Sugar and molasses
		25	ofd	Prepared and preserved fish, crustaceans etc
		26	b_t	Beverages, Tobacco products
		27	tex	Manufacture of textiles
		28	wap	Manufacture of wearing apparel

		29	lea	Manufacture of leather and related products
		30	lum	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
		31	ppp	Manufacture of paper and paper products, etc
		32	p_c	Manufacture of coke and refined petroleum products
		33	chm	Manufacture of chemicals and chemical products
		34	bph	Manufacture of pharmaceuticals, medicinal chemical and botanical products
		35	rpp	Manufacture of rubber and plastics products
		36	nmm	Manufacture of other non-metallic mineral products
		37	i_s	Manufacture of basic iron and steel etc
		38	nfm	Manufacture of basic precious and other non-ferrous metals, etc
		39	fmp	Manufacture of fabricated metal products, except machinery and equipment
		40	ele	Manufacture of computer, electronic and optical products
		41	eeq	Manufacture of electrical equipment
		42	ome	Manufacture of machinery and equipment n.e.c
		43	mvh	Manufacture of motor vehicles, trailers and semi-trailers
		44	otn	Manufacture of other transport equipment
		45	omf	Manufacture of furniture, etc
D	ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	46	ely	Production, collection and distribution of electricity, etc
		47	gdt	Manufacture of gas; distribution of gaseous fuels through mains
E	WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES	48	wtr	Collection, purification and distribution of water, etc
F	CONSTRUCTION	49	cns	Construction of buildings, etc
G	WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES	50	trd	Wholesale and retail trade etc
H	TRANSPORTATION AND STORAGE	52	otp	Land transport and transport via pipelines
		53	wtp	Water transport
		54	atp	Air transport
		55	whs	Warehousing and support activities for transportation
I	ACCOMMODATION AND FOOD SERVICE ACTIVITIES	51	afs	Accommodation etc
J	INFORMATION AND COMMUNICATION	56	cmn	Postal and courier activities etc
K	FINANCIAL AND INSURANCE ACTIVITIES	57	ofi	Financial service activities, etc
		58	ins	Insurance, etc
L	REAL ESTATE ACTIVITIES	59	rsa	Real estate activities
M	PROFESSIONAL, SCIENTIFIC AND TECHNICAL ACTIVITIES	60	obs	Professional, scientific and technical activities and Administrative and support service activities
O	PUBLIC ADMINISTRATION AND DEFENCE; COMPULSORY SOCIAL SECURITY	62	osg	Public administration and defense, etc
P	EDUCATION	63	edu	Education
Q	HUMAN HEALTH AND SOCIAL WORK ACTIVITIES	64	hht	Human health and social work activities
N, R, S, T, U	ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES	61	ros	Arts, entertainment and recreation; Other service activities; Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use

R	ARTS, ENTERTAINMENT AND RECREATION	65	dwe	Dwellings
S	OTHER SERVICE ACTIVITIES			
T	ACTIVITIES OF HOUSEHOLDS AS EMPLOYERS; UNDIFFERENTIATED GOODS- AND SERVICES-PRODUCING ACTIVITIES OF HOUSEHOLDS FOR OWN USE			
U	ACTIVITIES OF EXTRATERRITORIAL ORGANISATIONS AND BODIES			

Table A.3 Correspondence table GTAP V10 sectors to COICOP consumption categories.

	GTAP \ COICOP	CP011	CP012	CP02	CP031	CP032	CP041	CP042	CP043	CP044	CP045	CP051	CP052	CP053	CP054	CP055	CP056	CP061	CP062	CP063	CP071	CP072	CP073	CP081	CP082_083	CP091	CP092	CP093	CP094	CP095	CP096	CP10	CP111	CP112	CP121	CP122_127
1	pdr	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	wht	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	gro	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	v_f	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	osd	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	c_b	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	pfb	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	ocr	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	ctl	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	oap	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	rmk	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	wol	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	frs	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	fsh	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1
15	coa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	oil	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	oxt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	cmt	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	omt	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	vol	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	mil	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	pcr	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	sgr	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	ofd	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	b_t	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	tex	0.0	0.0	0.0	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	wap	0.0	0.0	0.0	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	lea	0.0	0.0	0.0	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	lum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2	0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	ppp	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.2	0.0
32	p_c	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	chm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
34	bph	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35	rpp	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
36	nmm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.2	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37	i_s	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	nfm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	fmp	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
40	ele	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
41	eeq	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.6	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0

42	ome	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
43	mvh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	otn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45	omf	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.1	0.1
46	ely	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47	gdt	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48	wtr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49	cns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	trd	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	afs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.2	0.0	0.0
52	otp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
53	wtp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	atp	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	whs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
56	cmn	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.1
57	ofi	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
58	ins	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
59	rsa	0.0	0.0	0.0	0.0	0.0	0.2	0.6	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	obs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.2
61	ros	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.2	0.0	0.0	0.1	0.0
62	osg	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1	0.0	0.0
63	edu	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.9	0.0	0.0	0.0
64	hht	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
65	dwe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

This report presents updated emission data for Austria, disaggregated by source, sector and income groups. Using Multi-Regional Input-Output (MRIO) method, we calculate consumption-based emissions and allocate them to income groups based on household survey data for Austria. We emphasize that production-based and consumption-based accounting principles cannot be fully aligned within emission accounting scopes. Our calculations show that, since 2004, Austrian consumption-based emissions have continued to decline in parallel with production-based emissions, maintaining a rather consistent ratio of around 1.45 — meaning consumption-based emissions remain around 50% higher than production-based emissions. We show that relevant drivers of consumption-based emissions are not only private household consumption but also government consumption and firm investment. Mobility is identified as the largest contributor for private household emissions. In line with the findings of other studies on Austria, we observe significant disparities in emissions across income groups: the highest income decile emits four to nine times more than the lowest income decile, depending on whether emissions are accounted for on a household or per capita basis. Furthermore, the highest income percentile is likely to emit over 50 t CO_2eq per capita per year, although actual figures may be even higher due to data limitations.

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