

# Equity and emissions

Who emits most?

Why?

And what does that mean for a degrowth society (or future climate mitigation)?

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# What are we looking at?

Consumption. Of households. In Germany.

# Radical action now!

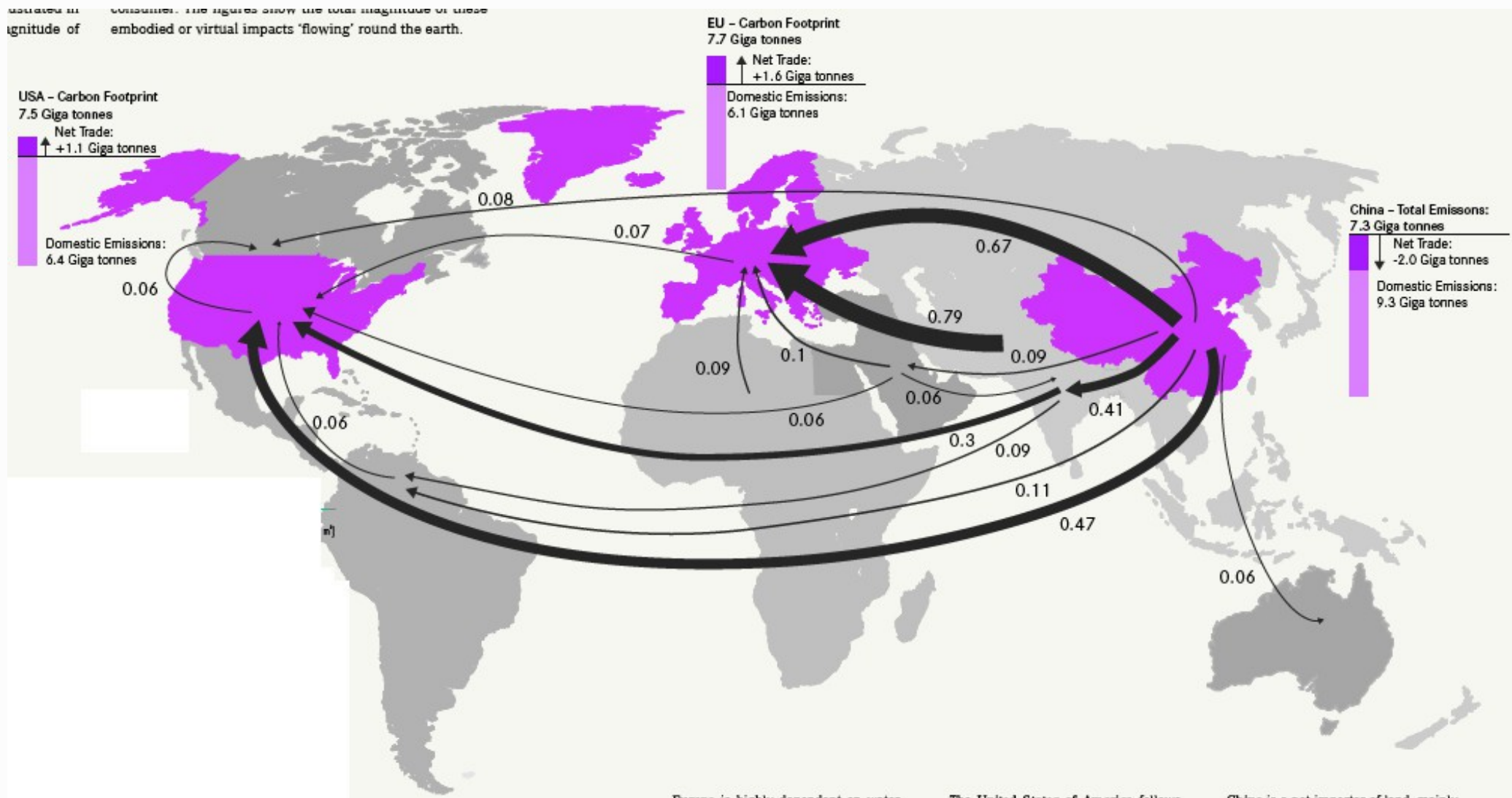
- IPCC (2013): on track for **2,6 to 4,8 ° C by 2100**
  - Lord Stern: **Carbon budget** to remain within 2°C warming will be **depleted within** the next **15-25 years**
- We need **radical and rapid emission reductions now** to avoid climate warming beyond 2°C!

# Carbon savings or carbon outsourcing?

- Kyoto Protocol: 37 states obliged themselves to curb emissions **within their national borders**

But what about **trade**?

# Carbon savings or carbon outsourcing?



China is highly dependent on imports. The United States of America follows. China is a net importer of lead, mainly...

# Carbon savings or carbon outsourcing?

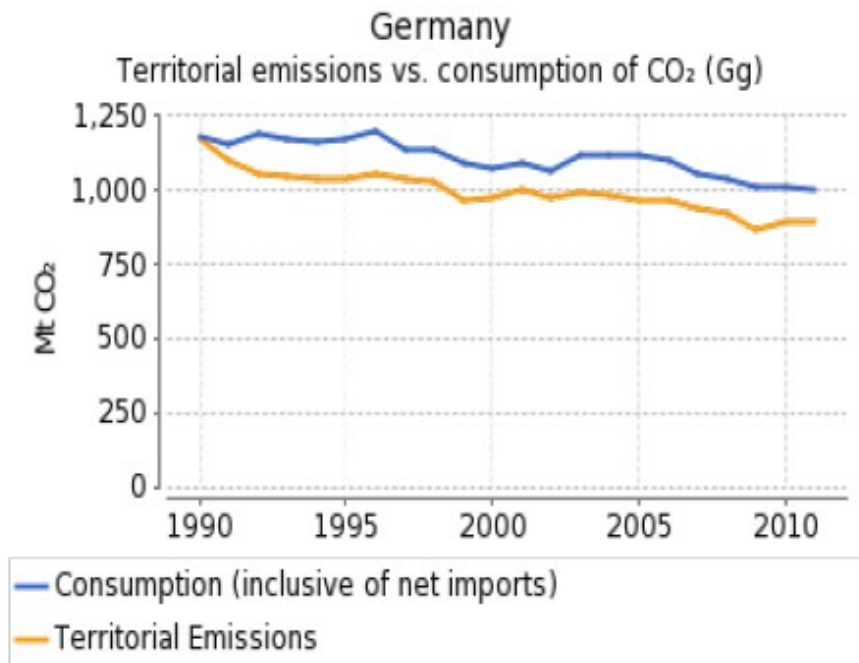


Figure 1: Territorial emissions and consumption of CO<sub>2</sub> in Ger. since 1990

Source: (Lenzen et al., 2013, 2012)

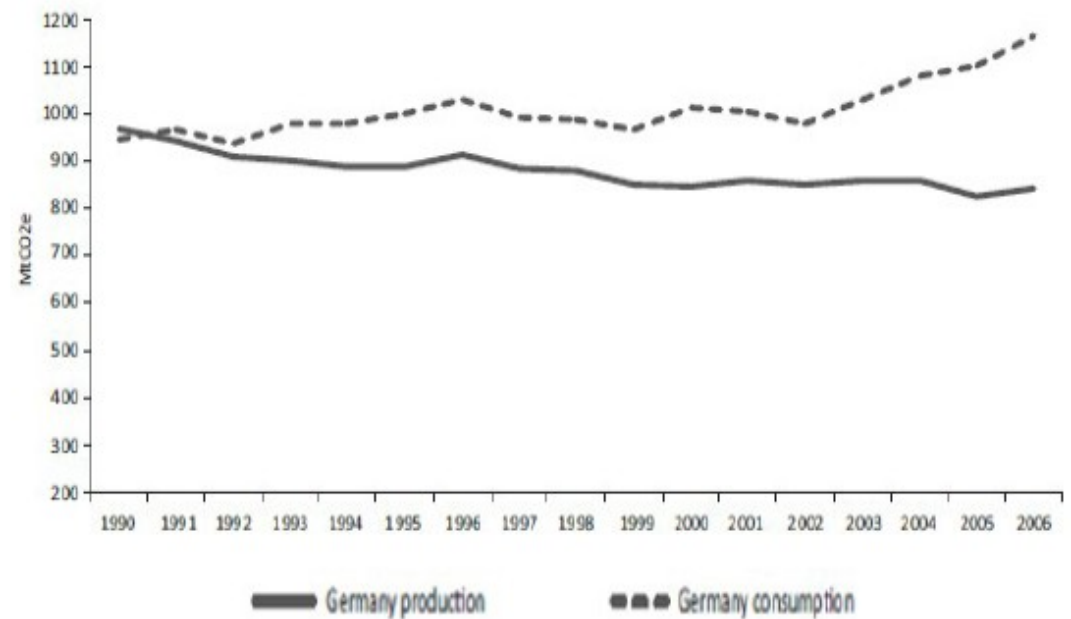


Figure 2: Territorial emissions and consumption of CO<sub>2e</sub> in Germany since 1990

Source: (Brinkley and Less, 2010:13)

# From a production to a consumption perspective

*“Low-carbon supply technologies cannot deliver the necessary rate of emission reductions – they need to be complemented with rapid, deep and early reductions in energy consumption”*  
(Tyndall° Centre, 2013)

# It's the households, stupid

- Globally, around 72% of CO<sub>2</sub> emissions are caused by households (Hertwich and Peters, 2009).
  - In Germany: ~ 67%, (Mayer and Flachmann, 2011)
- But lifestyles vary. Plus, households are very different.
  - How do household emissions differ?
  - Who emits most?
  - Why?



# Methodology

expenditure and  
income data for  
44088 households

+

Carbon intensity of  
different consumption  
(CO<sub>2</sub>/€)

=

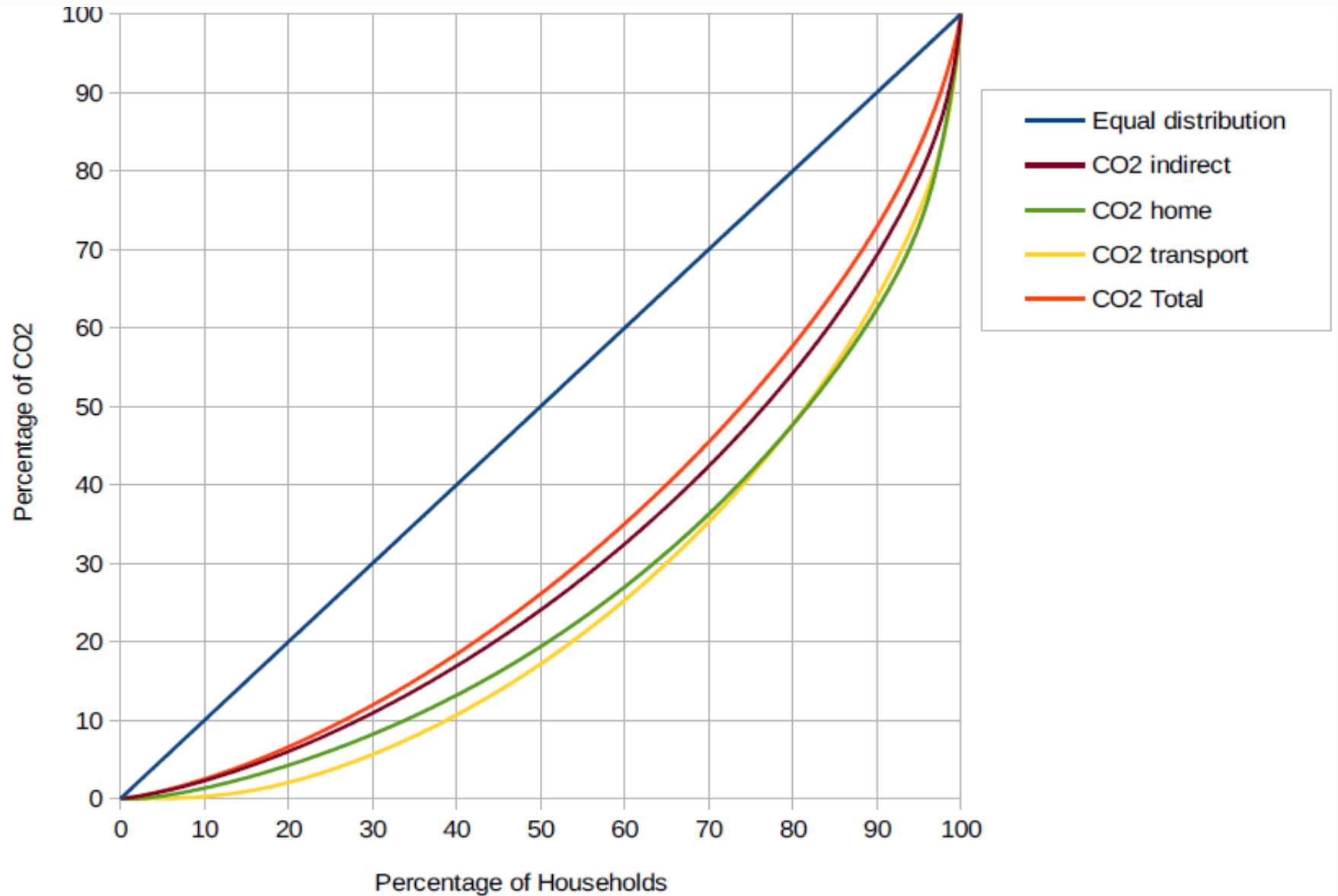
CO<sub>2</sub>/€ of expenditure

+

Statistical tests (descriptives, ANOVA, multivariate regression)

# Results!

# Concentration of emissions



*Figure 7: Lorenz curves of household CO2 emissions*

# Income and emissions

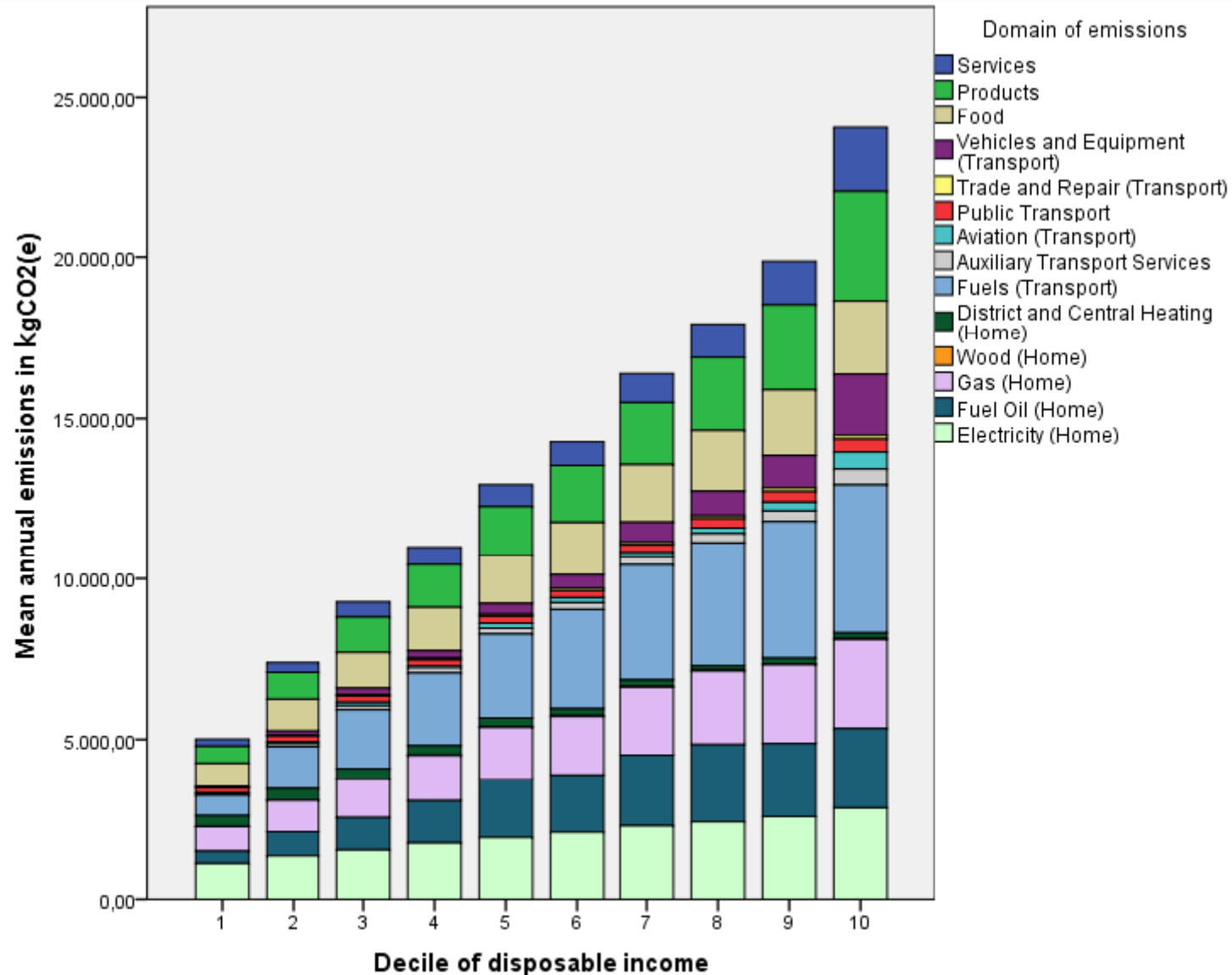


Figure 8: Emissions in kgCO2(e) of different disposable income deciles of households

# Social status and emissions

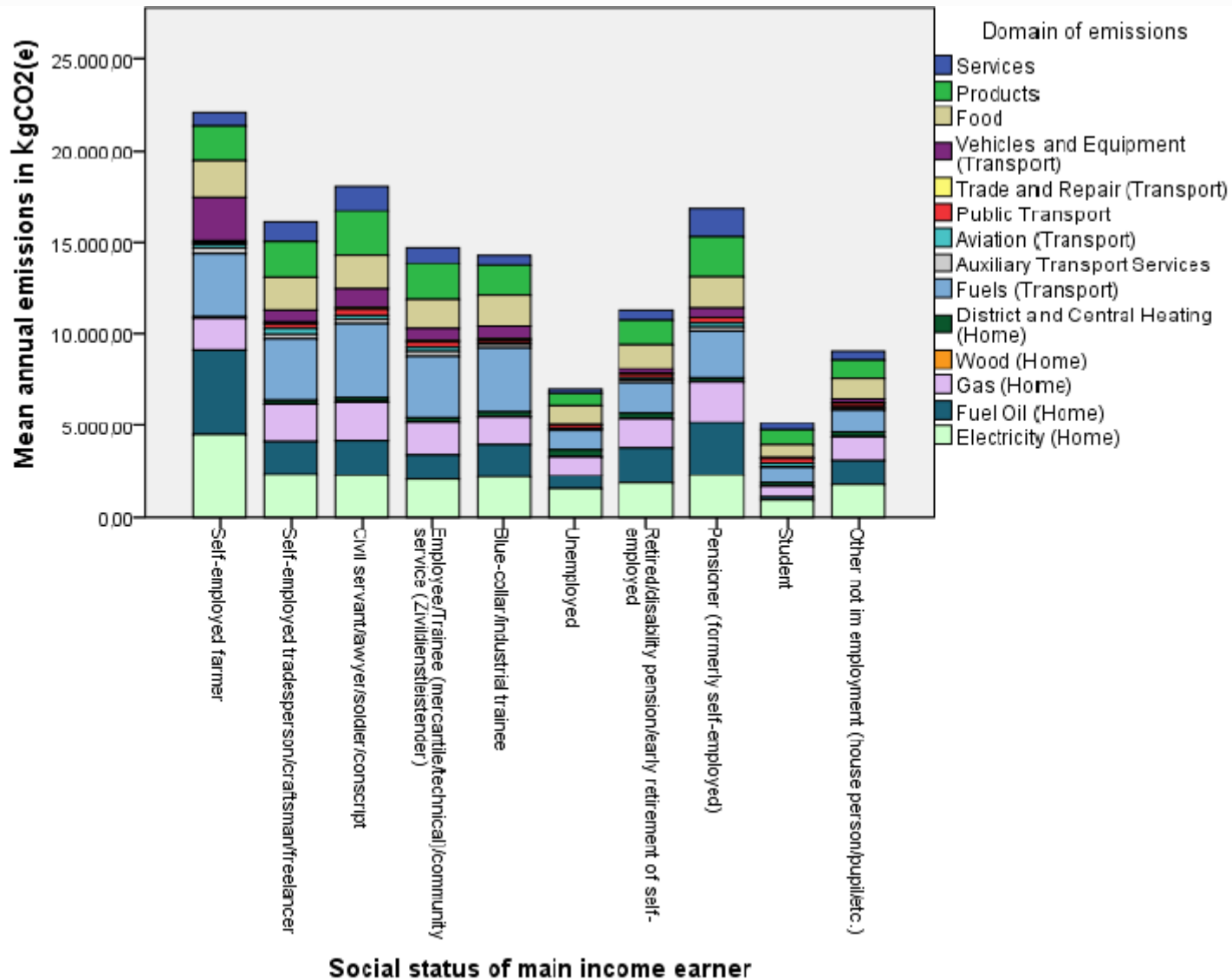


Figure 14: Emissions in kgCO<sub>2</sub>(e) of households with different social status of MIE

# Education / professional training and emissions

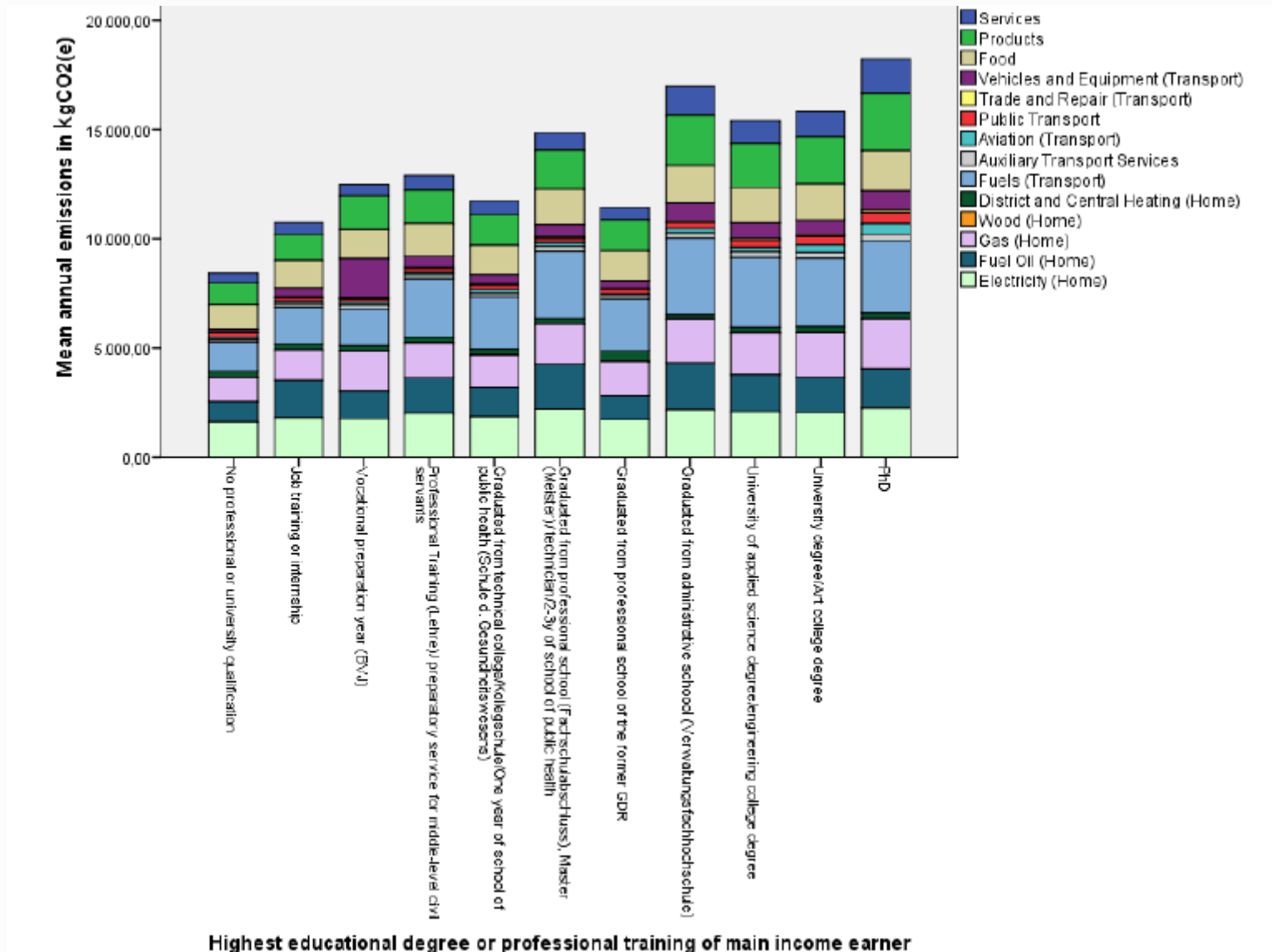


Figure 26: Emissions in kgCO<sub>2</sub>(e) of households with different educational and professional background of MIE

# Education / professional training and emissions

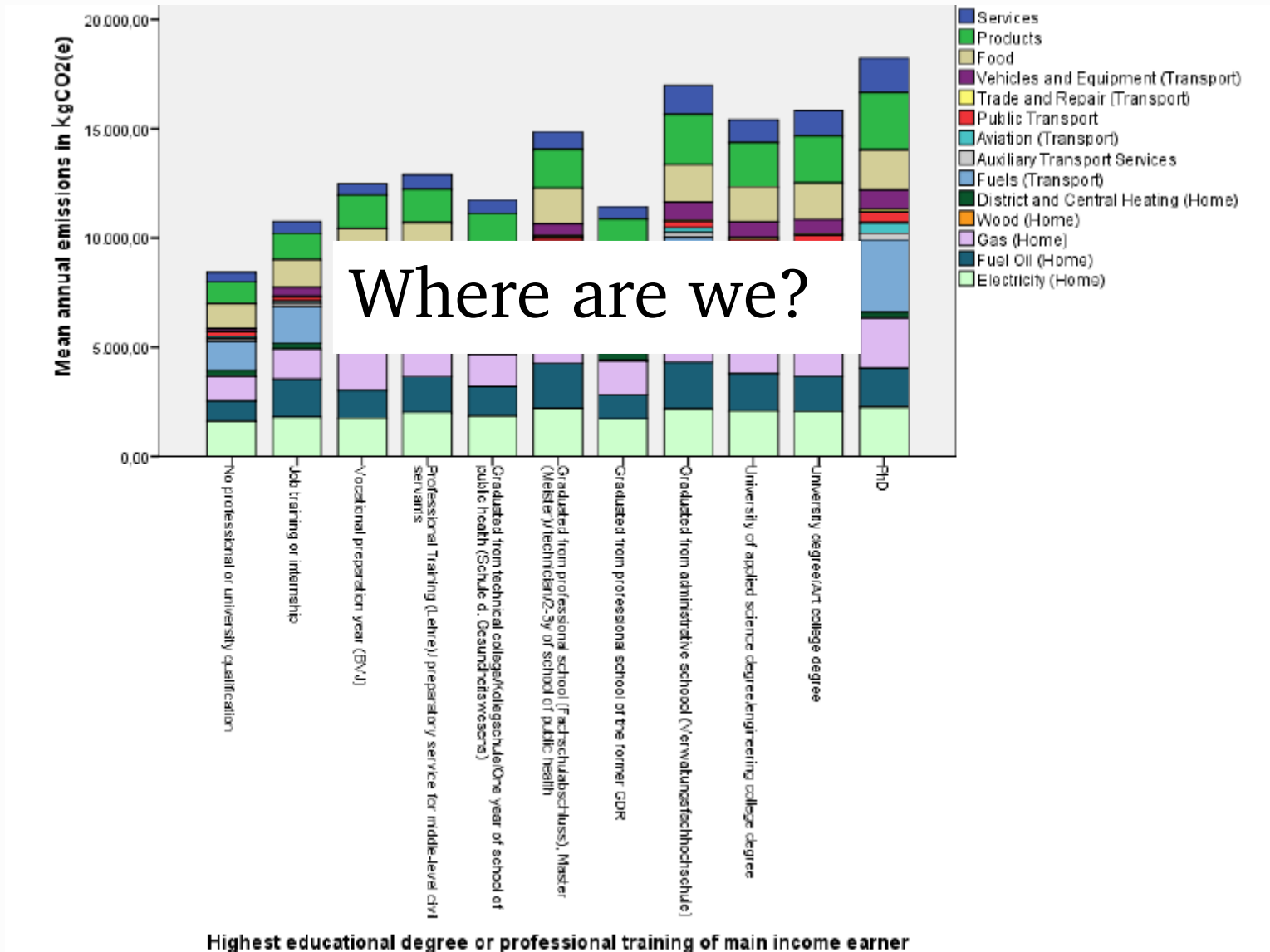


Figure 26: Emissions in kgCO<sub>2</sub>(e) of households with different educational and professional background of MIE

# Age and emissions

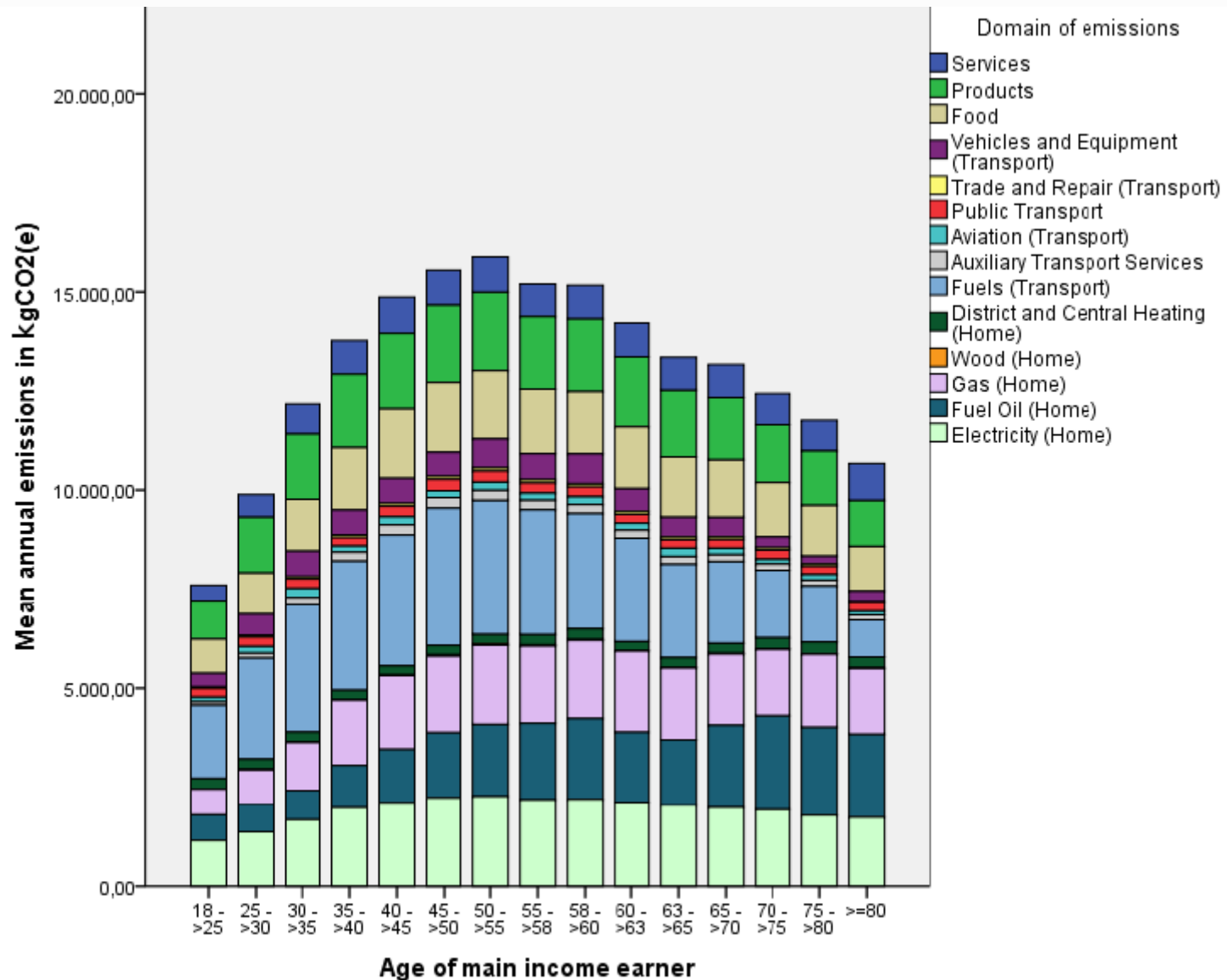


Figure 27: Emissions in kgCO<sub>2</sub>(e) of households with different age groups of MIE



But: descriptives don't tell us much about the relationships between emissions and socio-economic factors.

What are the actual drivers of emissions?

→ regression analysis

# Drivers of emissions

## Total emissions (similar for indirect emissions)

- Main drivers: **income** and **household size** ( $R^2 = 56\%$ )
- Further drivers:  $m^2$ , rural dwelling, professional training/higher education, female MIE, marriage ( $R^2$  change = 2,3%)

## Home energy emissions:

- Main drivers: **living space in  $m^2$** , **household size**
- Further drivers: income, home ownership, high age of the MIE (together  $R^2 = 26.8\%$ )

## Transport emissions:

- Main drivers: **Higher education**, **income** and **rural dwelling**
- Further drivers: marriage of the MIE, number of adults in the household (together  $R^2 = 37\%$  )

# Summary

- Emissions are concentrated
- There are high emitting households, low emitting households
- key drivers for total emissions: income and household size. BUT
- a lot of other socio-economic factors than income and household size have an effect on emissions
- different emissions: different drivers

# What does that mean for degrowth / future climate policy

- Emission reductions “on the basis of equity”  
(UNFCCC, 2009)
- The Polluter Pays Principle
- Targeting policies
- Only a small minority of very high emitters  
would need to radically mitigate/change.  
(Anderson, 2013:106 ff.)

# Take-home messages

- emissions are concentrated and unevenly distributed among households
- main drivers are income, household size (+ others)
- only a small minority of very high emitters would need to radically mitigate/change/de-grow
- Especially most vulnerable, poorest could be spared from changes
- Equity is key for future emission reductions

# Open Questions

- Do associations between emissions and socio-economic factors change over time?
- How do income trends and income (re-)distribution affect emissions? What are the climate effects of wealth increases in Germany? Would the climate impact of a more equitable income distribution be positive or negative?
- What are the political, economical and societal limitations and prospects of targeting high-emitting households to rapidly reduce emissions?

Thanks!

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# Methodological constraints

- Model only covers private consumption
  - Imported emissions are under-reported by the IO model
  - Data and model don't match well. 10% of expenditure data is lost due to reclassification
- indirect emissions are significantly under-reported



	Total CO2 emissions 1)		Home energy CO2 emissions 2)		Transport CO2 emissions 3)		Indirect CO2 emissions 1)	
	B	$\beta$	B	$\beta$	B	$\beta$	B	$\beta$
<b>Model 1</b>	// R <sup>2</sup> = 0.56		// R <sup>2</sup> = 0.182		// R <sup>2</sup> = 0.324		// R <sup>2</sup> = 0.558	
Constant	2.857***		4.14***		-5.519***		0.772***	
Ln disposable income	0.532***	0.57	0.274***	0.227	1.269***	0.493	0.66***	0.631
Number of children	0.066***	0.092	0.083***	0.088	0.046***	0.023	0.061***	0.075
Number of adults	0.192***	0.227	0.244***	0.225	0.261***	0.113	0.142***	0.15
<b>Model 2</b>	// R <sup>2</sup> = 0.583		// R <sup>2</sup> = 0.268		// R <sup>2</sup> = 0.370		// R <sup>2</sup> = 0.576	
Constant	3.509***		5.22***		-3.597***		0.721***	
Ln disposable income	0.439***	0.471	0.098***	0.081	1.025***	0.398	0.659***	0.631
Number of children	0.049***	0.068	0.075***	0.079	-0.058***	-0.029	0.079***	0.098
Number of adults	0.142***	0.168	0.169***	0.155	0.14***	0.06	0.128***	0.135
Living area in sqm	0.002***	0.112	0.004***	0.239	0**	0.012	0***	-0.023
Rural (< 20000 inhabitants)	0.052***	0.044	0.036***	0.023	0.252***	0.076	-0.027***	-0.02
Federal city state	-0.05***	-0.024	-0.012	-0.004	-0.258***	-0.043	0.02**	0.008
East German state	-0.007	-0.005	-0.037***	-0.021	0.102***	0.026	-0.04***	-0.026
Construction year > 1991	-0.066***	-0.048	-0.13***	-0.073	-0.019	-0.005	-0.044***	-0.029
Married MIE	0.082***	0.07	0.056***	0.037	0.241***	0.073	0.109***	0.083
Accommodation owned	0.003	0.003	0.161***	0.106	0.003	0.001	-0.105***	-0.08
Accommodation free	-0.081***	-0.021	0.165***	0.03	-0.041	-0.004	-0.115***	-0.027
Edu introductory training	0.026*	0.007	-0.037	-0.007	0.22***	0.02	0.005	0.001
Edu professional training	0.051***	0.043	-0.016	-0.011	0.533***	0.16	0.031***	0.023
Edu graduated tech. college	0.028**	0.01	-0.037	-0.01	0.513***	0.065	0.031**	0.01
Edu graduated master (crafts)	0.06***	0.033	-0.049**	-0.021	0.626***	0.126	0.047***	0.023
Eud graduated GDR	0.032**	0.011	-0.029	-0.008	0.5**	0.63	0.035**	0.011
Edu graduated administrative	0.071***	0.023	-0.063**	-0.016	0.577***	0.069	0.086***	0.025
Edu graduated from uni	0.04***	0.031	-0.07***	-0.041	0.563***	0.154	0.081***	0.055
Edu PhD	0.03*	0.008	-0.094***	-0.019	0.47***	0.044	0.113***	0.026
SocStat self-employed farmer	-0.149***	-0.011	-0.086	-0.005	-0.332**	-0.009	0.017	0.001
SocStat self-employed	-0.02*	-0.007	0.042**	0.011	-0.232***	-0.029	-0.003	-0.001
SocStat employee (whitecollar)	-0.006	-0.005	-0.01	-0.006	-0.067***	-0.02	0.029***	0.022
SocStat civil_servant	0.022**	0.011	0.006	0.002	-0.05	-0.009	0.073***	0.032
SocStat retired	-0.028	-0.02	0.059***	0.033	-0.428***	-0.113	-0.002	-0.001
SocStats pensioner (self-empl)	0.007	0.003	0.069***	0.02	-0.358***	-0.05	0.076***	0.026
SocStat student	-0.179***	-0.037	-0.121***	-0.018	-0.477***	-0.035	0.137***	0.026
SocStat unemployed	-0.092***	-0.037	0.077***	0.024	-0.781***	-0.111	-0.073***	-0.026
Female	0.018***	0.015	0.043***	0.027	-0.034**	-0.01	0.038***	0.028
Age 18-24	-0.06***	-0.014	-0.088***	-0.015	0.211***	0.018	-0.006	-0.001
Age 25-29	-0.017	-0.006	-0.064***	-0.018	0.094***	0.012	0.013	0.004
Age 40-49	0.001	0.001	0.069***	0.04	-0.117***	-0.032	0.018**	0.012
Age 50-59	0.011*	0.008	0.117***	0.063	-0.203***	-0.051	0.028***	0.017
Age 60-63	0.034***	0.014	0.126***	0.039	-0.149***	-0.021	0.081***	0.029
Age 64-75	-0.008	-0.006	0.078***	0.041	-0.131***	-0.032	0.087***	0.053
Age 76 +	-0.091***	-0.037	0.091***	0.029	-0.665***	-0.097	0.024	0.009
<b>From model 1 to model 2:</b>	// R <sup>2</sup> change: 0.023		// R <sup>2</sup> change: 0.086		// R <sup>2</sup> change: 0.047		// R <sup>2</sup> change: 0.018	

\*\*\* p < 0.01

\*\* p < 0.05

\* p < 0.1

1) N: 39867. Outliers filter: CO2\_total < 7788g per quarter, based upon Stem-and-Leaf plot for CO2\_total

2) N: 39059. Outliers filter: ln\_CO2\_home > 4.7 & ln\_CO2\_home < 9.1, based upon Stem-and-Leaf plot for ln\_CO2\_home

3) N: 42260. Outliers filter: none



# Household size and emissions

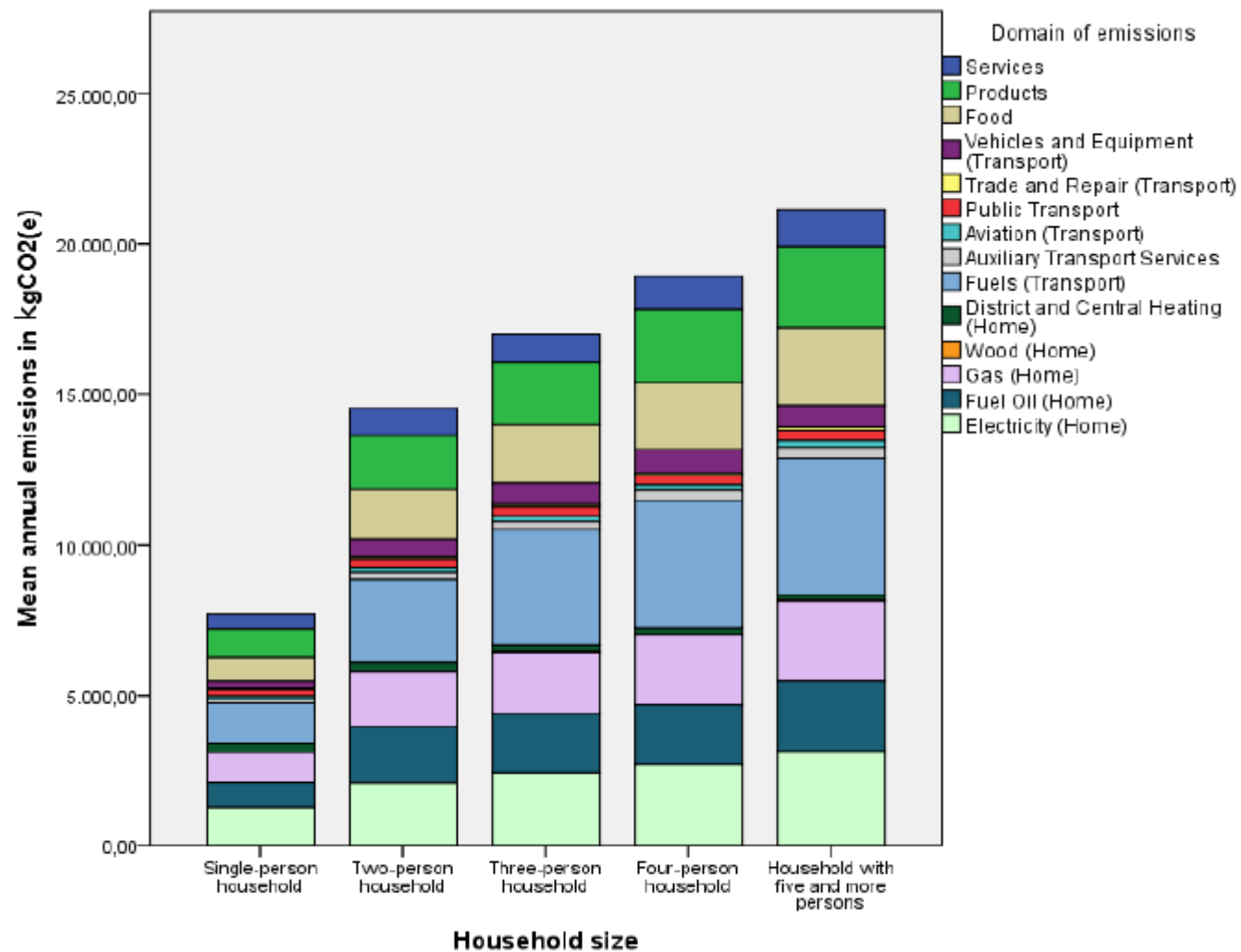


Figure 11: Emissions in kgCO<sub>2</sub>(e) from households with different size

# Income and emissions

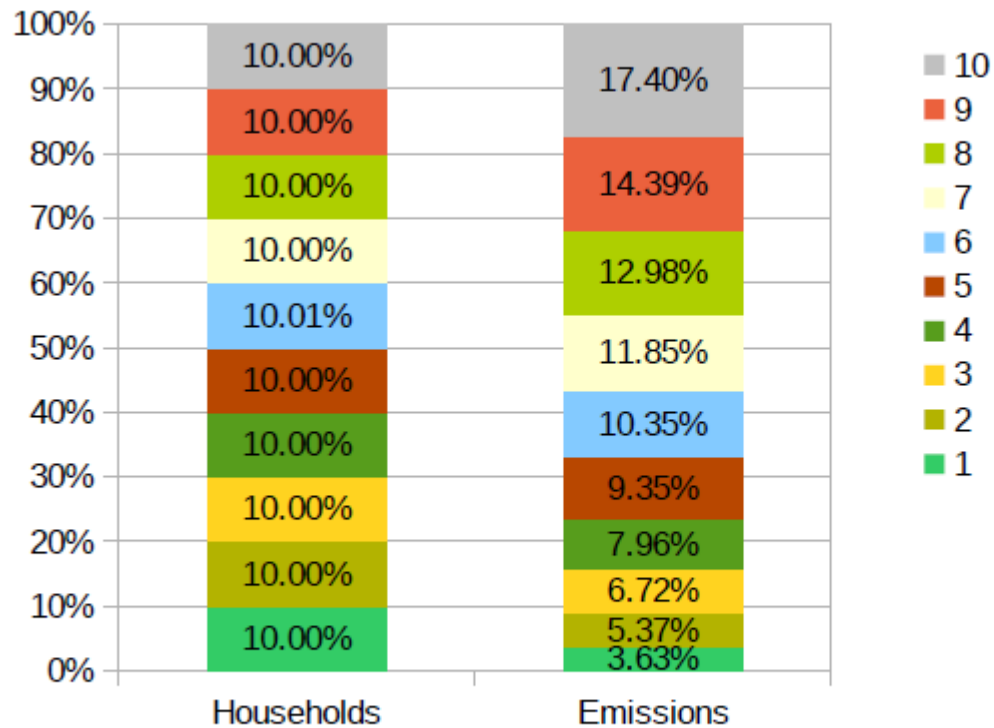
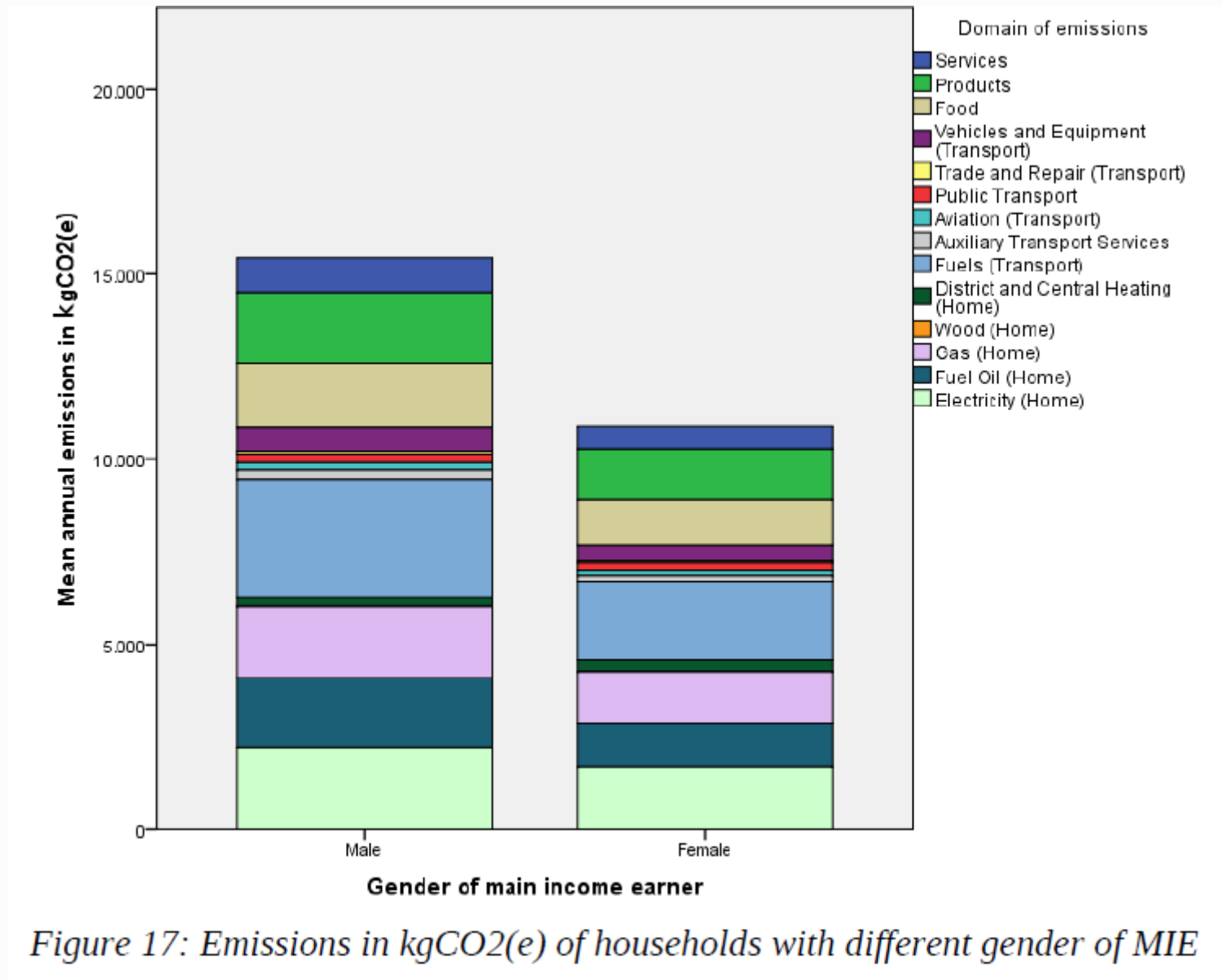


Figure 10: Share of households and share of household emissions by dispos. income deciles

# Gender of MIE and emissions



# Federal State (Bundesländer) and emissions

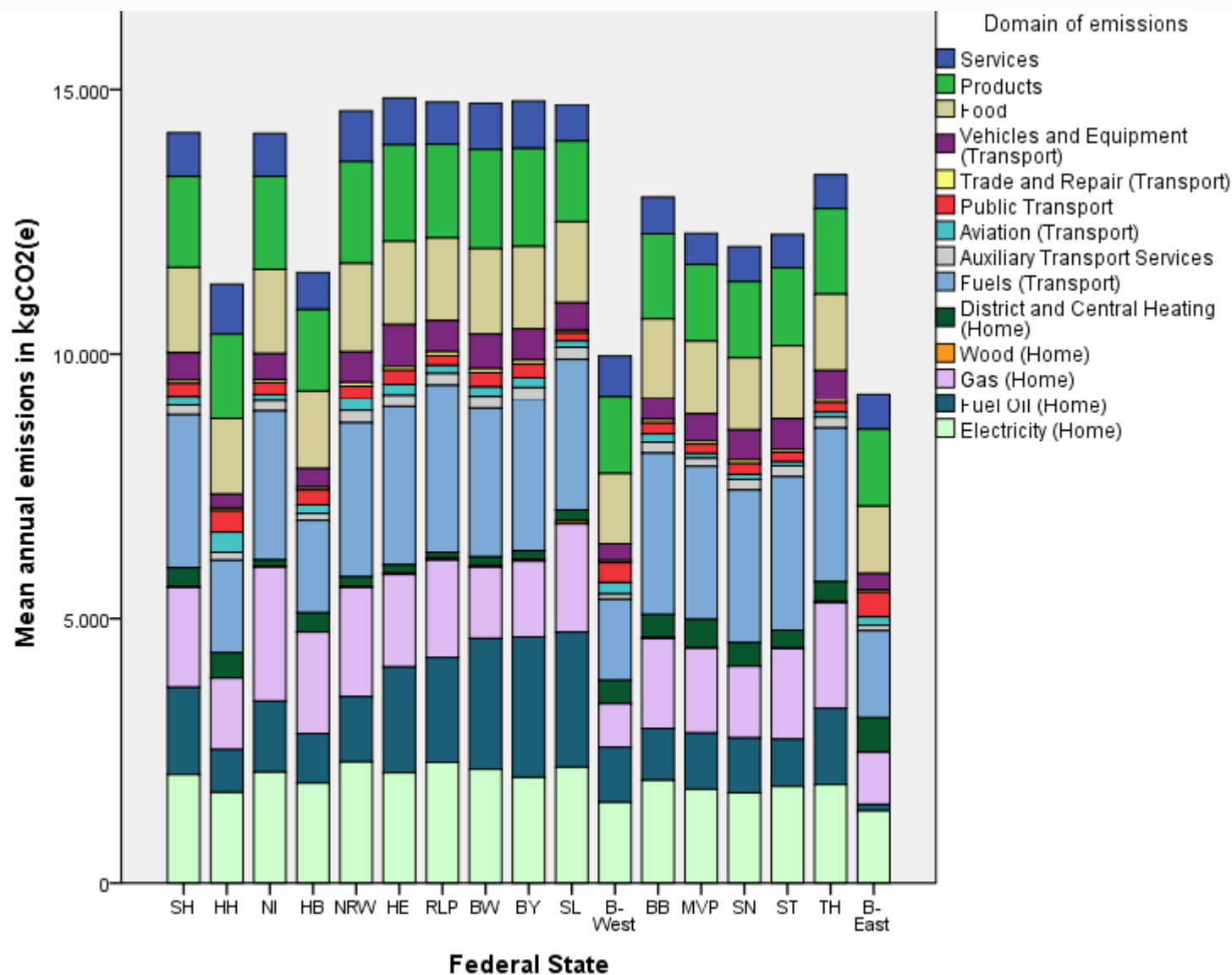


Figure 22: Emissions in kgCO<sub>2</sub>(e) of households in different federal states of Germany

# Federal State (Bundesländer) and emissions

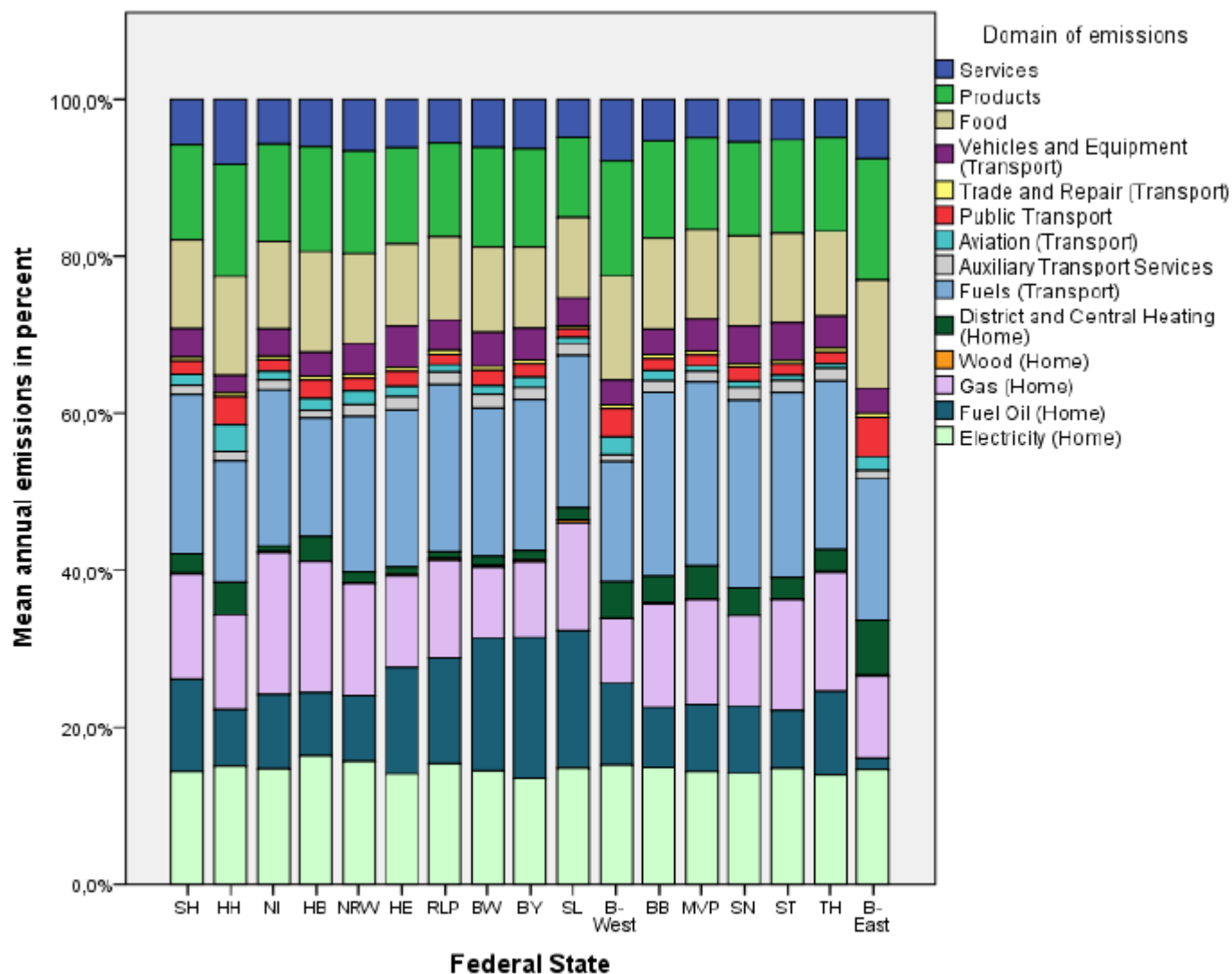


Figure 23: Emissions in percent of households in different federal states of Germany

# Urbanism and emissions

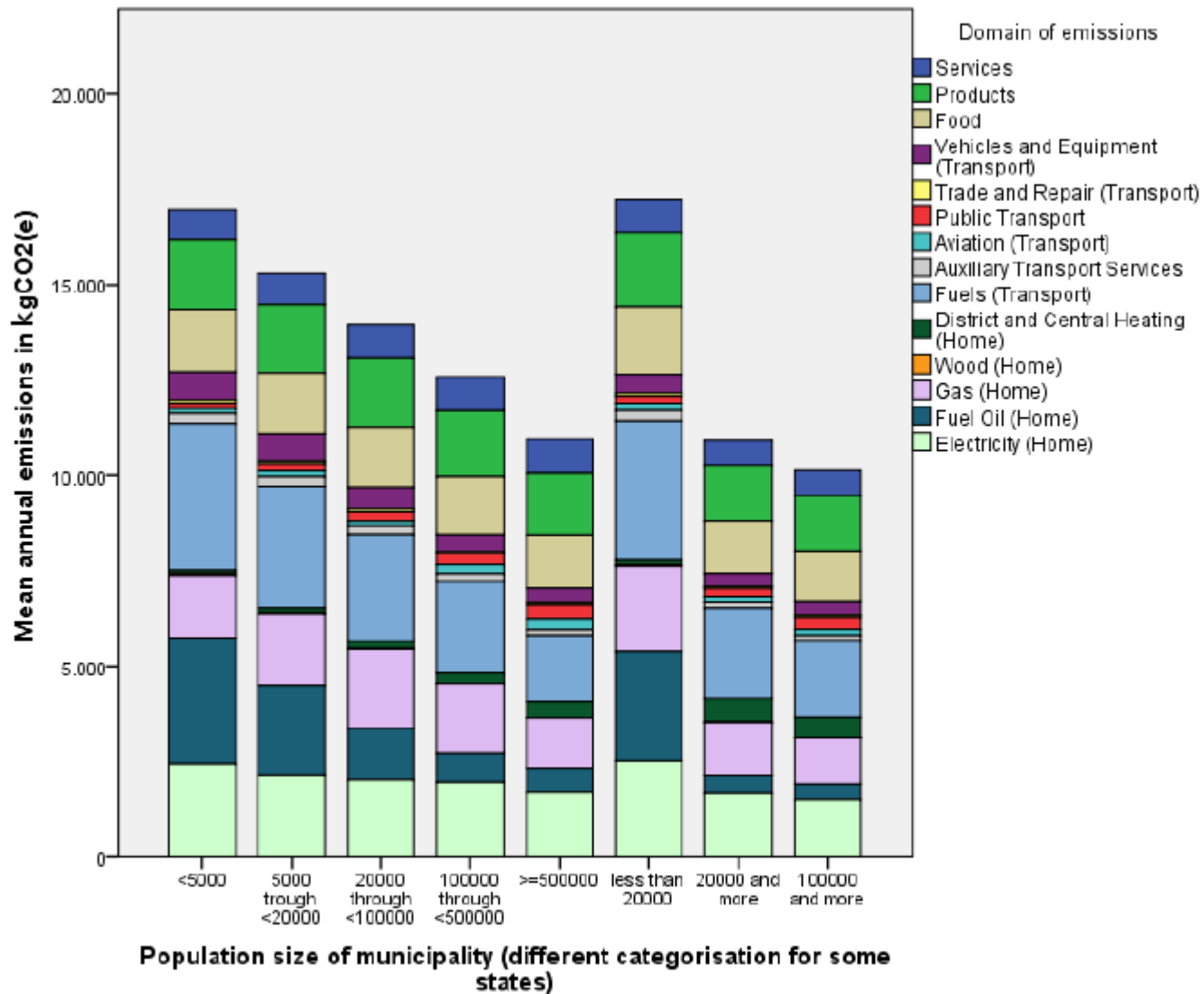
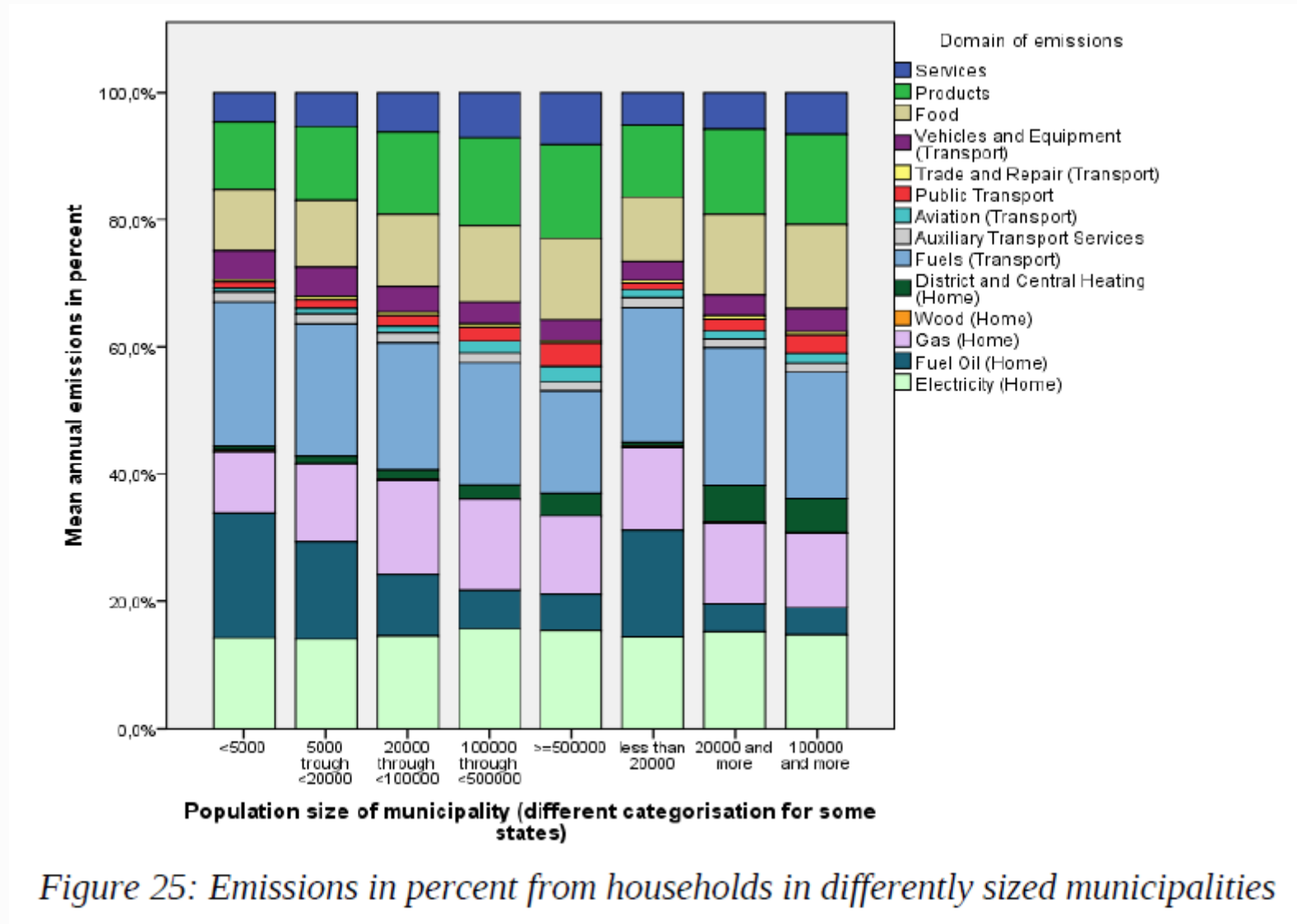


Figure 24: Emissions in kgCO<sub>2</sub>(e) from households in differently sized municipalities



# Urbanism and emissions



# Age and emissions

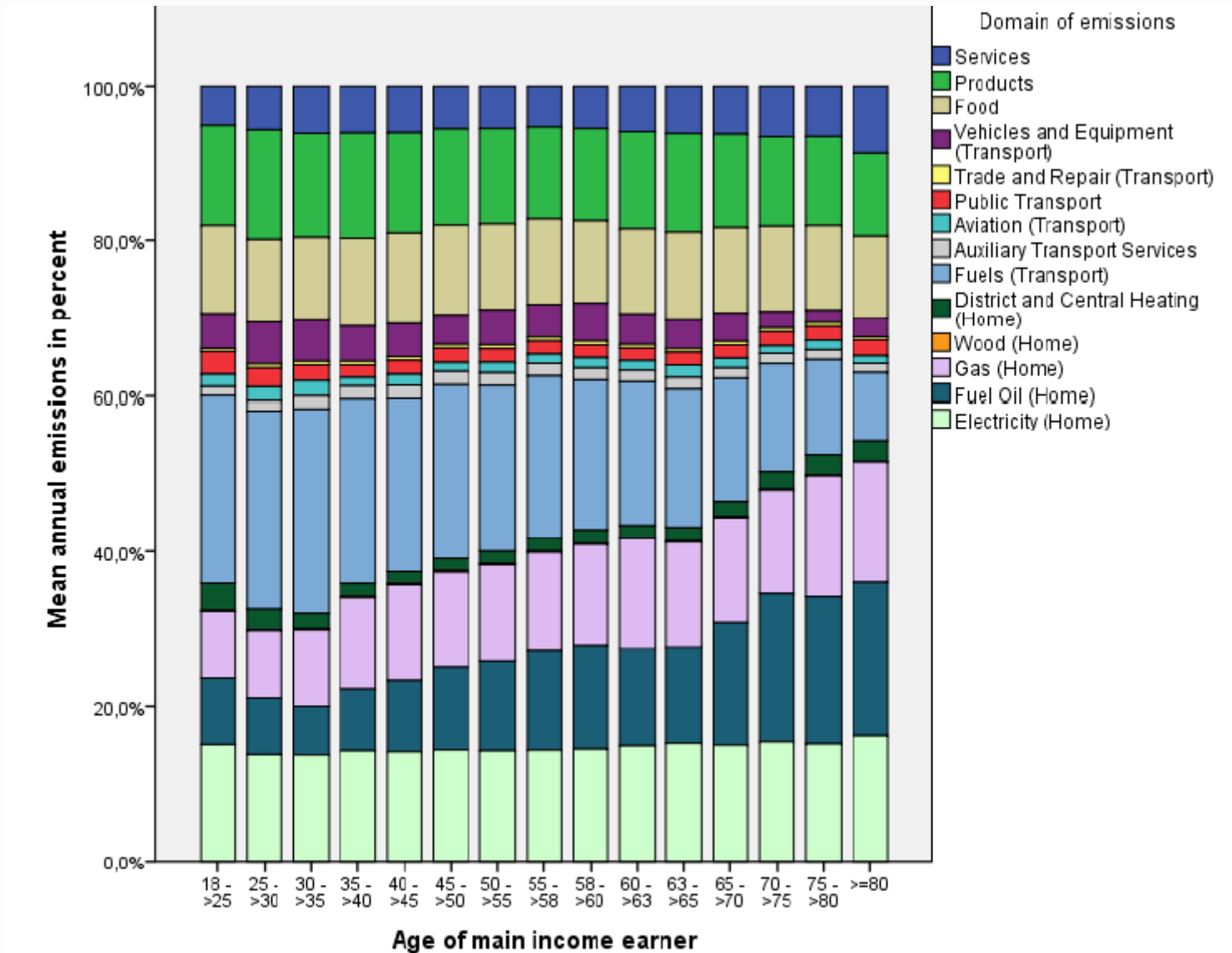


Figure 28: Emissions in percent of households with different age groups of MIE

# Household type and emissions

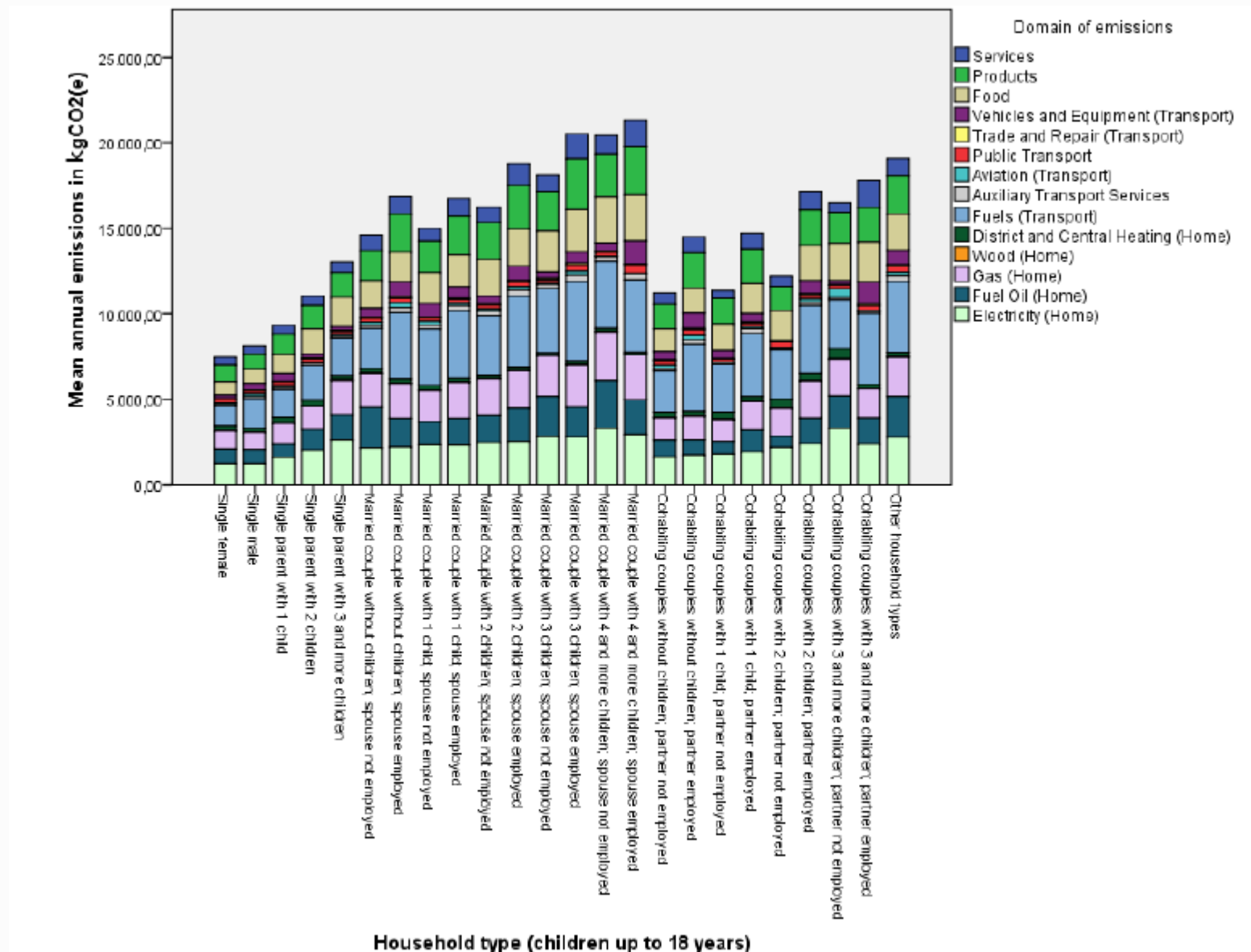


Figure 30: Emissions in kgCO<sub>2</sub>(e) from different household types

# Home ownership, renting and emissions

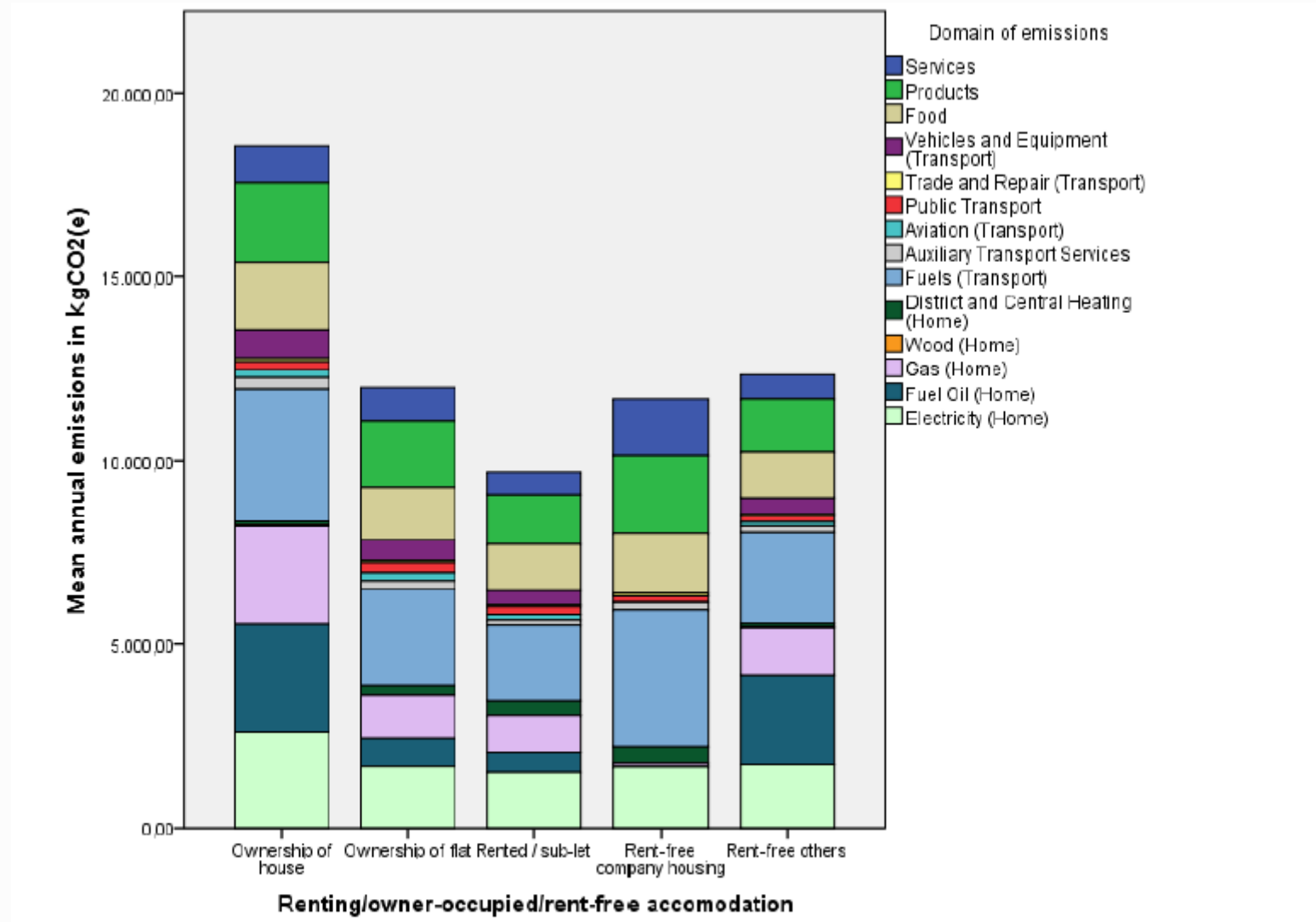


Figure 31: Emissions in kgCO<sub>2</sub>(e) of households living in rented, owner-occupied and rent-free accommodation

# Construction year of building and emissions

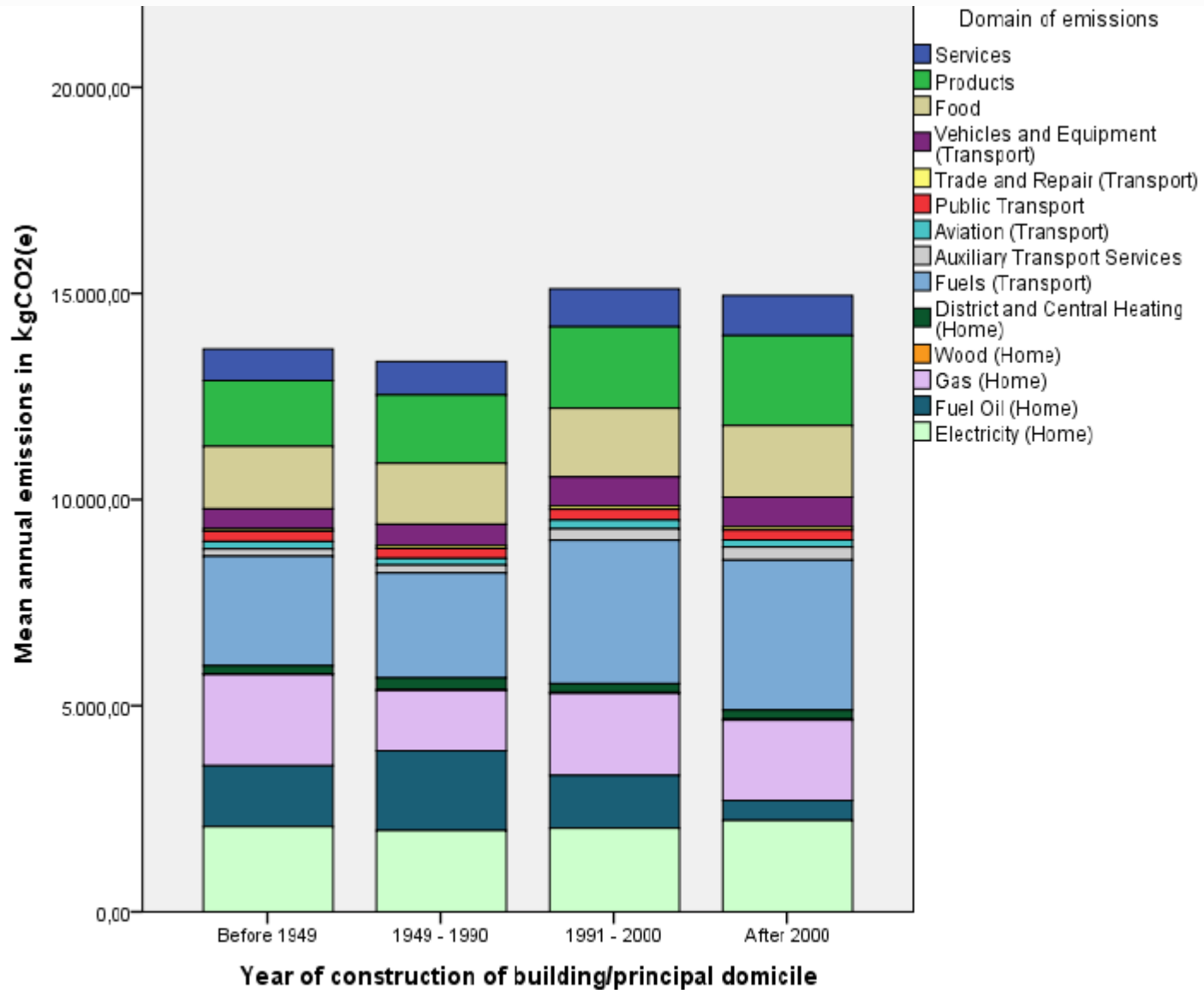


Figure 29: Emissions in kgCO<sub>2</sub>(e) of households with different construction year of building