

GILDED research project carbon calculator

Methods and results

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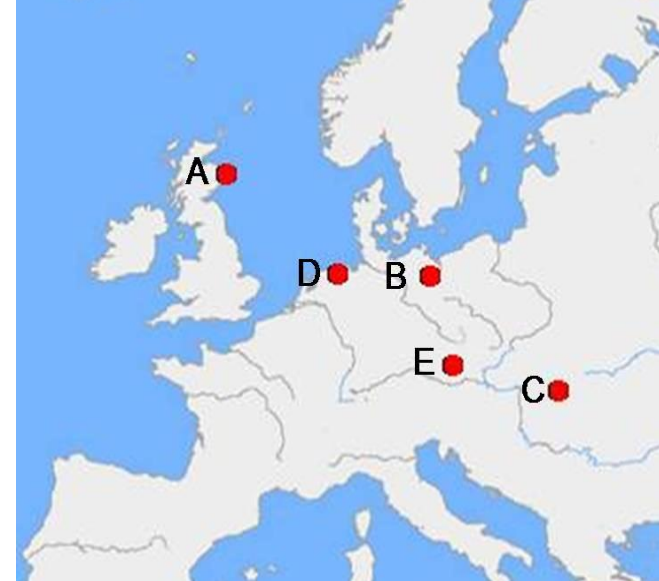
Vera Peters, Jan Vávra
*Methods and results of a CO₂
calculator*



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Study Design of GILDED



- Focus of the project is on household energy consumption and CO₂ emissions and social psychological, sociological and structural factors influencing it
- Collaborative research: Case studies in 5 European countries:
 - (A) **Scotland:** Aberdeen and Aberdeenshire
 - (B) **Germany:** Potsdam and Potsdam-Mittelmark
 - (C) **Hungary:** Debrecen and Hajdú-Bihar County
 - (D) **The Netherlands:** Assen and Assen Municipality
 - (E) **The Czech Republic:** České Budějovice and Budějoviceshire
- Quantitative Household survey 2010 & 2011 including an CO₂-calculator → in 2010 n=2.486
- Experimental design: combination of three intervention elements

Survey Design

- Cluster Sampling, Drop and Collect
- Intervention elements for experimental group



Fragebogen

Energienutzung von Haushalten

Durch den ersten Teil der Fragen lässt sich der CO₂-Fußabdruck Ihres Haushalts berechnen. Dies ist die Menge an CO₂, die durch Aktivitäten Ihres Haushalts erzeugt wird.

Hinweise zum Ausfüllen:

- Die meisten Fragen beziehen sich auf Ihren gesamten Haushalt.
- Es gibt nur wenige Fragen, die sich auf Sie als Person beziehen. Diese sind mit „individuelle Antwort“ gekennzeichnet.
- Bitte lassen Sie keine Fragen aus! Für uns ist es wichtig, dass alle Fragen beantwortet werden.
- Antworten Sie möglichst spontan.

Carbon Footprint Calculator

Before you fill out this questionnaire, you might find it useful to have your gas and electricity bills to hand.

Please answer these questions thinking about your whole household.

Energiespartipps

Mit Hilfe dieser 23 Energiespartipps können Sie in Ihrem Haushalt viel Energie sparen und die Umwelt schonen.

Ich erkläre mich bereit, den Verbrauch von Elektrizität und/ oder Heizenergie in meinem Haushalt in den nächsten 12 Monaten zu senken. Um meinen CO₂ Ausstoß zu reduzieren, werde ich...

Heizen/ Waschen&Badezimmer	Ich erkläre mich bereit, die folgenden Maßnahmen in meinem Haushalt umzusetzen	Mache ich bereits - und erkläre mich bereit, es weiterhin zu machen	Einsparung in Prozent an den jährlichen CO ₂ -Emissionen eines Haushalts
• Haus und Dach isolieren (pro 100 gm)	<input type="checkbox"/>	<input type="checkbox"/>	10%
• Nachts und bei längerer Abwesenheit die Heizung herunterdrehen (je 3 °C kühler)	<input type="checkbox"/>	<input type="checkbox"/>	1,8%
• Die Heizung tagsüber herunterdrehen (je 1 °C kühler)	<input type="checkbox"/>	<input type="checkbox"/>	1,2%
• Wäsche an der Luft trocknen	<input type="checkbox"/>	<input type="checkbox"/>	1,2%
• Die Waschmaschine immer voll laden	<input type="checkbox"/>	<input type="checkbox"/>	0,2%
• Wäsche bei niedrigeren Temperaturen waschen (60 °C statt 90 °C und 30 °C statt 60°C) je einmal die Woche	<input type="checkbox"/>	<input type="checkbox"/>	0,2%
• Kürzer duschen (2 Minuten pro Dusche)	<input type="checkbox"/>	<input type="checkbox"/>	0,2%
• Weniger häufig baden (einmal weniger pro Woche)	<input type="checkbox"/>	<input type="checkbox"/>	0,0%
• Einen Sparduschkopf anschaffen und benutzen	<input type="checkbox"/>	<input type="checkbox"/>	2%

Um meinen CO₂ Ausstoß zu reduzieren, werde ich...

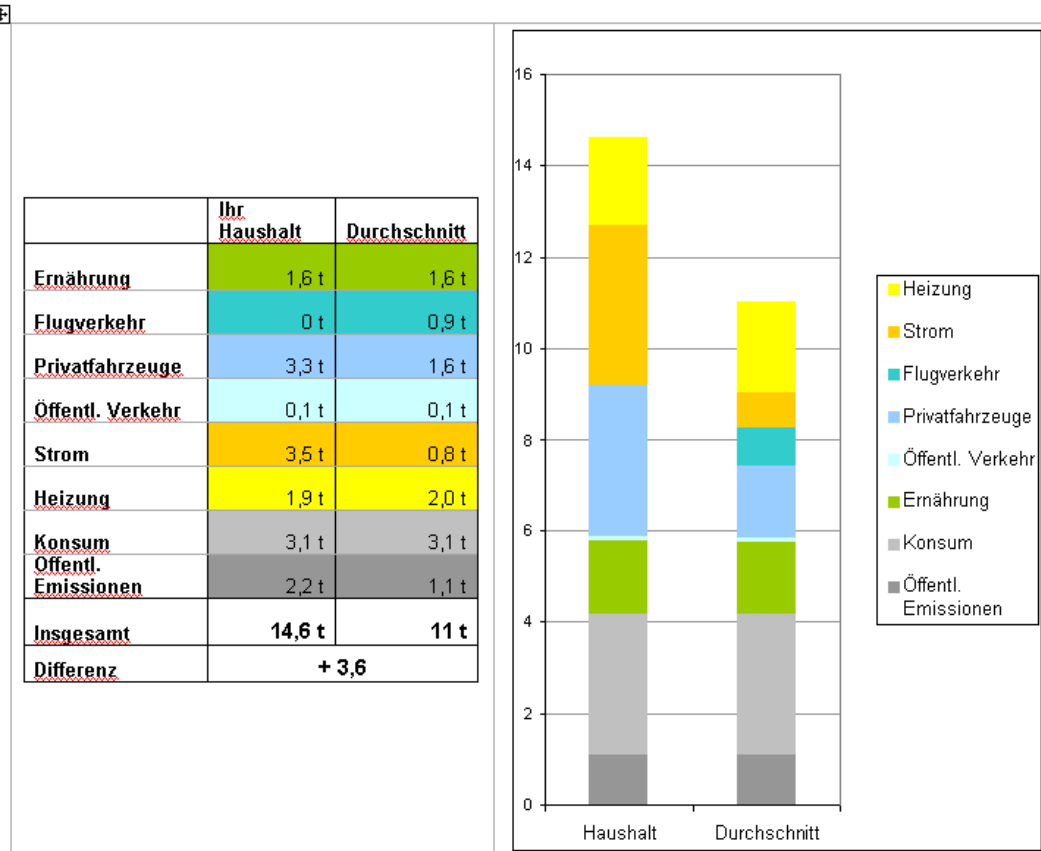
Elektrizität/ Neue Haushaltsgeräte	Ich erkläre mich bereit, die folgenden Maßnahmen in meinem Haushalt umzusetzen	Mache ich bereits - und erkläre mich bereit, es weiterhin zu machen	Einsparung in Prozent an den jährlichen CO ₂ -Emissionen eines Haushalts
• Geräte nicht im Stand-by Betrieb lassen	<input type="checkbox"/>	<input type="checkbox"/>	1,2%
• Energiesparlampen in fünf häufig benutzten Lampen einsetzen	<input type="checkbox"/>	<input type="checkbox"/>	1,2%

Response Rates

		Czech Republic	Germany
2010	Total target sample	5000	1842
	Number of questionnaires returned	500	543
	Response rate	10%	29%
2011	Number of questionnaires returned	309	320
	Drop-out rate between 2010 and 2011	38%	41%
	Number of Respondents a CO ₂ footprint could be calculated for	292	300

CO2 footprinting as a mobilizing tool in the field of climate protection

CO₂ Fußabdruck 2010/11* von Haushalt P_Ex_17 im Vergleich zum durchschnittlichen 1 Personen Haushalt in Deutschland



* Angaben aus der 2. Befragung

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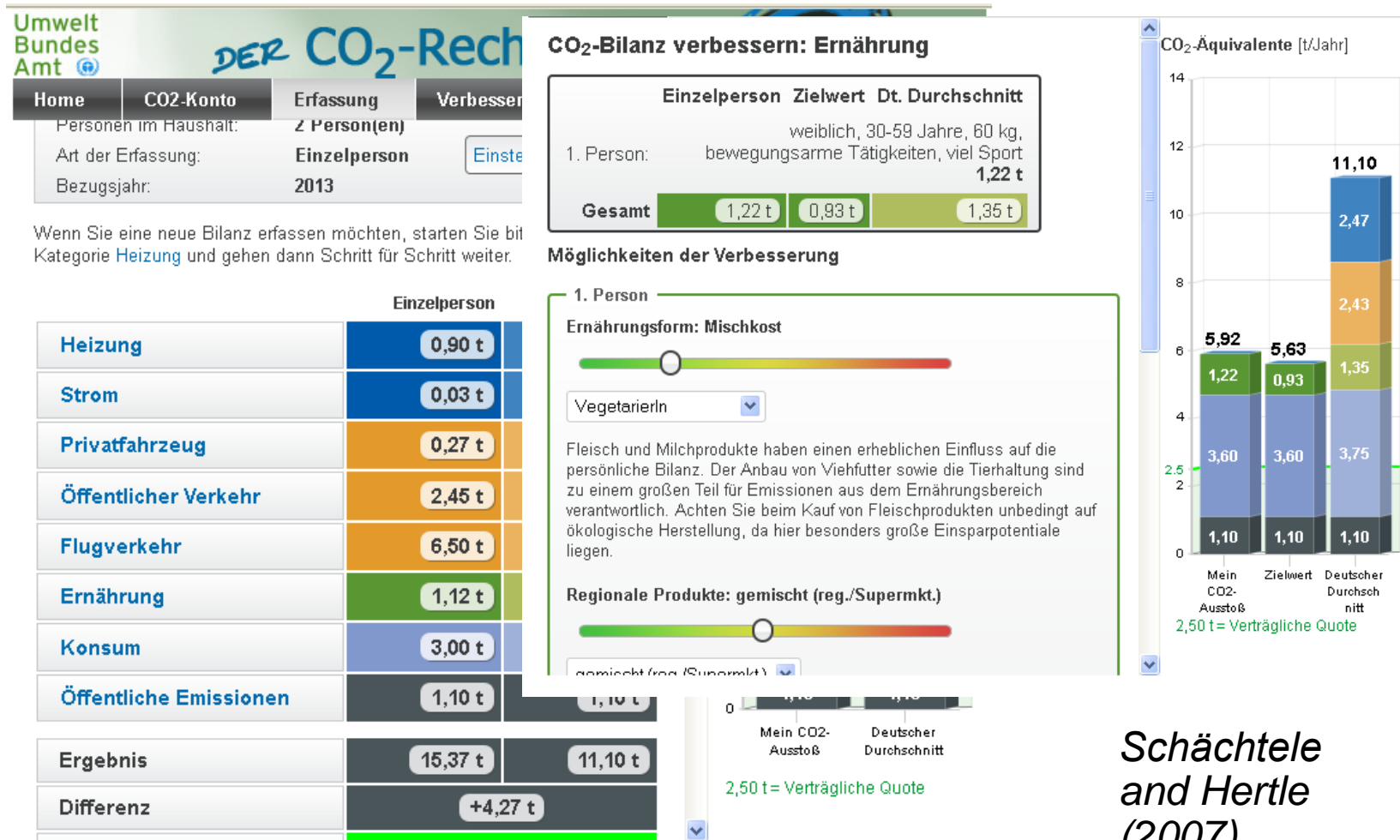


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Design of the personal CO2 Calculator

Definition: general carbon footprint as the **direct** and **indirect** greenhouse gas emissions measured in tons of **CO2-equivalents**, which is required to satisfy a **given consumption** (Minx et al., 2009).



Survey Data







19. Approximately how many lightbulbs does your house have?

20. How many of these lights have you swapped for low energy lightbulbs?

21. How often do you turn lights off when nobody is using them?

Never Always

22. Please tick which (and how many) of the appliances can be found in your household. Also indicate the efficiency class and the age of the appliances

Appliance	How old is this appliance (approximately)	What is the efficiency class? (A++, A+, A, B, C, D, E, F, or G)
 Fridge-Freezer Number <input type="text"/> Don't have one <input type="checkbox"/>	1 - 12 years <input type="checkbox"/> Over 12 years <input type="checkbox"/> I don't know <input type="checkbox"/>	Efficiency class: <input type="text"/> Don't know <input type="checkbox"/>
 Fridge Number <input type="text"/> Don't have one <input type="checkbox"/>	1 - 12 years <input type="checkbox"/> Over 12 years <input type="checkbox"/> I don't know <input type="checkbox"/>	Efficiency class: <input type="text"/> Don't know <input type="checkbox"/>
 Freezer Number <input type="text"/> Don't have one <input type="checkbox"/>	1 - 12 years <input type="checkbox"/> Over 12 years <input type="checkbox"/> I don't know <input type="checkbox"/>	Efficiency class: <input type="text"/> Don't know <input type="checkbox"/>
 Dish Washer Number <input type="text"/> Don't have one <input type="checkbox"/>	1 - 2 years <input type="checkbox"/> 3 - 5 years <input type="checkbox"/> Over 5 years <input type="checkbox"/> I don't know <input type="checkbox"/>	Efficiency class: <input type="text"/> Don't know <input type="checkbox"/>
 Dryer Number <input type="text"/> Don't have one <input type="checkbox"/>	1 - 12 years <input type="checkbox"/> Over 12 years <input type="checkbox"/> I don't know <input type="checkbox"/>	Efficiency class: <input type="text"/> Don't know <input type="checkbox"/>
 Washing Machine Number <input type="text"/> Don't have one <input type="checkbox"/>	1 - 12 years <input type="checkbox"/> Over 12 years <input type="checkbox"/> I don't know <input type="checkbox"/>	Efficiency class: <input type="text"/> Don't know <input type="checkbox"/>

15. Do you have your energy bills to hand, or know how much you pay on average for your energy usage?

Yes
 No

What kind of GAS payments do you make? <input type="checkbox"/> Not applicable <input type="checkbox"/> Monthly <input type="checkbox"/> Quarterly <input type="checkbox"/> Yearly <input type="checkbox"/> Pre-payment meter (estimate monthly spend)	What is your spend/usage? Spend (£) <input type="text"/> or..... Usage (kWh) <input type="text"/>
What kind of ELECTRICITY payments do you make? <input type="checkbox"/> Not applicable <input type="checkbox"/> Monthly <input type="checkbox"/> Quarterly <input type="checkbox"/> Yearly <input type="checkbox"/> Pre-payment meter (estimate monthly spend)	What is your spend/usage? Spend (£) <input type="text"/> or..... Usage (kWh) <input type="text"/>
What kind of OIL payments do you make? <input type="checkbox"/> Not applicable <input type="checkbox"/> Monthly <input type="checkbox"/> On Delivery <input type="checkbox"/> Yearly	What is your spend/usage? Spend (£) <input type="text"/> or..... Usage (litres) <input type="text"/>
What kind of LPG payments do you make? <input type="checkbox"/> Not applicable <input type="checkbox"/> Monthly <input type="checkbox"/> On Delivery <input type="checkbox"/> Yearly	What is your spend/usage? Spend (£) <input type="text"/> or..... Usage (litres) <input type="text"/>
What kind of COAL payments do you make? <input type="checkbox"/> Not applicable <input type="checkbox"/> Monthly <input type="checkbox"/> On Delivery <input type="checkbox"/> Yearly	What is your spend/usage? Spend (£) <input type="text"/> or..... Usage (Kg) <input type="text"/>
What kind of WOOD/BIO MASS payments do you make? <input type="checkbox"/> Not applicable <input type="checkbox"/> Monthly <input type="checkbox"/> On Delivery <input type="checkbox"/> Yearly	What is your spend/usage? Spend (£) <input type="text"/> or..... Usage (kg) <input type="text"/>

Calculations

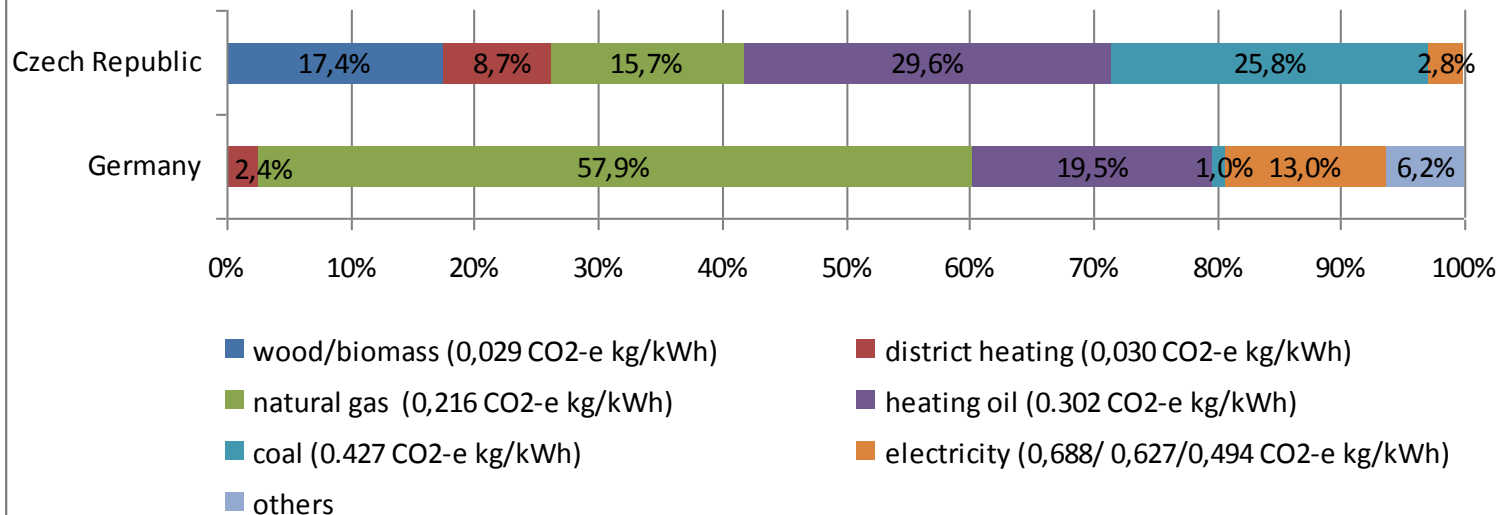
- national data and coefficients of different countries were used when possible

➤ Emission factors for **electricity**, additionally the emission factor for green electricity based on Gemis 4.5 (Öko-Institut)

German electricity mix	CO2-e kg/kWh	0.627
Czech electricity mix	CO2-e kg/kWh	0.688
UK electricity mix	CO2-e kg/kWh	0.494
German green electricity	CO2-e kg/kWh	0.04

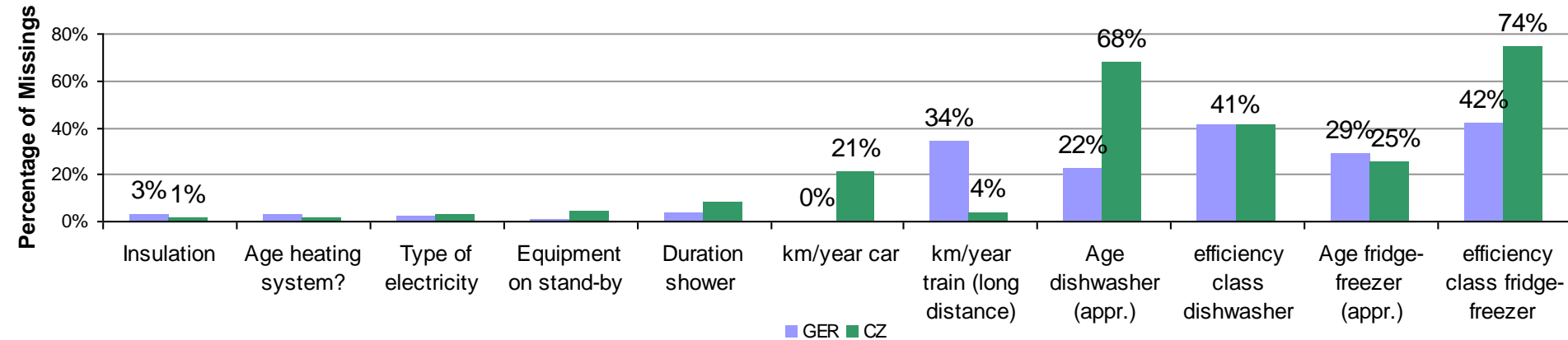
➤ Emission factors for **heating**, based on Klimaktiv 2.0

Share of energy sources used for heating 2011

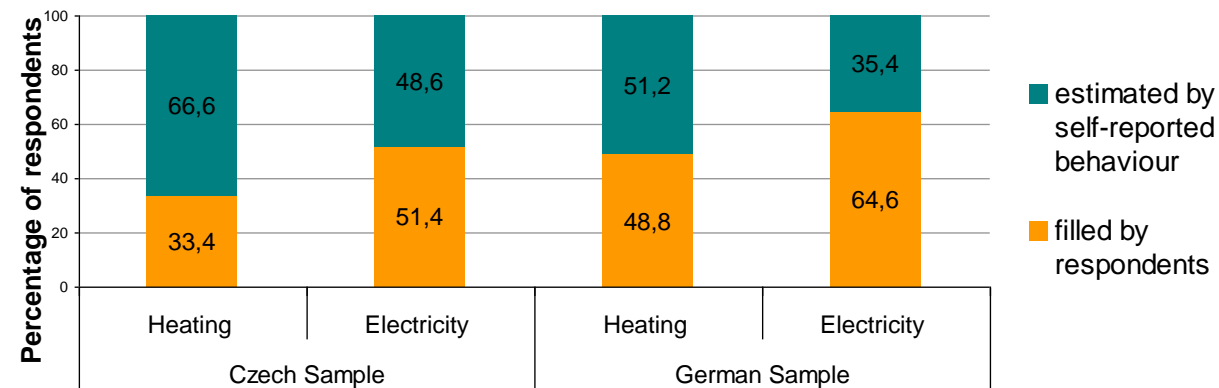


First Results of the the CO2 Calculator

(a) Missing Data



(b) Self-reported behaviour vs. energy bills



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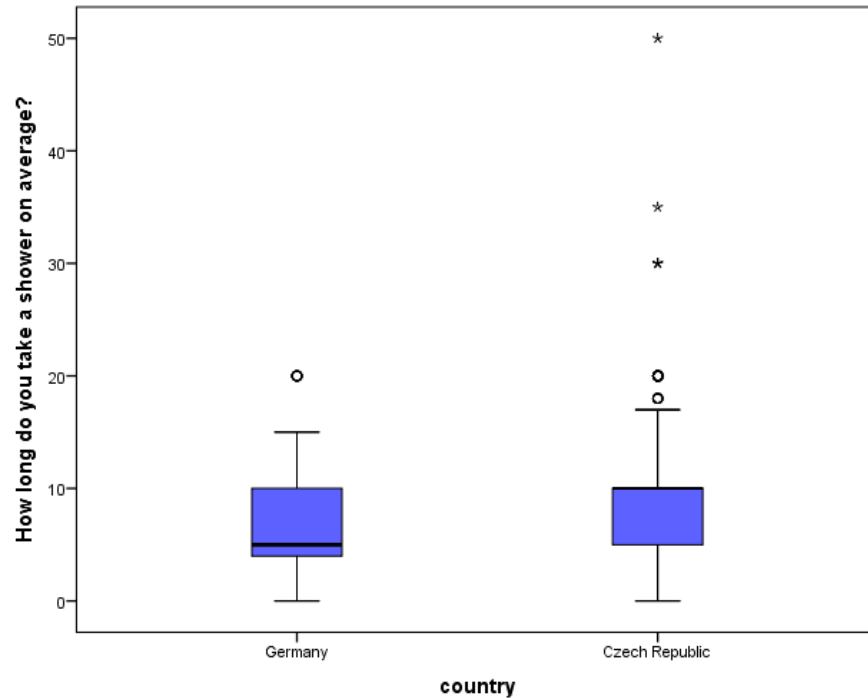


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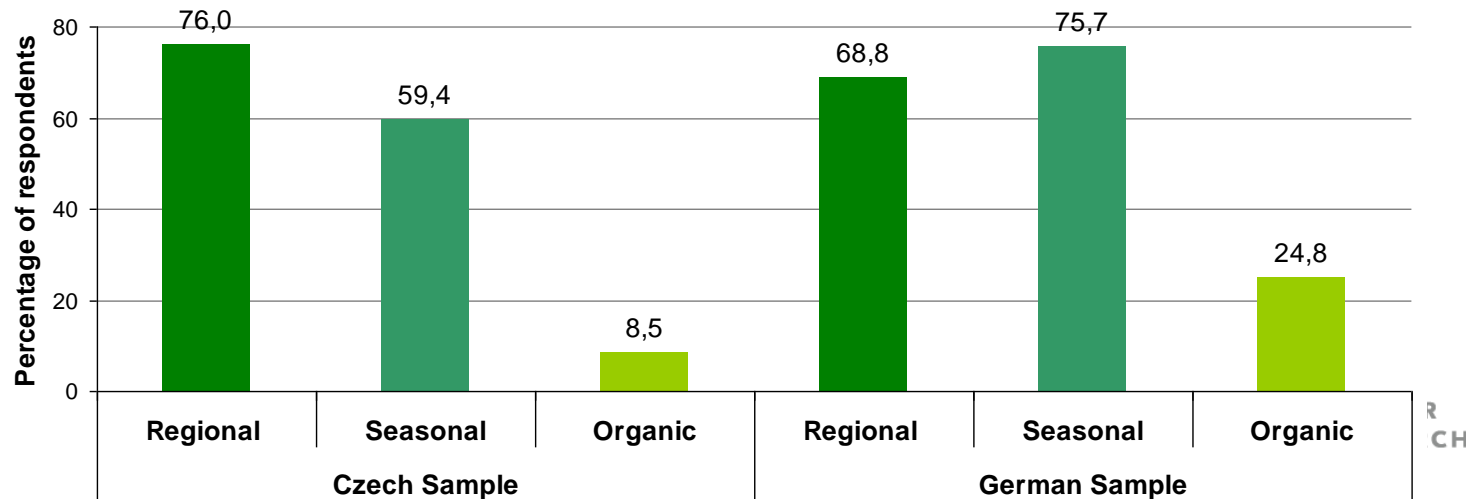


First Results of the the CO2 Calculatur

(c) Extreme & mistaken Data



(d) Biased data (normative topic)



RECH

Quality of the Data

*Pearson's r for Bills * Predictions*

Notieren Sie die verbrauchte Menge des entsprechenden Brennstoffs
(z.B. Erdgas/Biogas, Heizöl, LPG, Holzpellets, Fernwärme etc.)

Beispiel

Heizsystem/Brennstoff	Verbrauch	Einheit	Zeitraum
Erdgas	1.143	kWh	10.02.2006 – 8.2.2007

14480 Potsdam, Beispielerstr. 10
Verbrauchsstelle: 50000000-40000000-30000000

Verbrauchsermittlung Gas
Zählpunkt: DE70102714480000000000000000000000

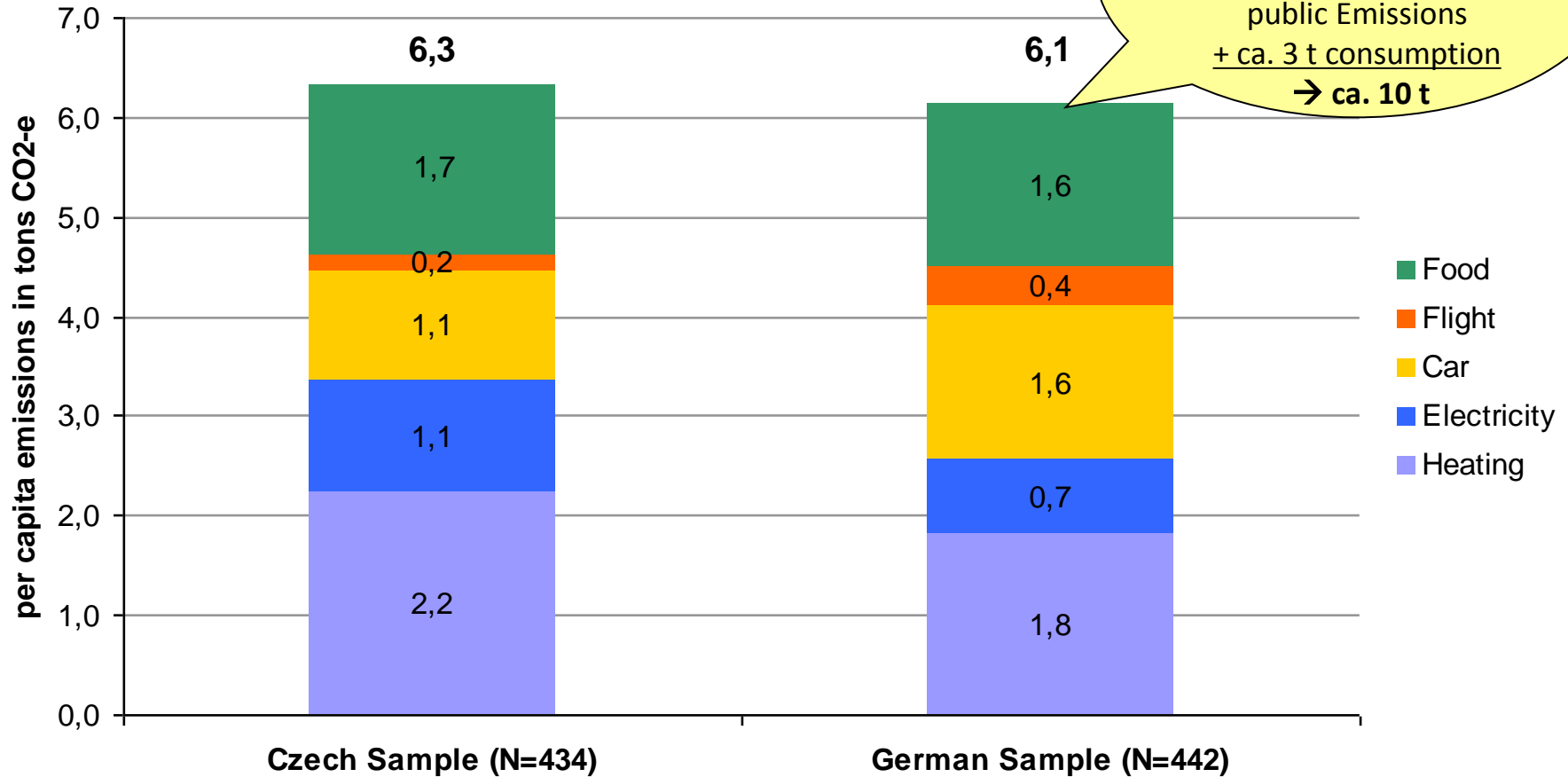
Abrechnung 1	2	Zähler- nummer 3	Zählerstand alt 4	Zählerstand neu 5	Ableses- zeit 6	Differenz 7	Faktor 8	Lieferungs- Menge 9
10.02.2006	31.07.2006	12302617	1.521	1.572	14/03	51	10,989	560 kWh
01.08.2006	30.09.2006	12302617	1.572	1.589	14/03	17	10,989	187 kWh
01.10.2006	31.12.2006	12302617	1.589	1.617	09/02	28	10,989	308 kWh
01.01.2007	08.02.2007	12302617	1.617	1.629	24/01	8	11,017	88 kWh

Verbrauchsperiode: 1.143 kWh für 364 Tage
Verbrauch Vorperiode: 1.260 kWh für 366 Tage

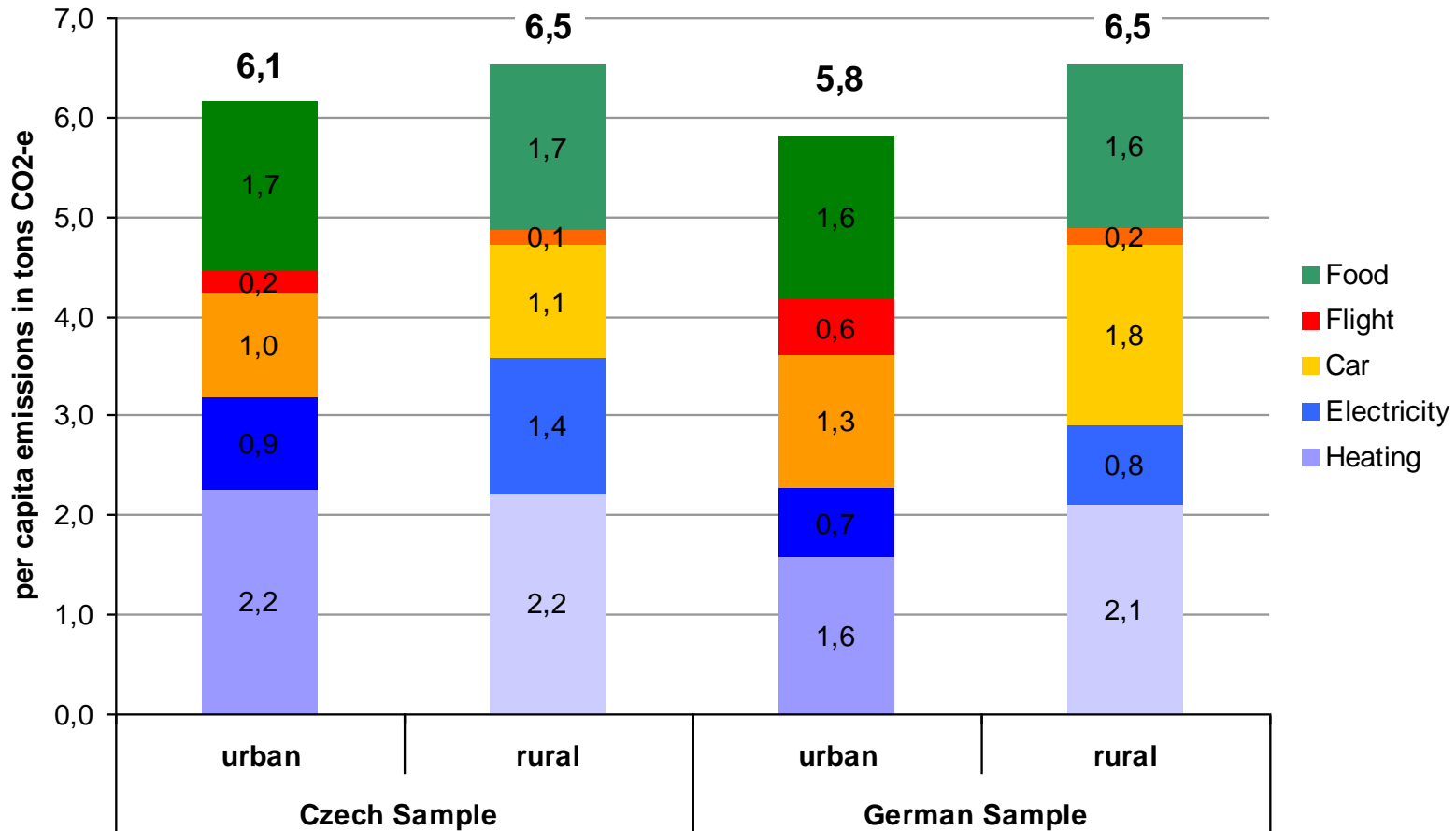
Heizsystem/Brennstoff	Verbrauch	Einheit	Zeitraum
		(z.B. kWh, m3, etc.)	(TT/MM/JJ-TT/MM/JJ)

	Electricity	Heating
Czech	,469***	,510***
rural	,393***	,451***
urban	,450***	,668***
German	,551***	104**
rural	,492***	-1,168
urban	,718***	,418***

CO2 calculations



Comparison rural and urban data



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Conclusions

- Interesting tool to estimate the overall environmental impact of individuals; but there are still aspects of energy consumption missing
- Estimations for heating and electricity appear to be of good quality (exception heating in German rural sample)
- But high amount of missing data
- For better results, more effort has to be put into the collection process: preferably direct interviews

References & Thank you!

Minx, J. C., Wiedmann, T., Wood, R., Peters, G. P., Lenzen, M., Owen, A., ... (2009). Input-output analysis and carbon footprinting: an overview of application. *Economic Systems Research*, 21(3), 187–216.

Klimaktiv (n.d.) CO2-Calculator Klimaktiv 2.0, retrieved from <http://klimaktiv.klimaktiv-CO2-582.rechner.de>

Öko-Institut (n.d.), GEMIS 4.5 (Globales emissions-modell integrierter systeme). Retrieved from <http://www.gemis.de/>

Schächtele, K. & Hertle, H. (2007). Die CO2 Bilanz des Bürgers: Recherche für ein internetbasiertes Tool zur Erstellung persönlicher CO2 Bilanzen. (CO2-Calculations for Citizens: Research for an online-based tool for personal CO2-calculations). Retrieved from <http://www.umweltdaten.de/publikationen/fpdf-l/3327.pdf>

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