Income-induced changes in resource usage – An LCA-based study of German households

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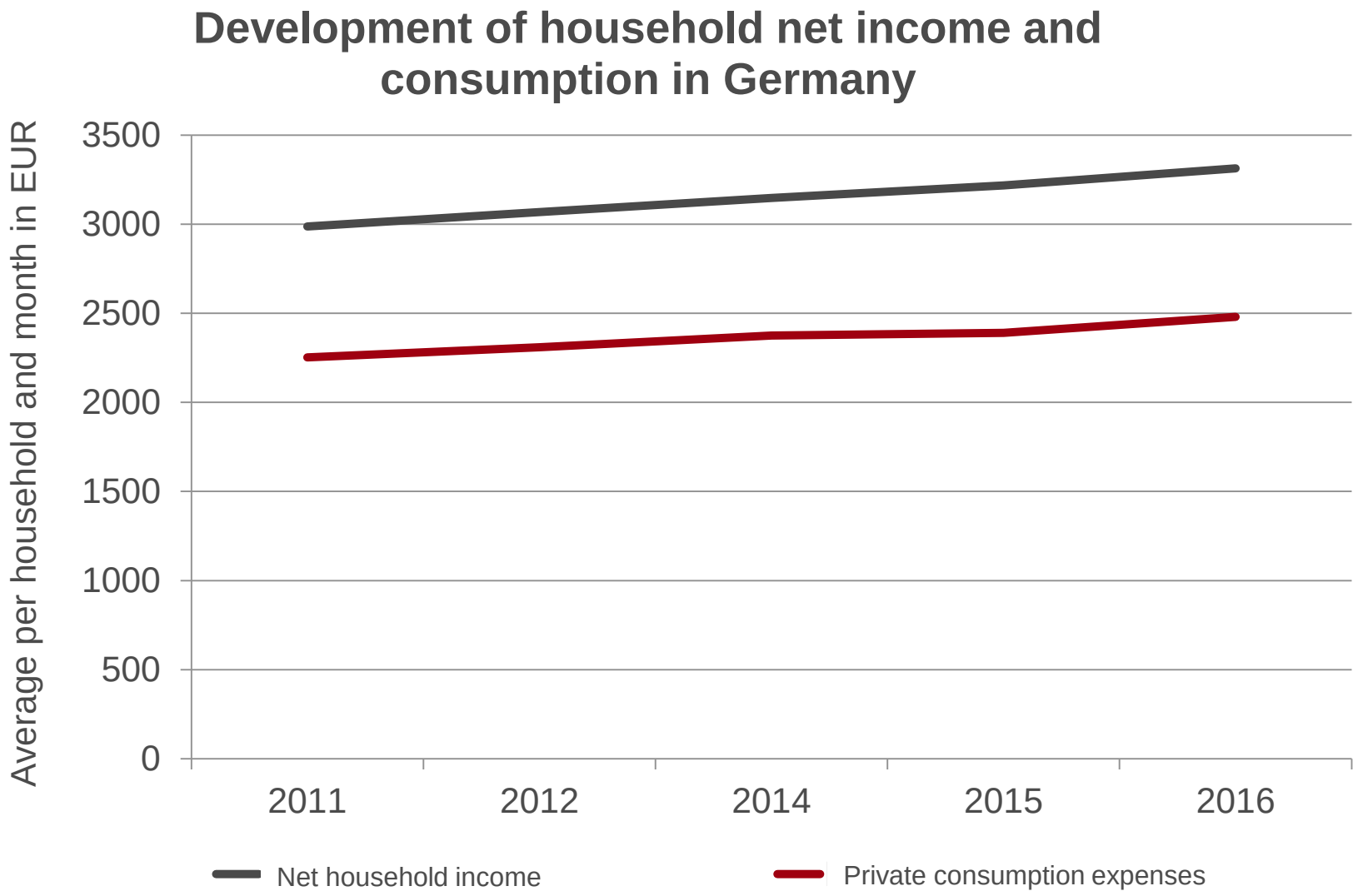
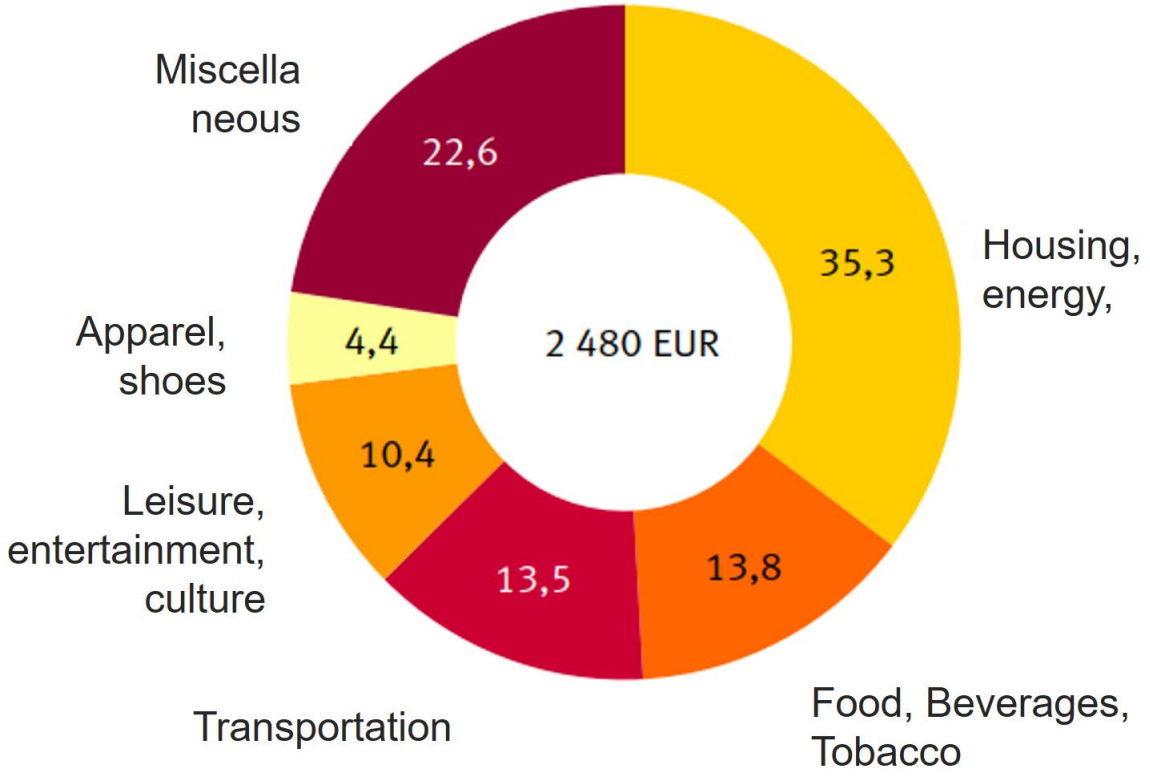
Background, Objective – Household income & consumption



Results from the *Laufende Wirtschaftsrechnungen* (LWR) „Continuous household budget surveys“

Background, Objective – the structure of consumption expenses

Consumption expenses of private households 2016 in Germany (shares in %)



Federal Statistical Office, Fachserie 15 Reihe 1, LWR 2016

Background, Objective: summary

- Consumption has direct and indirect (via the life cycle) resource depletion impact
- There is lack of empirical evidence about how household income, and household income change, relates to resource depletion, via consumption change
- Aim of the project: Determine the relation, on an empirical basis, between income and income changes on consumption and on resource depletion for selected products, services, and „areas of need“ (Bedarfsfelder)

Data & Methods – Bedarfsfelder (areas of needs)

- Considered: Mobility, food, clothing, habitation, HH goods, ICT
- Hypotheses developed about relationship between income (and other variables) and consumption
- Examples
  - M1: more HH income is connected with higher level of motorisation
  - W1: more HH income is connected with larger amount of living space
- Analysis also performed for entire *Areas of Needs*

GfK MobilityMonitor
- data basis -

Aim	Measuring mobility behaviour
Sample	▪ representative sample of net 18,500 private German households, with about 37,000 individuals
Population	▪ 74 Mio. German persons starting from age of 0 years
Type of investigation	▪ monthly, retrospektive, self-evaluation ▪ Ca. 92% online-participation, 8% offline-participation
Representative by:	▪ Age of the person ▪ HH size ▪ number of children under 14 ▪ Profession of HH main income person ▪ Bundesland, Regierungsbezirk ▪ size of the city / village (in classes) ▪ Internet usage yes/no ▪ Intensity of the internet usage

GfK MobilityMonitor - Detailled questionnaire topics

Holiday travel

- Target areas Germany
  Travel countries abroad
  Holiday region
  Travel time
  number of overnight stays
  Number of travelers
  Year of birth / Gender
  travel occasion
  Local activities
  Main means of transportation
  Accommodation (cat / hotel brand / catering)
  organizational form
  Booking period, location, type
  Used device for online bookings
  Online booking portal
  Information sources (for pre-booked trips)
  Travel expenses, expenses (on site, in total)
  tour operators
  departure Airport
  airline
  Satisfaction, recommendation, revisit

Day trips

- Private travel without overnight stay (50km easy distance)
  Travel time
  Furthest destination foreign destination
  Number of travelers
  Year of birth / Gender
  Travel description, occasion
  Main means of transportation
  departure Airport
  airline
  expenditure
  frequency

Business trips (1- and n-days)

- Business travel with / without overnight stay (over 50 km easy distance)
  Travel time
  Year of birth / Gender
  Number of travelers
  frequency
  travel occasion
  Distance Destination
  Furthest destination foreign destination
  Main means of transportation
  number of overnight stays
  Mileage covered
  accommodation

Commuting

- travel occasion
  frequency
  aim
  Distance to the place of residence
  Mileage covered
  Main means of transportation

Data & Methods – other data sources

- GfK Panel non-food, FMCG
- UFOPLAN-Project FKZ 3713 17 311 „Repräsentative Erhebung von Pro-Kopf-Verbräuchen natürlicher Ressourcen in Deutschland“
  - *Representative assessment of per-capita use of natural resources in Germany*
- ad-hoc questionnaire, developed to complement the data sources, in project
  - sample size: 1,082 HH (929 usable replies)
  - time: mid August 2018
  - sample per household (not: persons in HH)

Data & Methods – calculating resource impacts

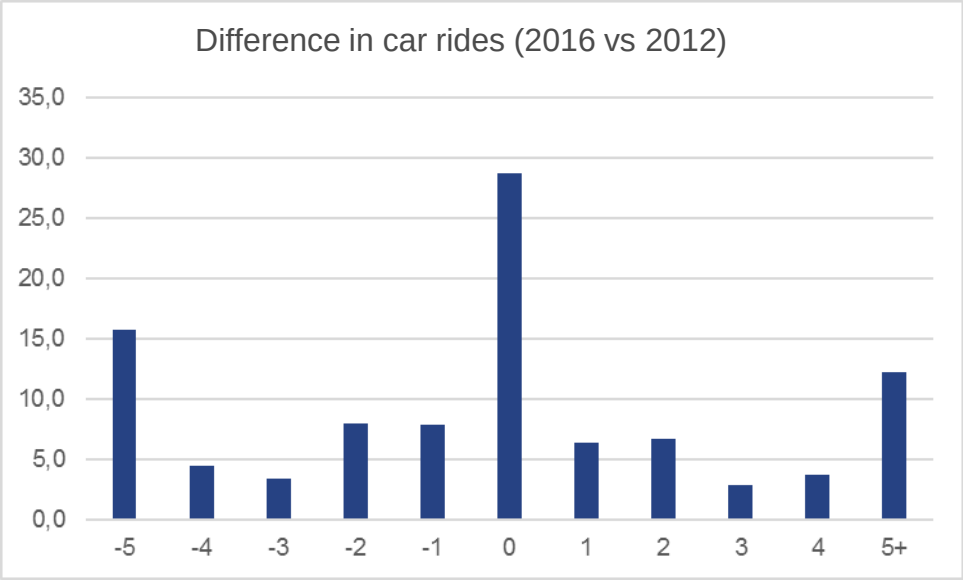
Ressource depletion indicators

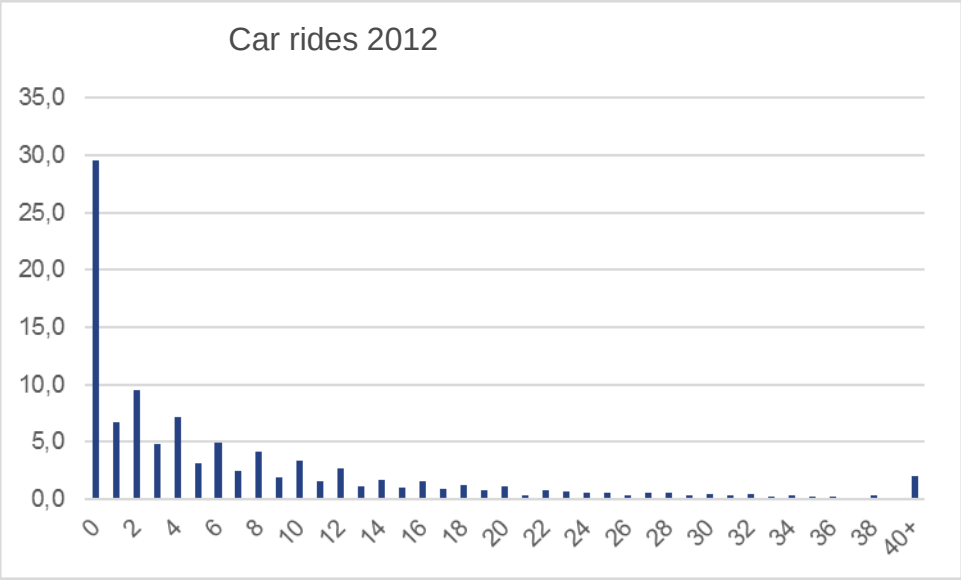
- cumulative energy demand [MJ]
- climate change potential (GWP100, IPCC 2013) [kg CO_2 eq.]
- abiotic resource depletion [kg Sb eq.], CML
- fossil resource depletion [MJ], CML
- land use, transformation [m^2/Jahr]
- water input [m^3]
- (cumulative resource demand – KRA [t])

Results, income and consumption

Results, mobility and consumption

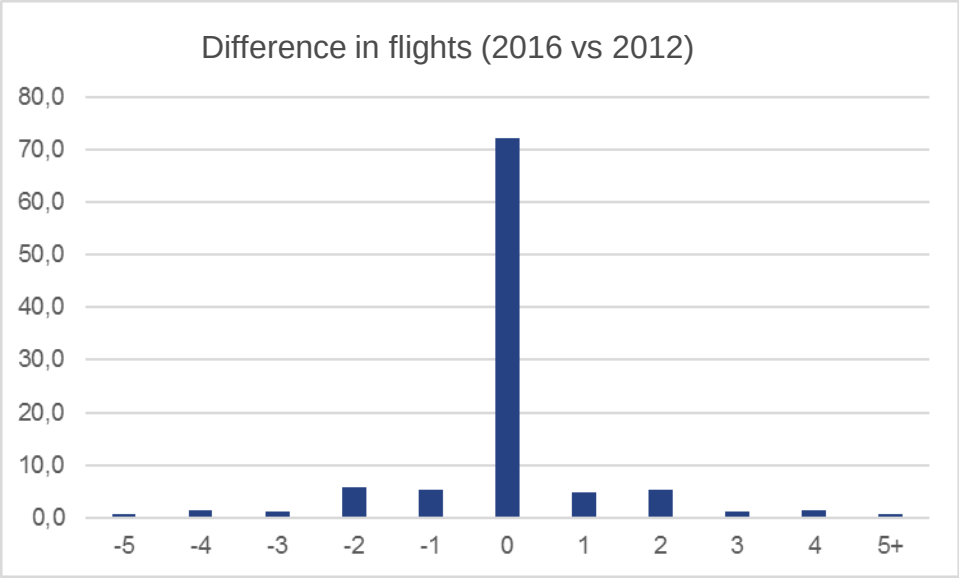
Private car rides, 2016 vs 2012 and amount 2012

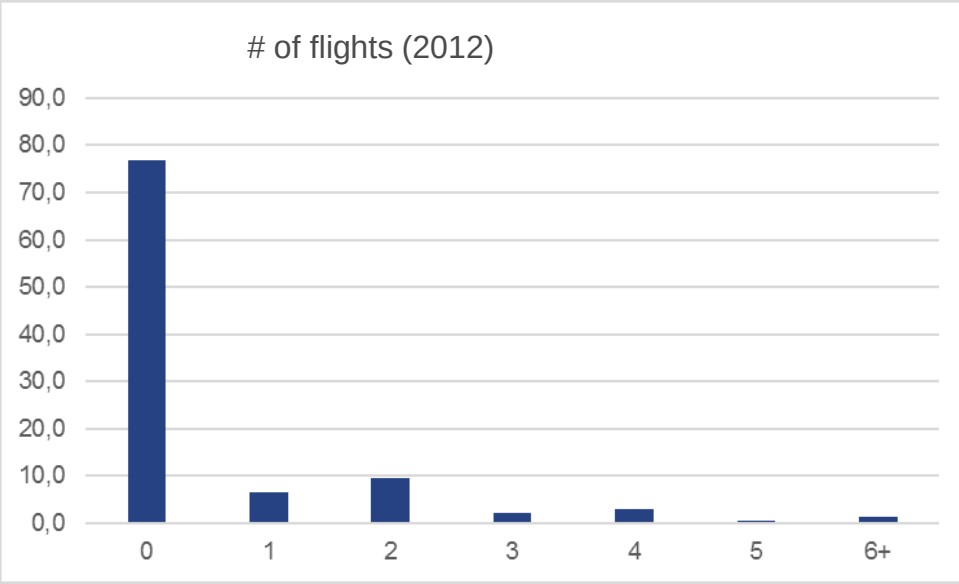




Results, mobility and consumption

flights - 2016 vs 2012 and amount 2012

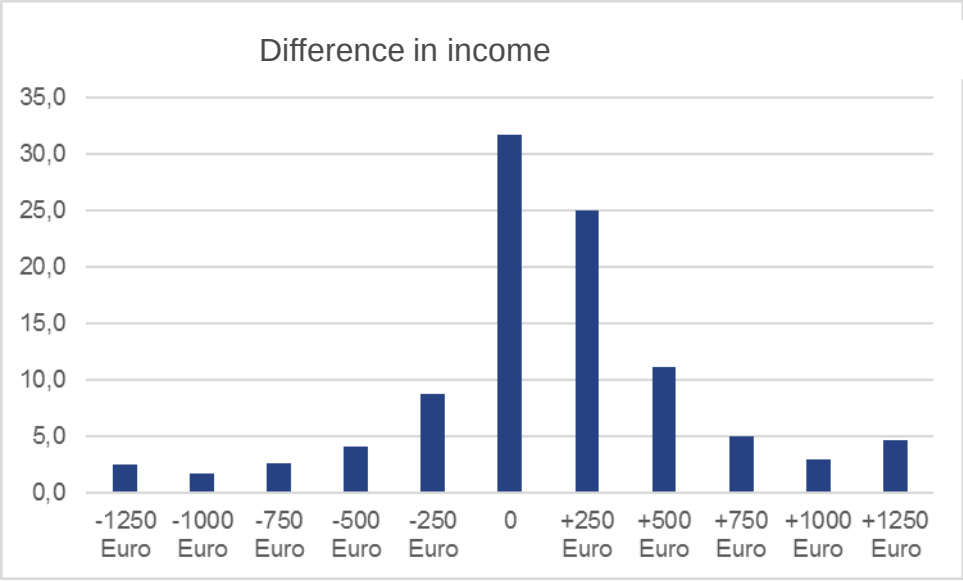


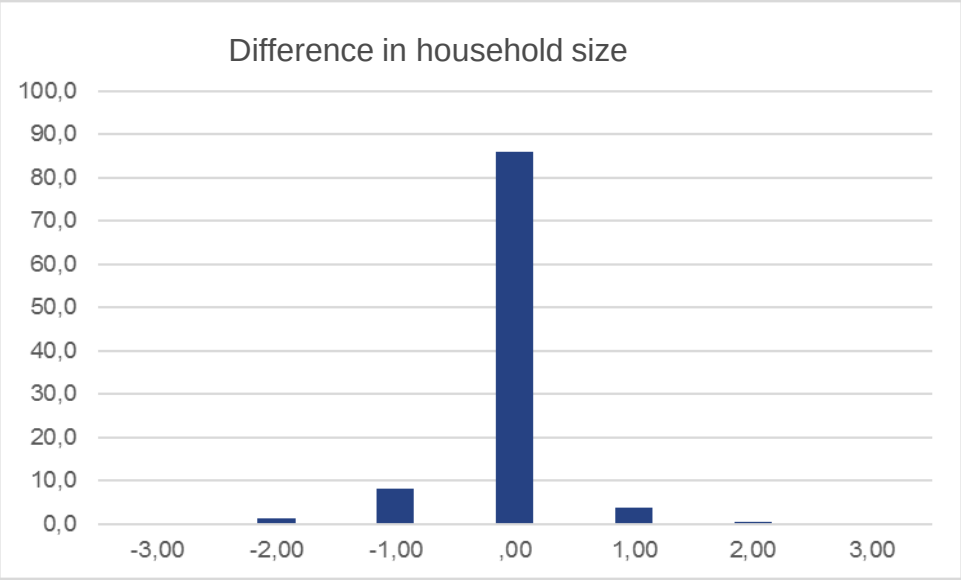


Results, mobility and consumption

Influencing variables, example: HH income

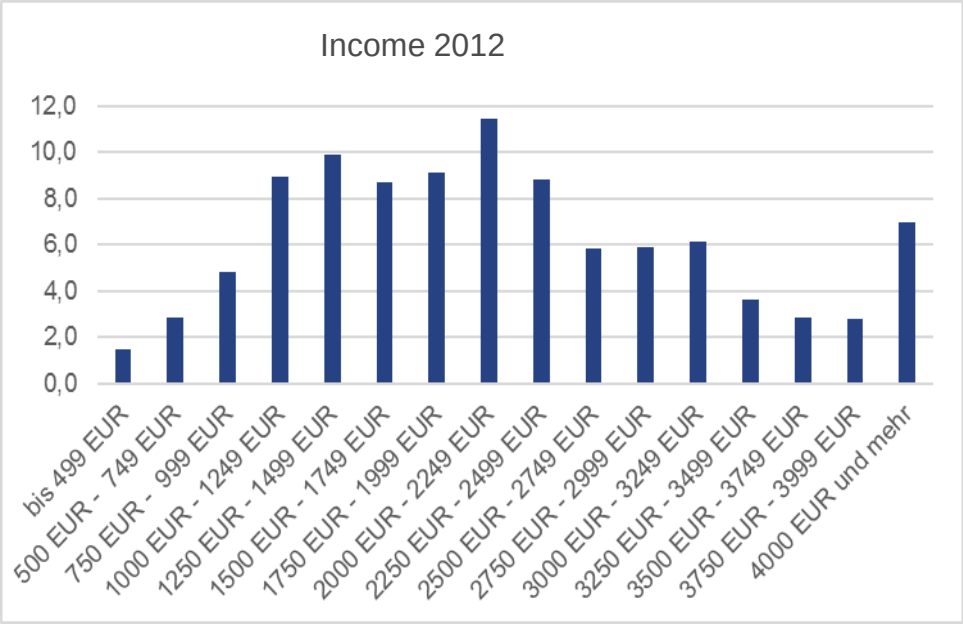
Change in income and change in HH size 2016 vs 2012

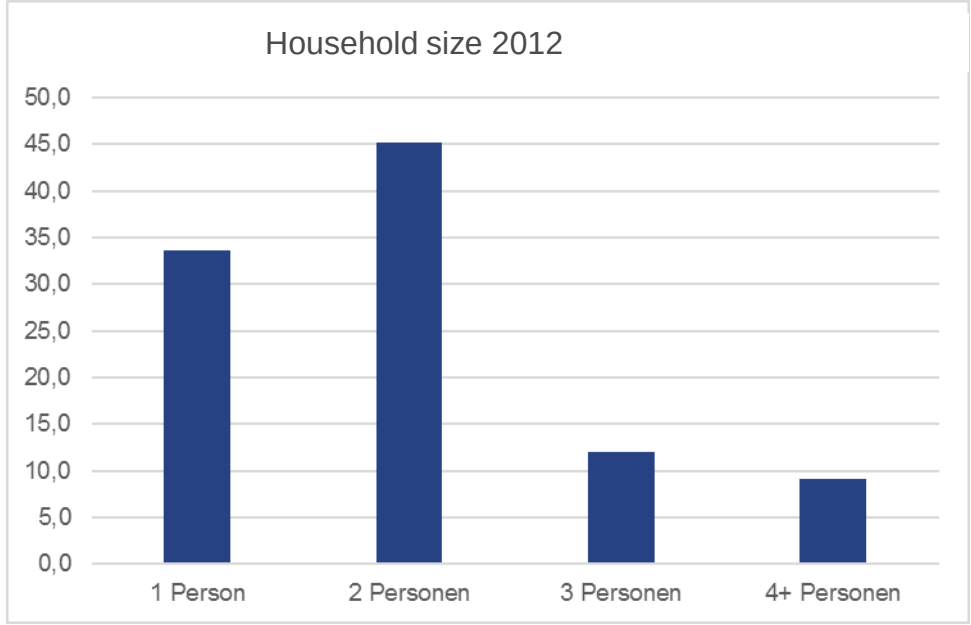




Results, mobility and consumption

HH income and HH size, 2012





Results, mobility and consumption

Correlation of consumption and changes in income

Correlation between change in income and amount of journeys		PKW	Flights	Cruises	Pub. Trans. (50-100km)	Pub. Trans. (>100km)
		Mean	Mean	Mean	Mean	Mean
Einkommensdiffe	-1250 Euro	0,74	-0,10	0,01	0,01	0,11
renz	-1000 Euro	-1,04	-0,18	0,03	-0,05	-0,10
	-750 Euro	0,27	0,00	0,06	0,02	-0,02
	-500 Euro	-0,90	0,02	-0,03	0,01	0,02
	-250 Euro	-0,54	-0,07	-0,02	-0,01	0,15
	0	-0,65	-0,11	0,00	-0,02	-0,02
	+250 Euro	-0,10	-0,04	0,01	-0,04	0,00
	+500 Euro	-0,21	0,11	-0,01	-0,06	0,13
	+750 Euro	0,86	0,11	0,03	-0,02	-0,02
	+1000 Euro	-0,89	0,20	0,10	-0,13	-0,06
	+1250 Euro	-1,52	0,17	0,04	-0,01	-0,06
	Korrelation	-0,28	0,83	0,34	-0,50	-0,22

Results nutrition – Consumption

Correlation of consumption and change in income

Change in income and expenses for nutrition		Dairy products (white)	Dairy products (yellow)	Meat (conventional)	Meat (organic)	Meat substitutes
		Mean	Mean	Mean	Mean	Mean
Einkommensdifferenz	-1250 Euro	-23,98	-15,15	-27,19	0,22	1,00
	-1000 Euro	-19,32	-12,49	-13,72	0,39	-1,27
	-750 Euro	-22,85	-9,31	-21,20	0,18	0,50
	-500 Euro	-15,16	-9,42	-20,83	0,30	0,30
	-250 Euro	-18,34	-7,35	-19,94	0,13	0,44
	0	-12,95	-3,06	-17,11	0,23	1,60
	+250 Euro	-10,30	-1,77	-15,82	0,33	1,52
	+500 Euro	-16,09	-1,72	-20,94	0,35	1,06
	+750 Euro	-12,68	-5,23	-20,35	0,62	1,14
	+1000 Euro	-11,86	2,71	-17,96	0,88	2,21
	+1250 Euro	-4,06	8,09	-8,80	0,48	2,00
	Korrelation	0,87	0,94	0,52	0,68	0,73

Results nutrition – Consumption

Correlation of consumption and change in income

Correlation between change in income and expenses for nutrition		Poultry	Poultry (organic)	Beef	Beef (organic)
		Mean	Mean	Mean	Mean
Einkommensdifferenz	-1250 Euro	-13,19	0,00	-2,63	0,19
	-1000 Euro	-6,76	0,00	-2,54	0,39
	-750 Euro	-7,74	0,05	-3,65	0,17
	-500 Euro	-8,27	0,27	-4,17	0,01
	-250 Euro	-8,08	0,03	-2,63	0,15
	0	-7,30	0,06	-2,05	0,18
	+250 Euro	-7,33	0,07	-1,68	0,23
	+500 Euro	-9,83	0,12	-3,15	0,24
	+750 Euro	-10,50	0,29	-2,30	0,26
	+1000 Euro	-9,84	0,23	-2,35	0,62
	+1250 Euro	-6,73	0,22	-2,25	0,25
	Korrelation	0,14	0,67	0,40	0,40

Correlation between change in income and expenses for nutrition		Pork	Pork (organic)	Lamb
		Mean	Mean	Mean
Einkommensdifferenz	-1250 Euro	-11,43	0,03	0,06
	-1000 Euro	-4,41	0,00	-0,01
	-750 Euro	-10,32	-0,04	0,51
	-500 Euro	-9,05	0,03	0,67
	-250 Euro	-9,66	-0,05	0,44
	0	-8,05	0,00	0,29
	+250 Euro	-7,21	0,02	0,40
	+500 Euro	-8,45	0,00	0,49
	+750 Euro	-7,48	0,07	-0,08
	+1000 Euro	-6,87	0,04	1,10
	+1250 Euro	0,15	0,02	0,02
	Korrelation	0,57	0,39	0,18

Results nutrition – Consumption

Correlation of consumption and change in income

Correlation between change in income and expenses for nutrition		Milk conventional	Milk organic	Bread conventional	Bread organic	Apples conventional	Apples organic	Coffee conventional	Coffee organic
		Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean
Einkommensdifferenz	-1250 Euro	-9,93	0,80	-7,22	0,22	-5,91	-0,29	-5,64	-0,23
	-1000 Euro	-11,27	1,07	-9,14	-1,11	-2,94	0,63	-5,55	-0,55
	-750 Euro	-11,39	2,19	-4,65	-0,84	-7,37	0,06	-4,10	0,49
	-500 Euro	-9,22	2,38	-6,45	0,25	-5,25	-0,32	-5,78	0,30
	-250 Euro	-8,95	0,71	-7,47	0,43	-5,84	-0,28	-4,98	0,11
	0	-8,40	0,13	-7,47	0,91	-4,20	0,10	-3,75	-0,07
	+250 Euro	-8,27	1,11	-6,57	-0,25	-5,37	0,34	-3,91	0,28
	+500 Euro	-8,55	1,88	-3,97	0,22	-5,00	-0,82	-2,84	0,19
	+750 Euro	-6,24	0,21	-8,17	-0,20	-3,15	-0,60	-3,10	0,72
	+1000 Euro	-8,11	0,51	-4,63	0,30	-4,29	-0,52	-2,30	0,74
	+1250 Euro	-6,08	0,43	-4,89	0,03	-3,90	-0,19	-1,56	0,48
	Korrelation	0,87	-0,41	0,45	0,31	0,42	-0,46	0,92	0,71

Results, mobility and consumption – regression results

Beta coefficients, only significant results (sign. level <=10%)

Effekte im Überblick (Beta)	PKW	Flugreisen	Kreuzfahrten	Bus/Bahn 50-100 KM	Bus/Bahn 100+ KM
Einkommensdifferenz		0,074	0,035		
Veränderung der HH Größe					**-0,046**
Einkommen 2012	**0,066**	**0,075**	**0,063**		
HH Größe 2012	**0,052**	0,068			**-0,035**
Ortsgröße 2012					**0,023**
Age HHF 2012			**0,052**		
Geschelcht HHF 2012			**-0,027**		
Zahl der Reisen 2012	**-0,328**	**-0,676**	**-0,702**	**-0,082**	**-0,349**
Ausgaben für Reisen 2012		**0,103**	**0,171**	**-0,269**	**-0,072**
Bildung Studium		**0,041**	**0,037**	**0,034**	**0,068**
Bildung Abitur			**0,044**		
Bildung Mittlere Reife		**0,028**	**0,045**		
RCS Abenteurer 2012					
RCS Anspruchsvolle 2012					**0,046**
RCS Haeusliche 2012					**0,031**
RCS Kritische 2012		0,039			**0,032**
RCS Realisten 2012					**0,045**
RCS Traeumer 2012					
RCS Weltoffene 2012					

Results, mobility and consumption – regression results

Effects of + 100 € income on consumption, number of „mobility acts“ (sign. level <=10%)

2016 vs. 2013 (2012 für Mobility)	Effekte einer Einkommensveränderung von 100 Euro auf die Konsumveränderung		
	Veränderung der Zahl an Käufen/Reisen		
	Effekt	Signifikanz	Art des Effektes
PKW Fahrten	0,02	ns	linear
Flugreisen	**0,02**	**<0,01**	**linear**
Kreuzfahrten	**0,00**	**<0,01**	**exp**
ÖPNV 50-100KM	0,00	ns	linear
ÖPNV 100KM+	0,01	ns	linear

e.g., +100 Euro income leads to 0.02 additional flight trips (1 flight trip for +5000 Euro income increase

Results, mobility and consumption – regression results

Regression results in detail – flight trips

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,578[a]	0,334	0,331	1,08722

a. Predictors: (Constant), RS_Weltoffene_12, hhsize_metric_12, diff_hhincome5,

Coefficients[a]

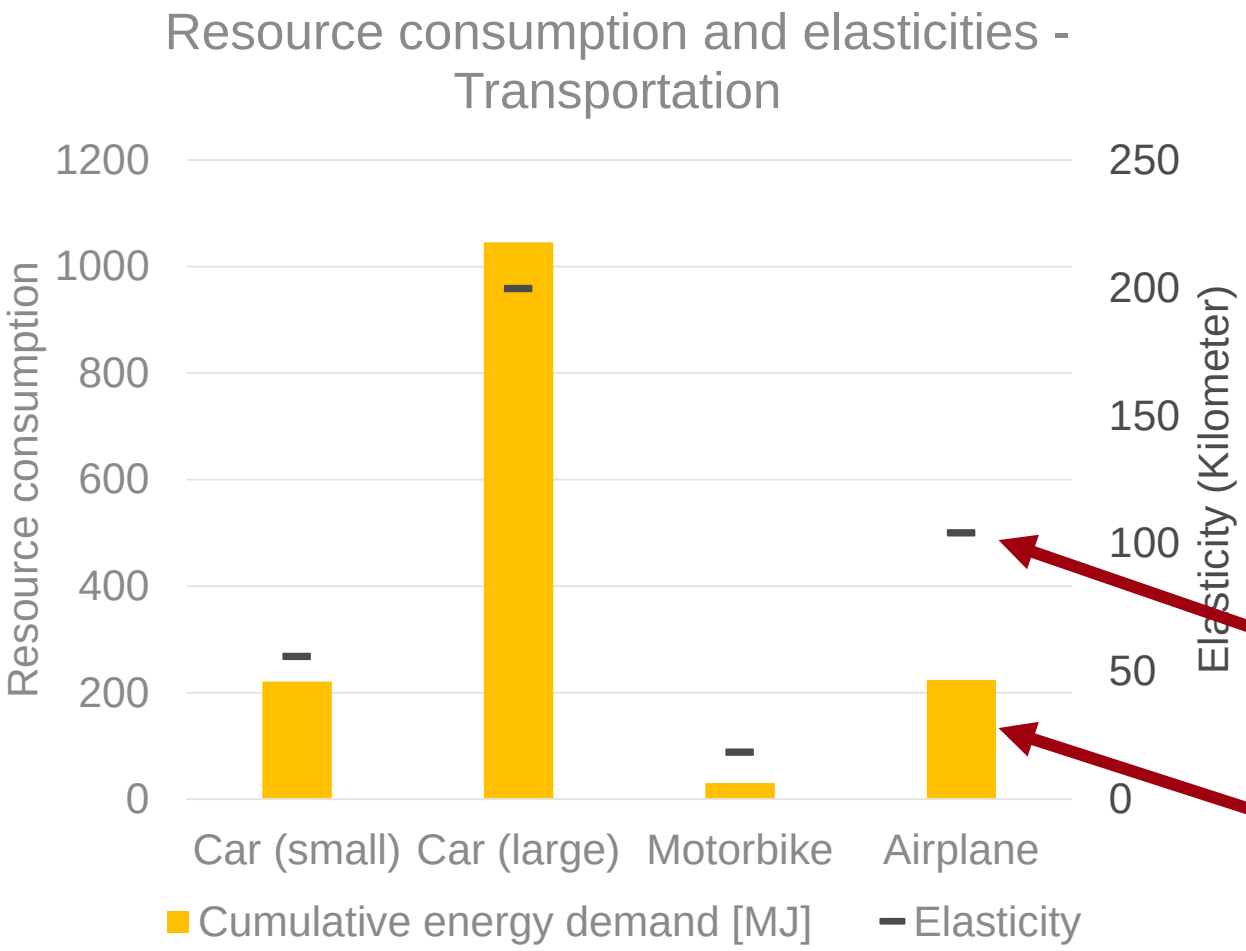
Model		Unstandardized Coefficients		Standardized Coefficients			Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	-0,108	0,128		-0,845	0,398		
	diff_hhincome5	**0,050**	**0,009**	**0,074**	**5,731**	**0,000**	**0,823**	**1,214**
	diff_hhsize	-0,011	0,038	-0,004	-0,283	0,777	0,779	1,284
	hhincome_metric_12	**0,025**	**0,005**	**0,075**	**5,131**	**0,000**	**0,650**	**1,539**
	hhsize_metric_12	**0,100**	**0,023**	**0,068**	**4,279**	**0,000**	**0,540**	**1,851**
	citysize_metric_12	0,005	0,005	0,011	0,866	0,387	0,930	1,076
	age_metric_12	-0,011	0,007	-0,021	-1,476	0,140	0,688	1,453
	male_12	0,010	0,041	0,003	0,258	0,796	0,823	1,215
	zahl_flugreisen_12	**-0,678**	**0,022**	**-0,676**	**-31,131**	**0,000**	**0,291**	**3,432**
	spend_flugreisen_12	**7,438E-05**	**0,000**	**0,103**	**4,742**	**0,000**	**0,294**	**3,407**
	EDU_UNI_12	**0,134**	**0,050**	**0,041**	**2,700**	**0,007**	**0,599**	**1,671**
	EDU_ABI_12	0,054	0,059	0,013	0,913	0,361	0,718	1,394
	EDU_MR_12	**0,075**	**0,040**	**0,028**	**1,863**	**0,063**	**0,607**	**1,648**
	RS_Abenteurer_12	0,042	0,081	0,008	0,523	0,601	0,580	1,724
	RS_Anspruchsvolle_12	-0,042	0,060	-0,013	-0,705	0,481	0,396	2,523
	RS_Haeusliche_12	-0,044	0,069	-0,010	-0,628	0,530	0,512	1,954
	RS_Kritische_12	**0,147**	**0,064**	**0,039**	**2,289**	**0,022**	**0,473**	**2,115**
	RS_Realisten_12	-0,023	0,068	-0,005	-0,332	0,740	0,531	1,883
	RS_Traeumer_12	-0,001	0,085	0,000	-0,007	0,994	0,670	1,493
	RS_Weltoffene_12	0,101	0,063	0,030	1,619	0,106	0,406	2,465

a. Dependent Variable: diff_zahl_flugreisen

Results, resource depletion

Income induced changes in consumption of resources

… how to read

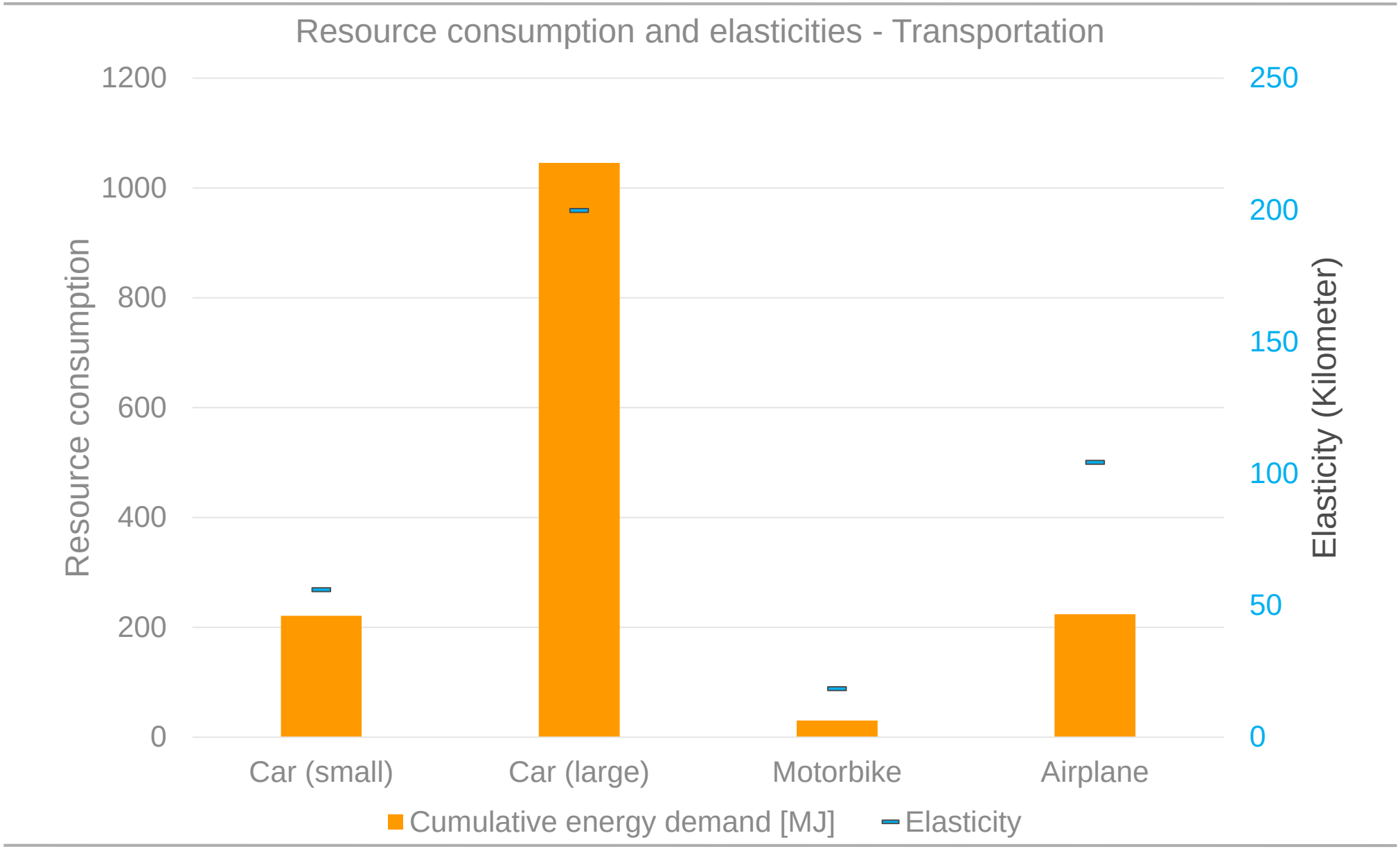


- **Elasticity**: Change in consumption per increase of monthly household income by 100 Euros
  - In EURO – Converted into consumed goods via the price
  - or in consumed amount
- **Resource consumption:** Per impact category (e.g. MH, CO2 eq., m³, …)

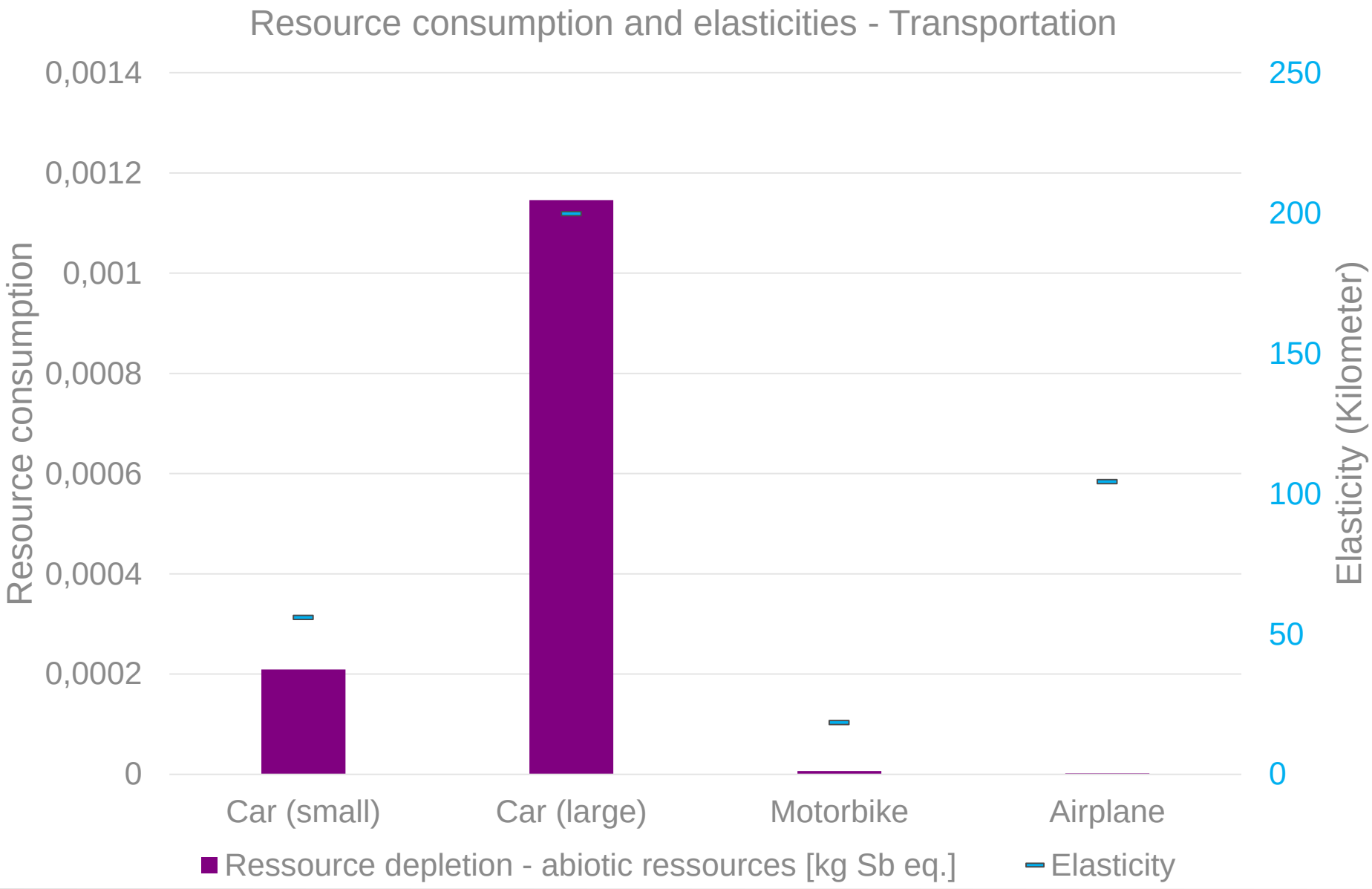
Elasticity

Resource use

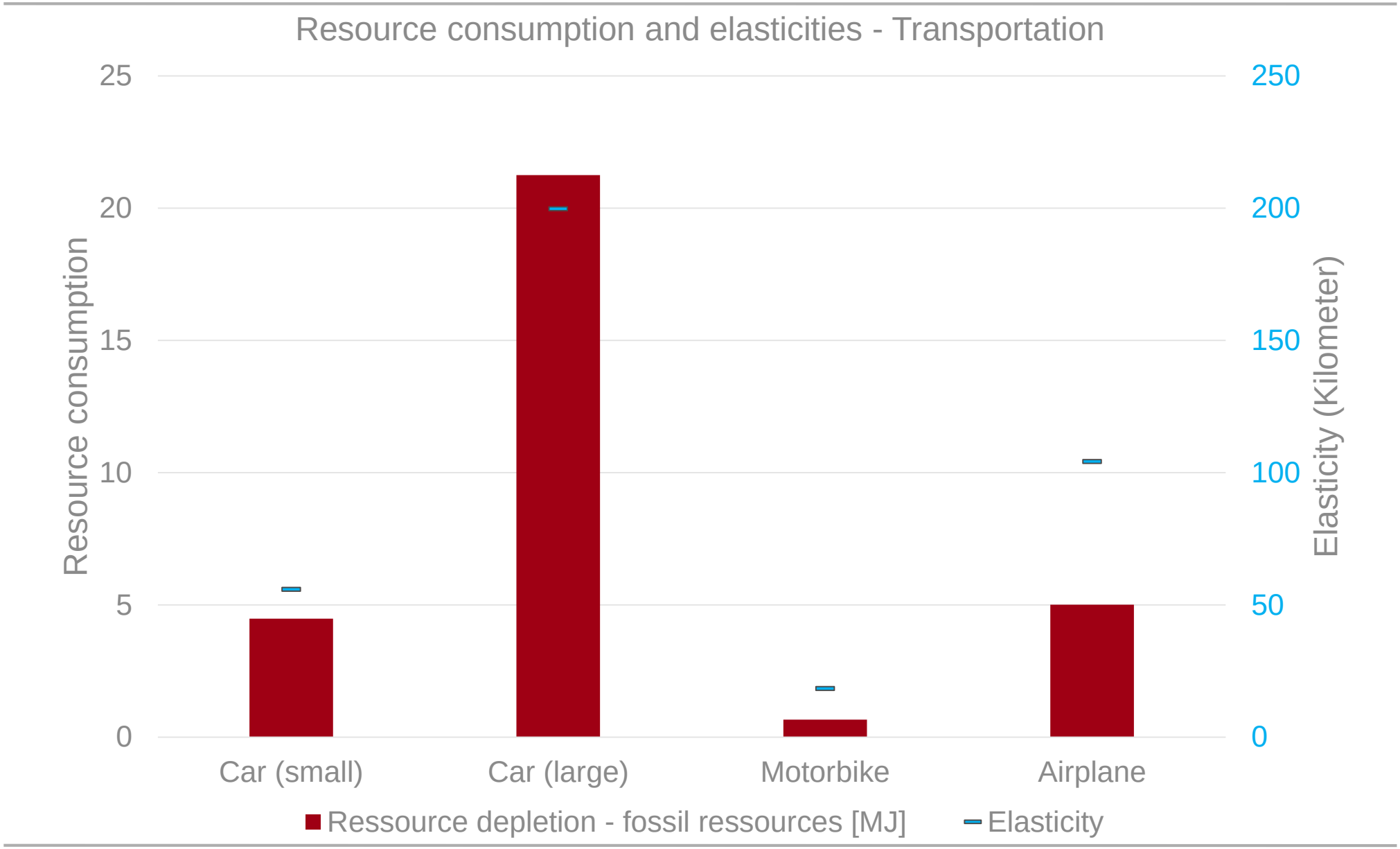
Resource consumption – Mobility (ad-hoc questionnaire)



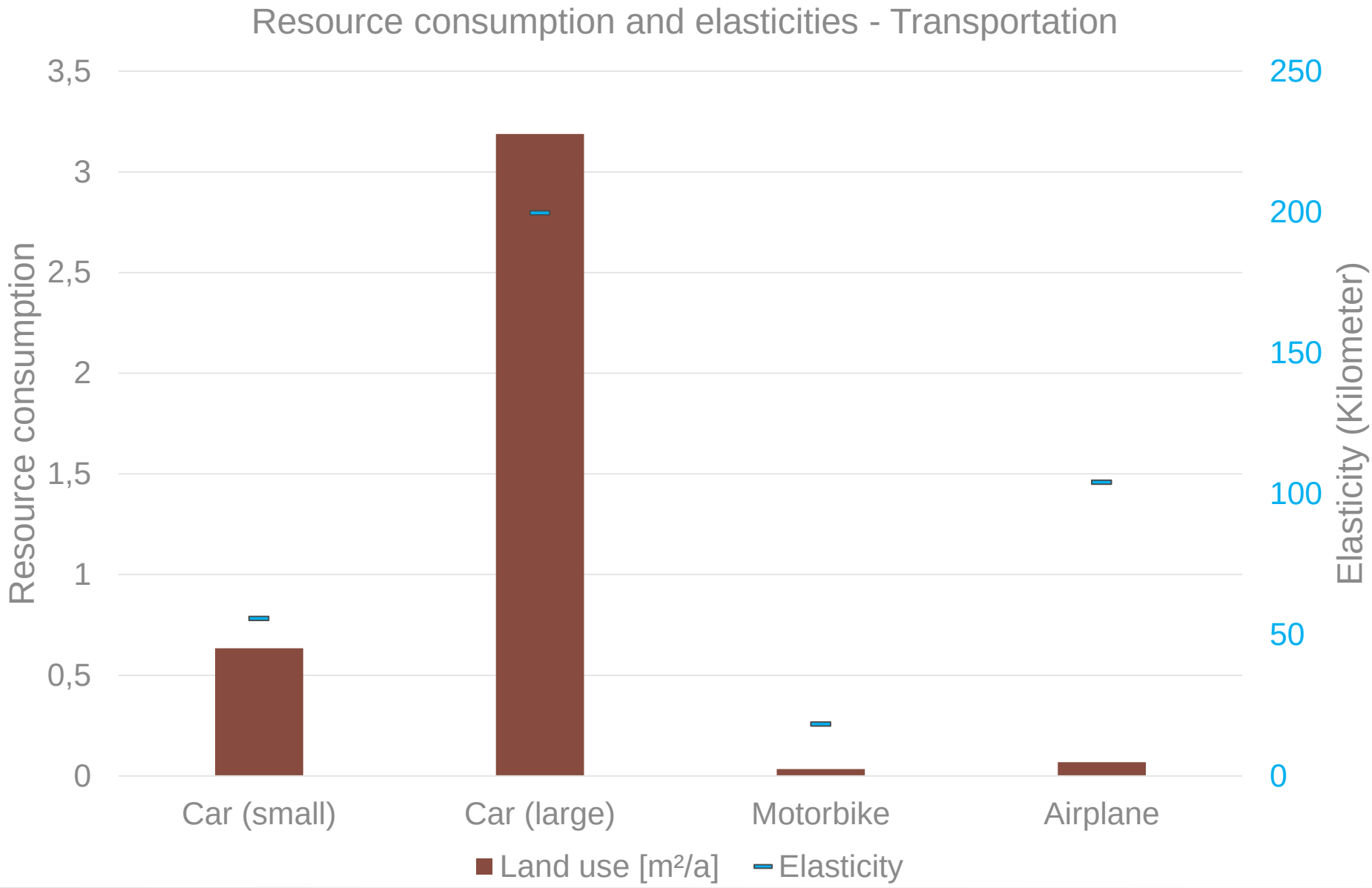
Resource consumption – Mobility (ad-hoc questionnaire)



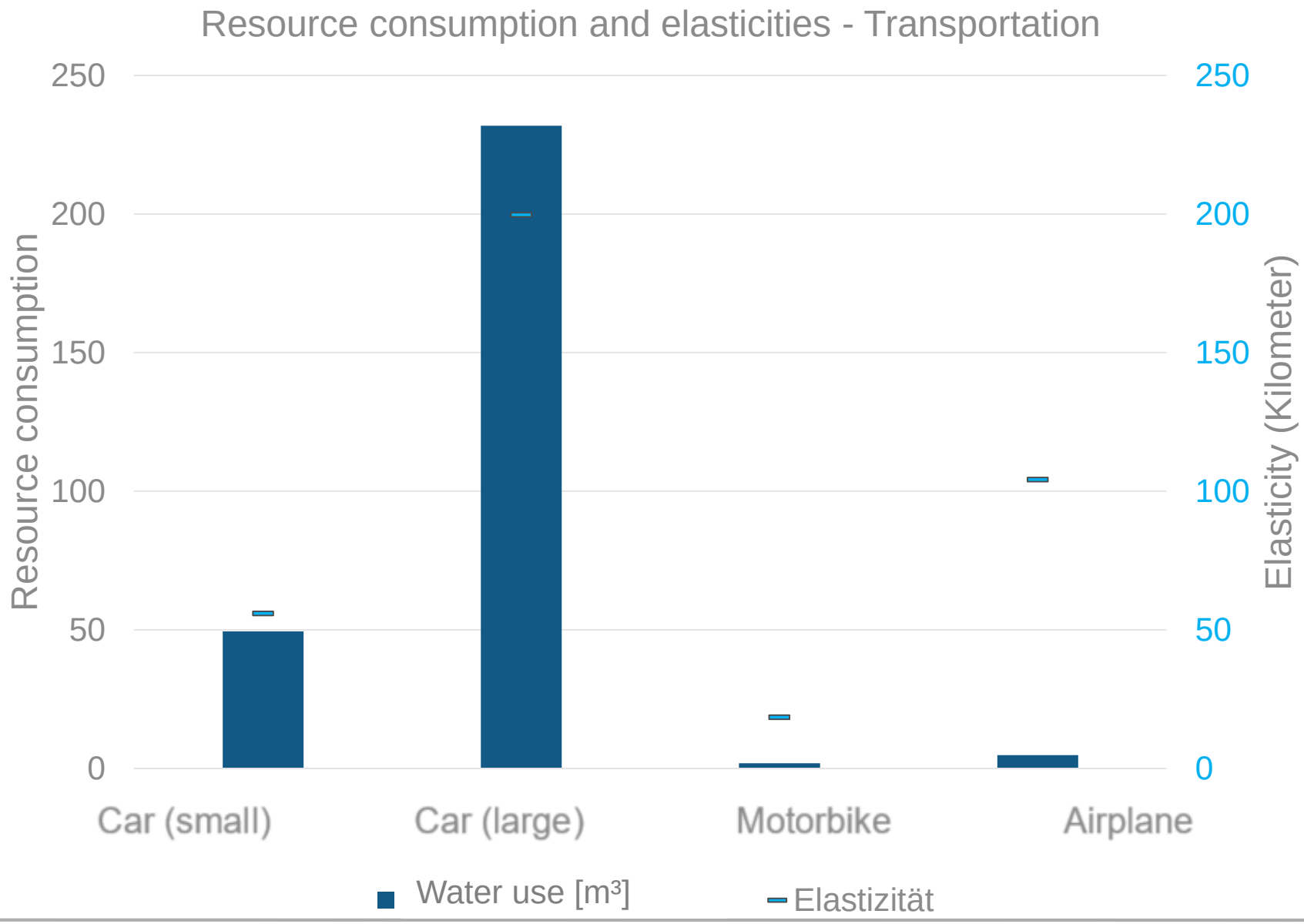
Resource consumption – Mobility (ad-hoc questionnaire)



Resource consumption – Mobility (ad-hoc questionnaire)



Resource consumption – Mobility (ad-hoc questionnaire)



Conclusion and recommendations

- Correlations between HH income change and consumption are now available, based on a very detailed, empirical data basis, which is unique (at least for Germany)
- Correlations are in parts as expected (higher income – more cruises and flights) and in parts surprising (higher income – less biofruit)
- Sometimes, cross-variables are important (conventional meat, decreased consumption)
- No causality considered, only „coexistence“
- A big picture is not provided, substitution effects are not considered

→(we believe) this is a first, very useful and descriptive step. No direct policy advise, but basis for a next analysis.

(and the LCA part is relatively easy)

Thank You for Your Attention!

Feedback and Discussion

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- Project Wirkungen veränderter Einkommen auf den Ressourcenverbrauch
- UFOPLAN Vorhaben FKZ 3714 93 104 0
- Commissioned by German Umweltbundesamt