How Does Inequality Shape Household Energy Footprints?

A contribution to the LiLi – Living well within Limits project

and

13th Conference of the International Society for Industrial Ecology (ISIE) - Socio-Economic Metabolism Section, held in Berlin, Germany, 13-15 May 2019 (14th of May)

by

Yannick Oswald

Dr. Anne Owen

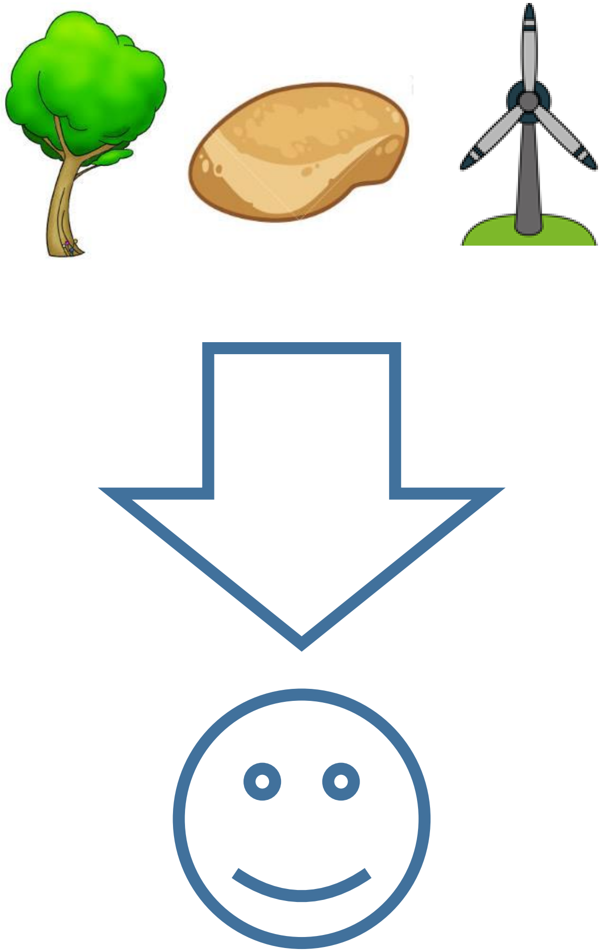
Prof. Julia Steinberger

E-mail: eeyo@leeds.ac.uk

One slide of project background

- PhD Student within the Living well within Limits Project – LiLi, University of Leeds
- Lead by Prof. Julia Steinberger

What do we do?



Bio-physical Resources

Provisioning Systems (Economic, Social, Political, Technological etc.)

“Good” Life

Picture from https://www.theatlantic.com/international/archive/2019/01/macron-grand-debate-yellow-vests/580810/, JAN 20, 2019

The billionaires' donations will turn Notre Dame into a monument to hypocrisy – The Guardian, Opinion, Thursday 18th Of April

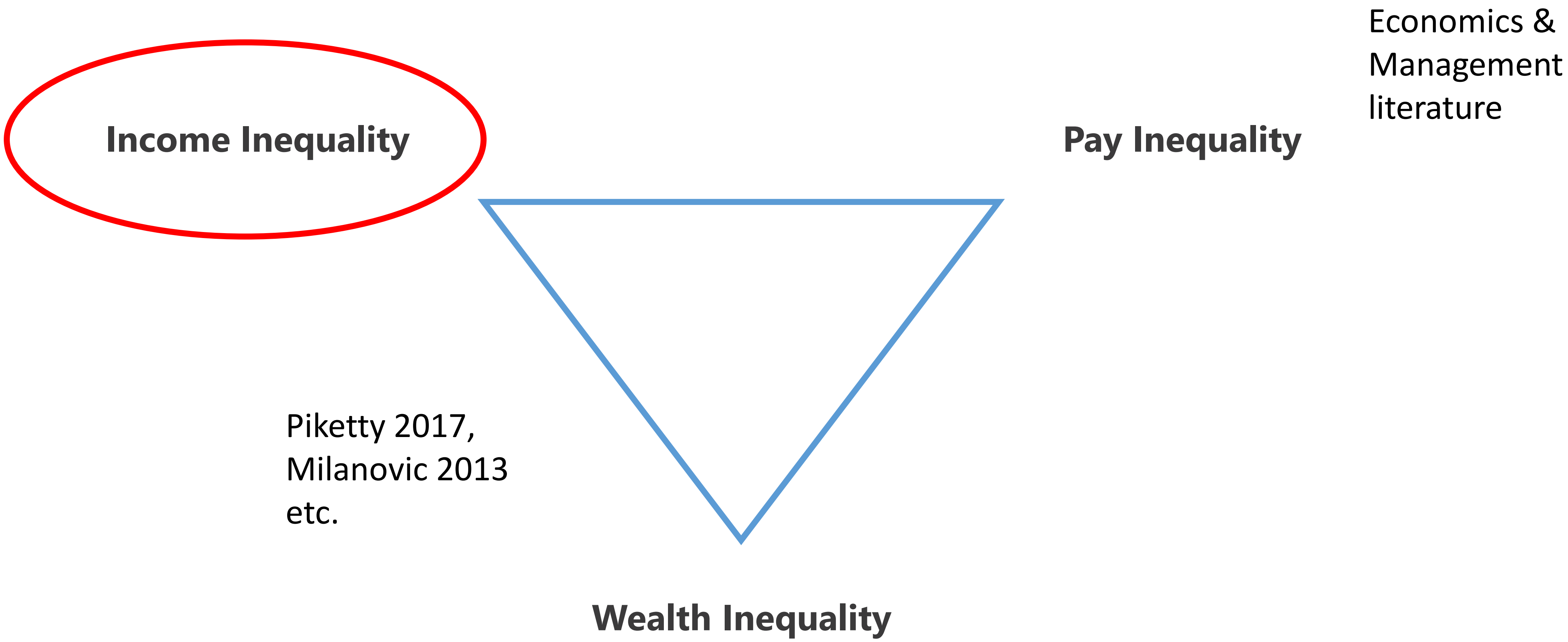
Picture from https://www.politico.eu/article/fire-strikes-shakes-france-emmanuel-macron/ 15 APRIL, 2019

No matter the political standpoint:

Inequality is there and it seems to be a decisive parameter of our time.

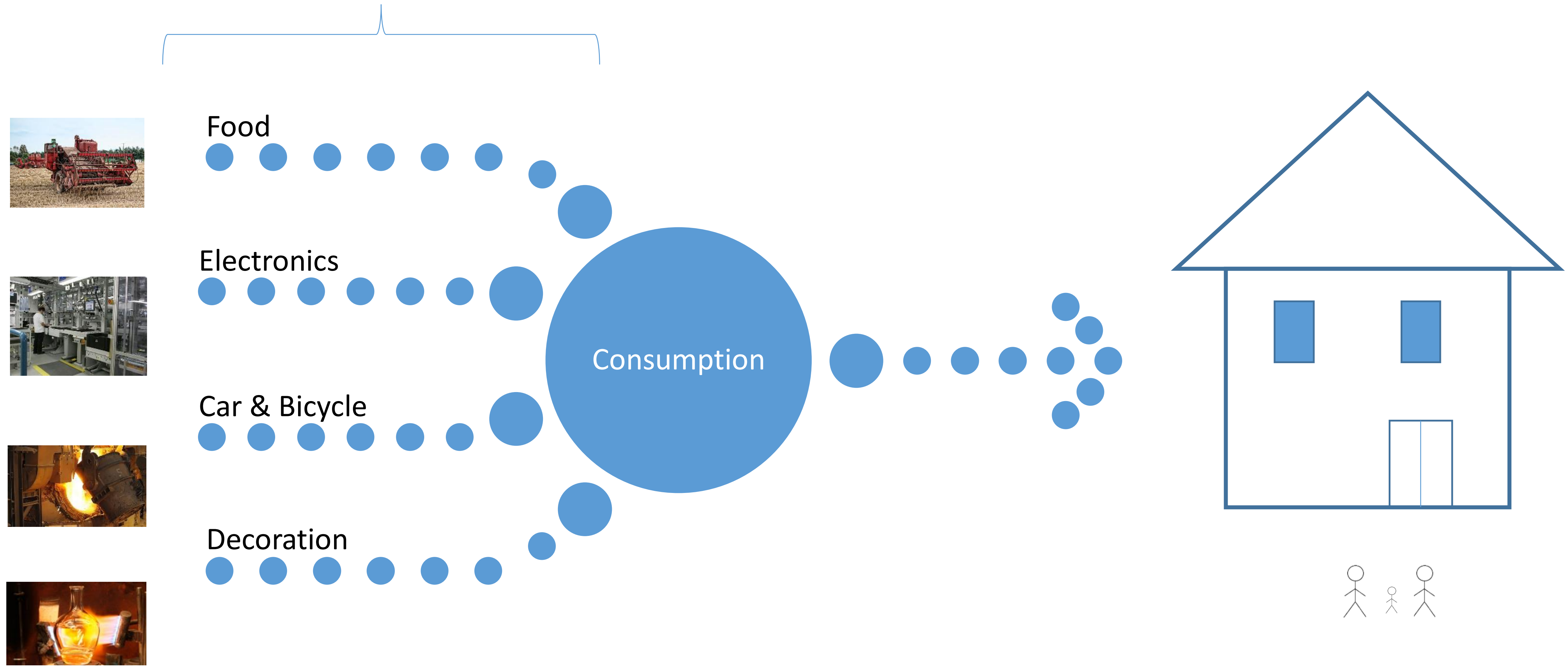
It is worth to take a look at what other implications emerge e.g. on the social metabolism in energy and materials.

Economic Inequality?


Income Inequality
Pay Inequality
Economics &
Management
literature
Piketty 2017,
Milanovic 2013
etc.
Wealth Inequality

Household Energy Footprints?

Consumption Based Accounting: $EF = e * L * Y_h$ e.g. Leontief 1936; Miller and Blair 2009



$$\sum energy\ food + \cdots + energy\ something + direct\ energy\ = Energy\ Footprint$$

$$\frac{\sum energy\ heating + \cdots + energy\ something}{\sum costs\ heating + \cdots + costs\ something} = \frac{Energy}{Value} = \frac{MJ}{\$} := \text{Energy Intensity}$$

whole

$$\frac{\text{Energy heating}}{\text{Cost heating}} \qquad \frac{\text{Energy something}}{\text{Cost something}}$$

parts

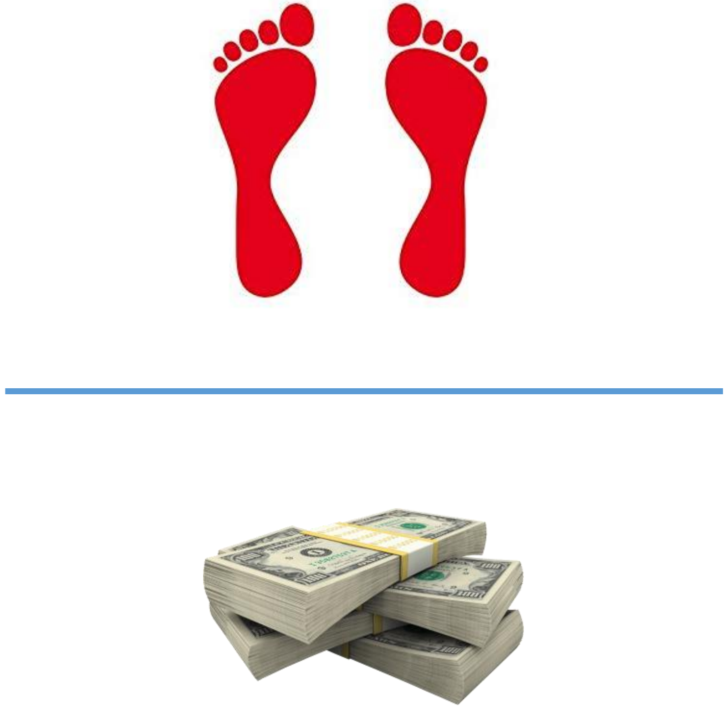
How? Consumption Baskets Vary !

Income Elasticity of demand!

At least used since Lehfeldt 1914 “The elasticity of wheat demand”;
Modern example Hubacek et al. 2017 “Global Carbon Inequality”

Income Elasticities of Consumption Categories

Energy Footprint Intensity of Consumption Categories



The scope

Spatial

- 86 countries including BRIC states, most of Europe, South Africa, Indonesia etc.
- Excluding the USA, Japan so far

Temporal

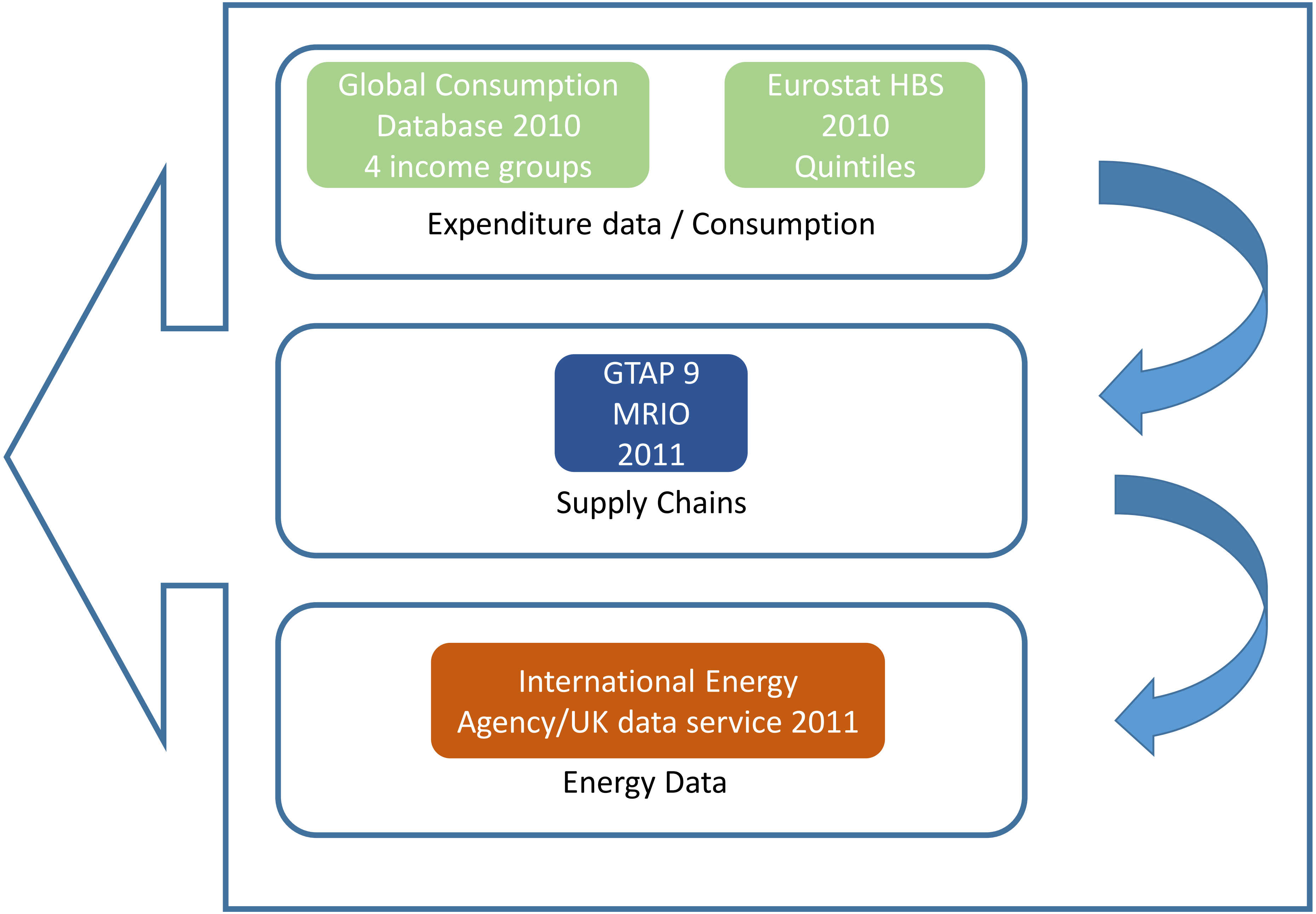
2011

Structural

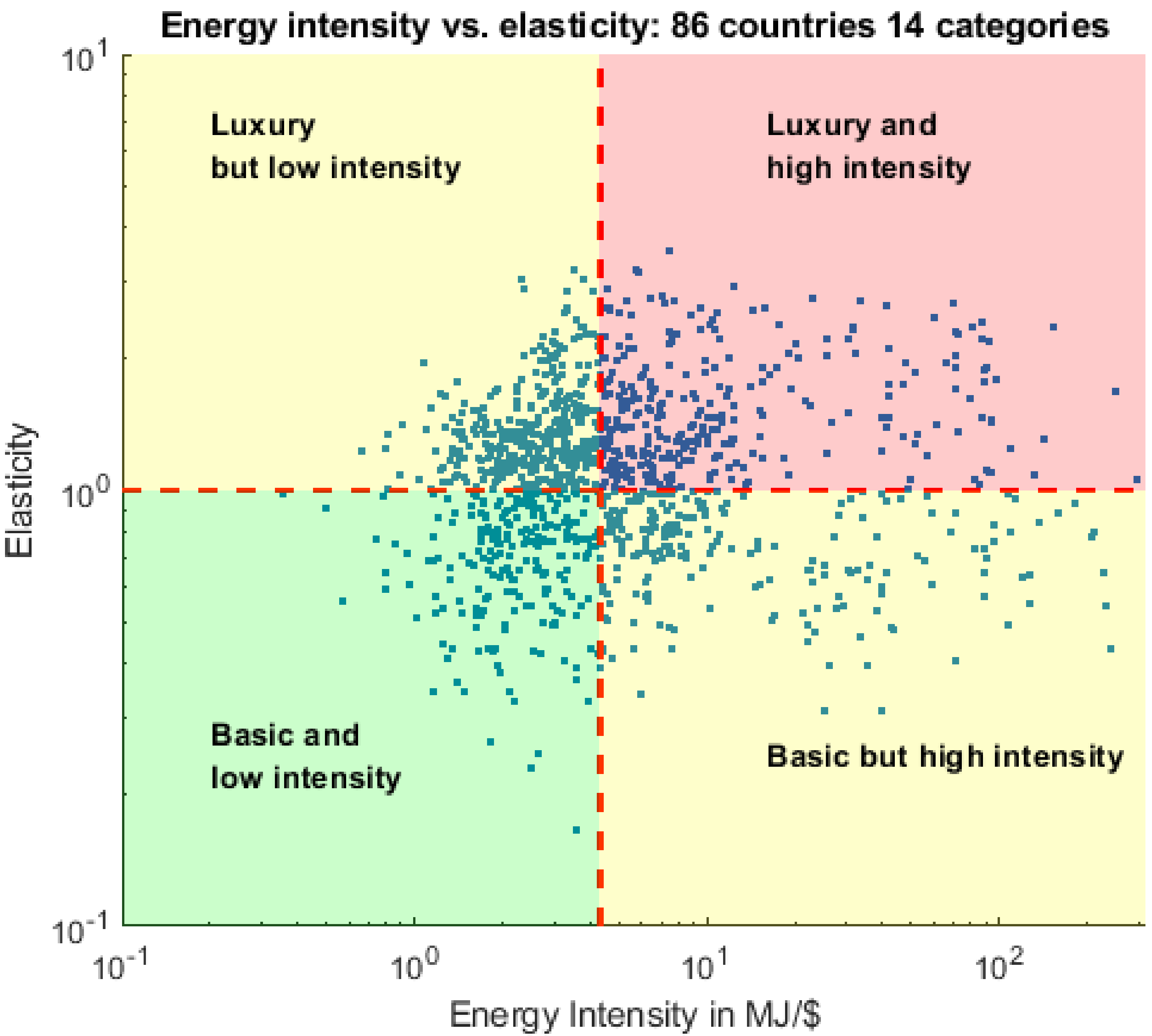
- COICOP 14-18 consumption categories e.g. Food, transport modes, package holiday, household appliances etc.
- **4-5 Income groups**

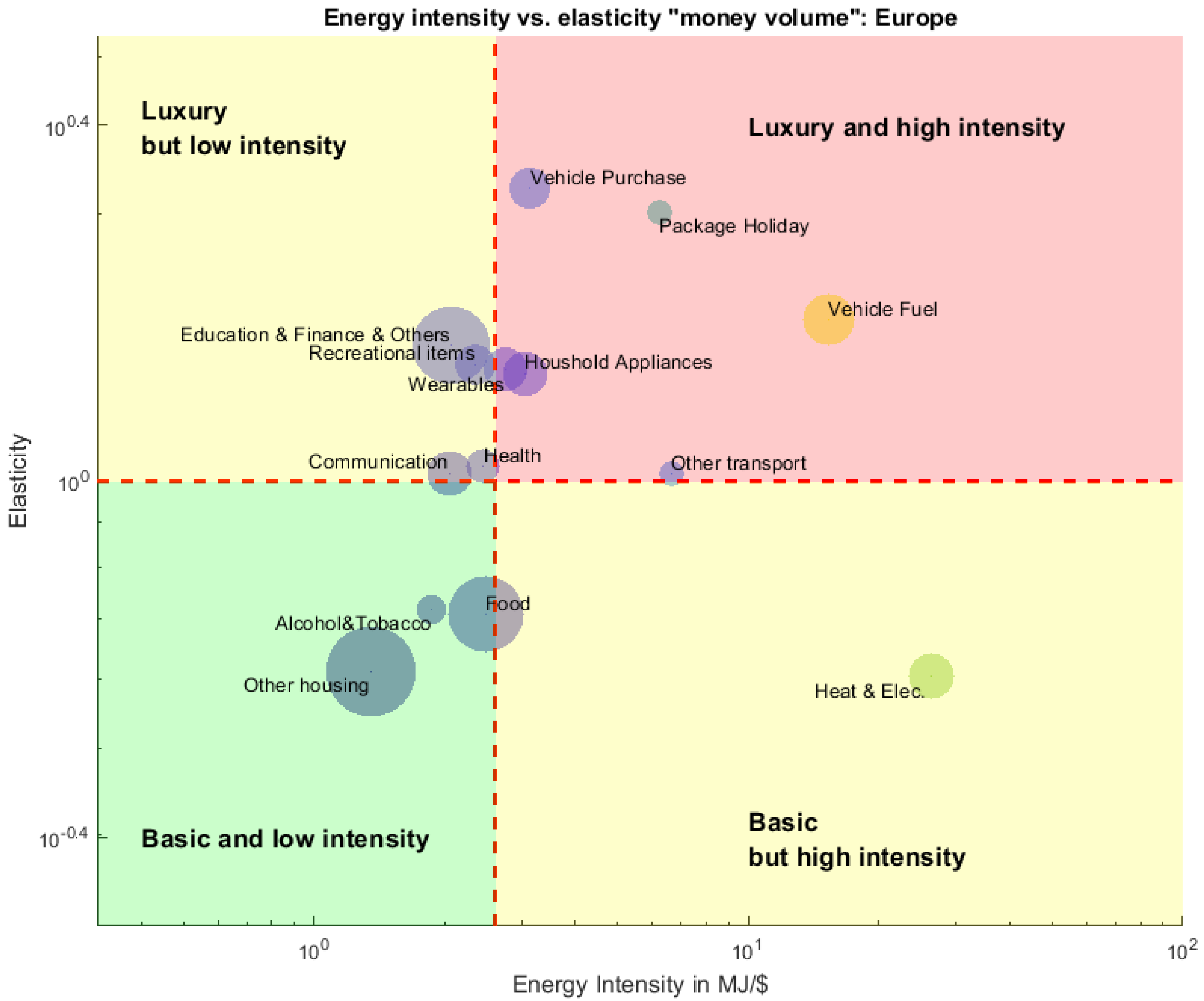
Elasticities 2010

Energy footprints 2011

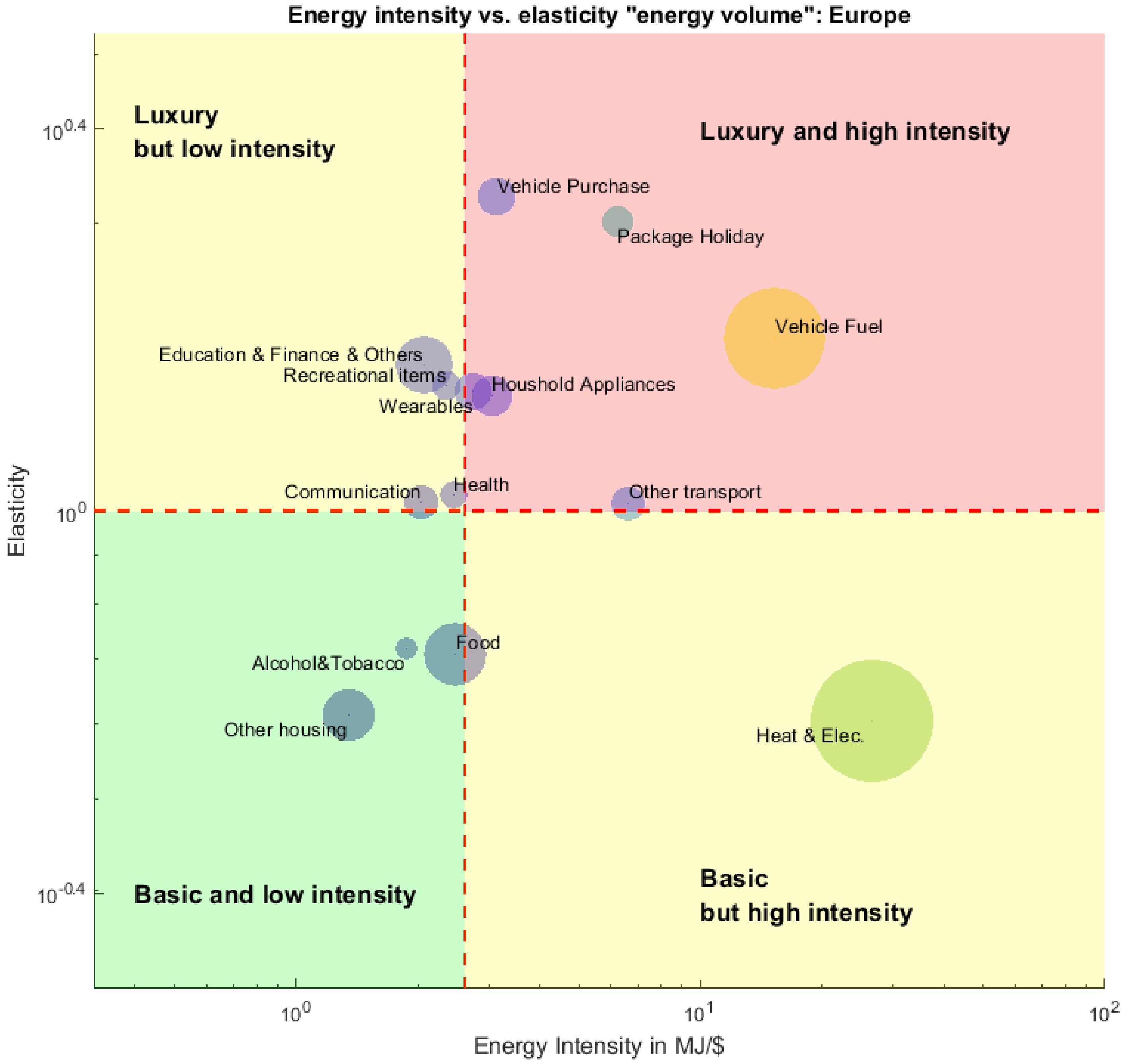


*Assumption of constant expenditure translation from 2010 to 2011

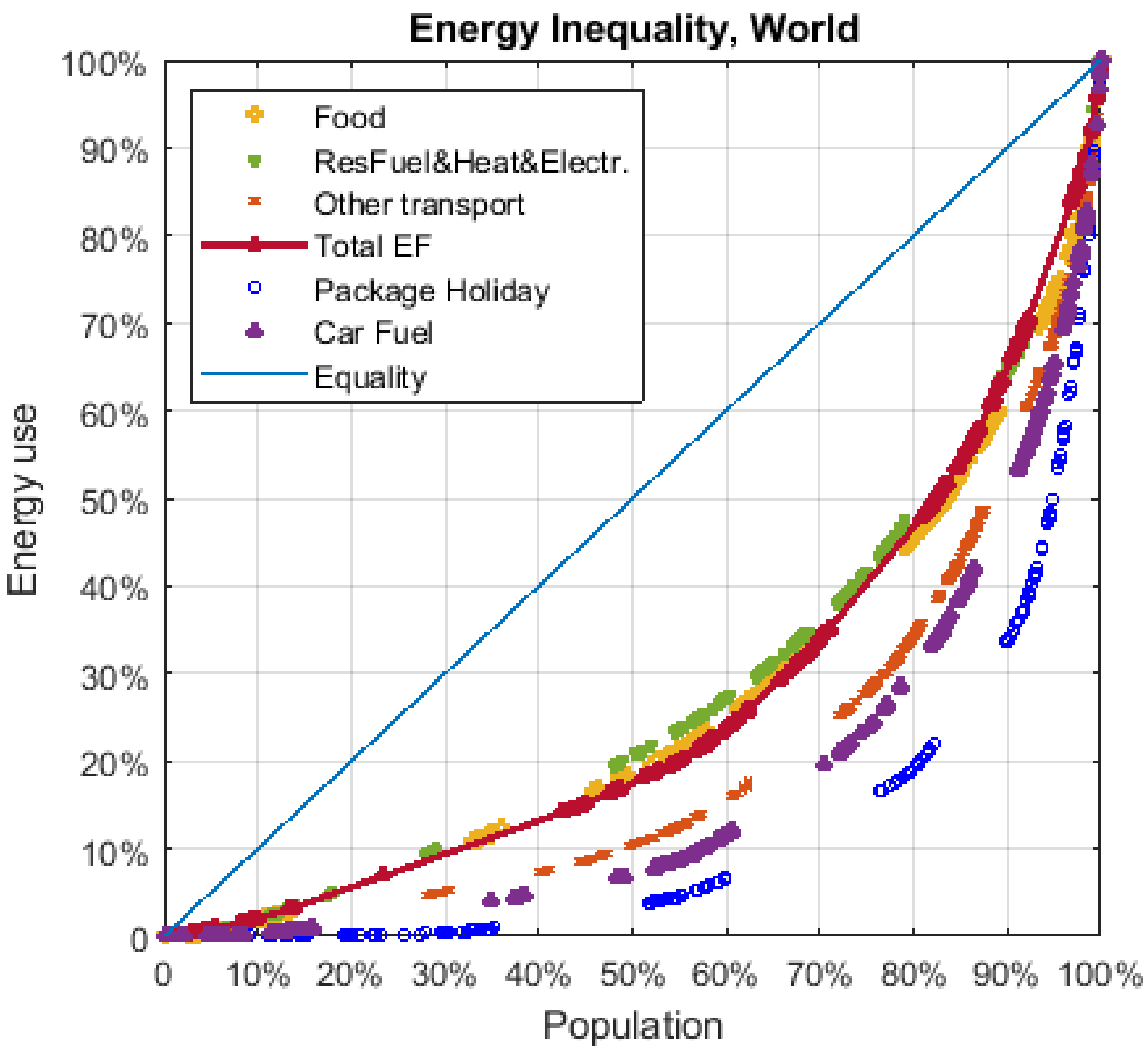

Energy intensity vs. elasticity: 86 countries 14 categories
Luxury
but low intensity
Luxury and
high intensity
Basic and
low intensity
Basic but high intensity
Elasticity
Energy Intensity in MJ/$
10^{1}
10^{0}
10^{-1}
10^{-1}
10^{0}
10^{1}
10^{2}



Population weighted mean in both variables for 30 European countries including Turkey

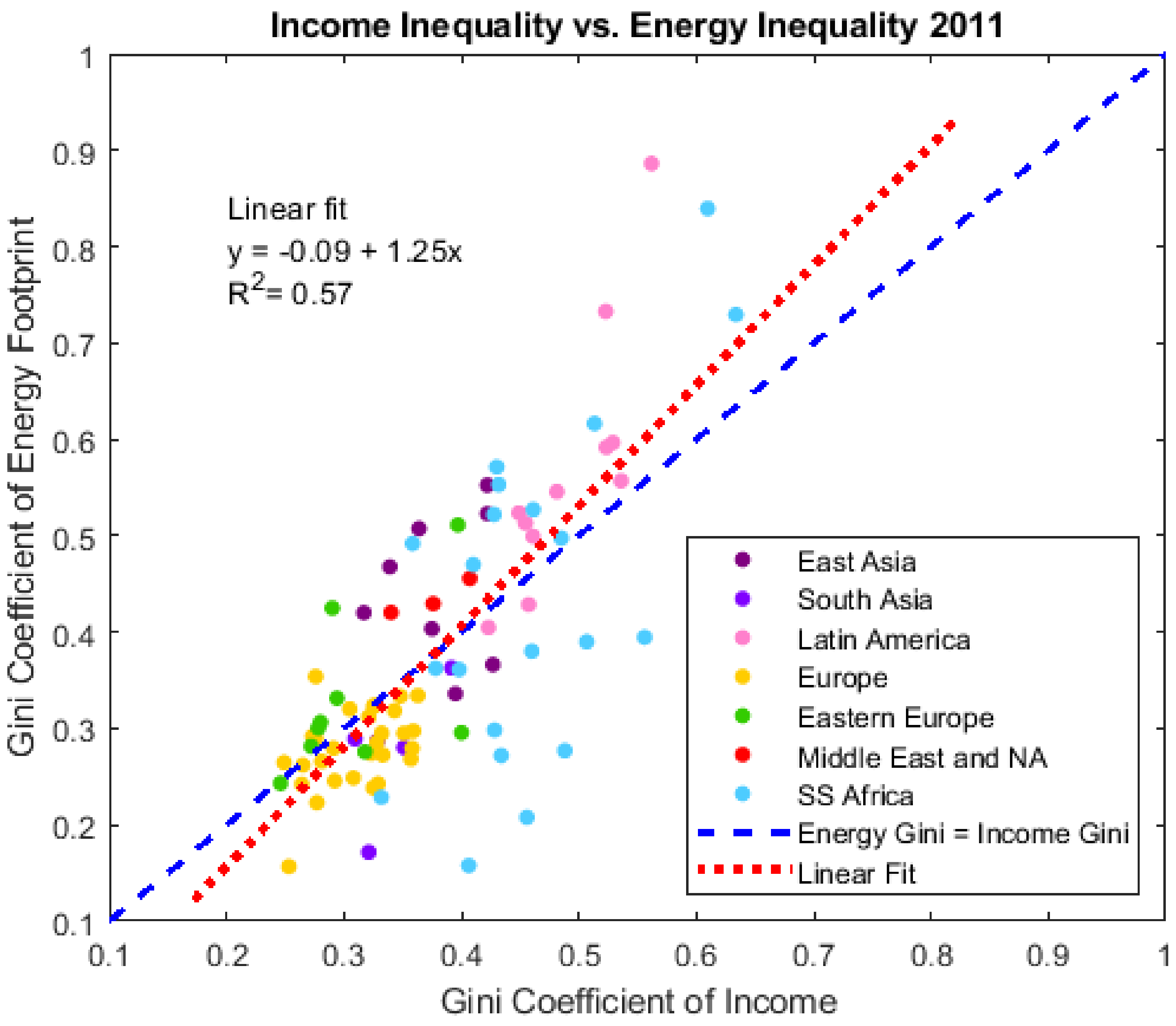


Population weighted mean in both variables for 30 European countries including Turkey



Consumption Category	Gini Coefficient
TOTAL EF	0.48
Food	0.48
ResFuel&Heat&Electricity	0.44
Other transport	0.60
Package Holiday	0.77
Car Fuel	0.66

N countries only = 86
Up to N countries times income segments
= 30*5+56*4 = 374

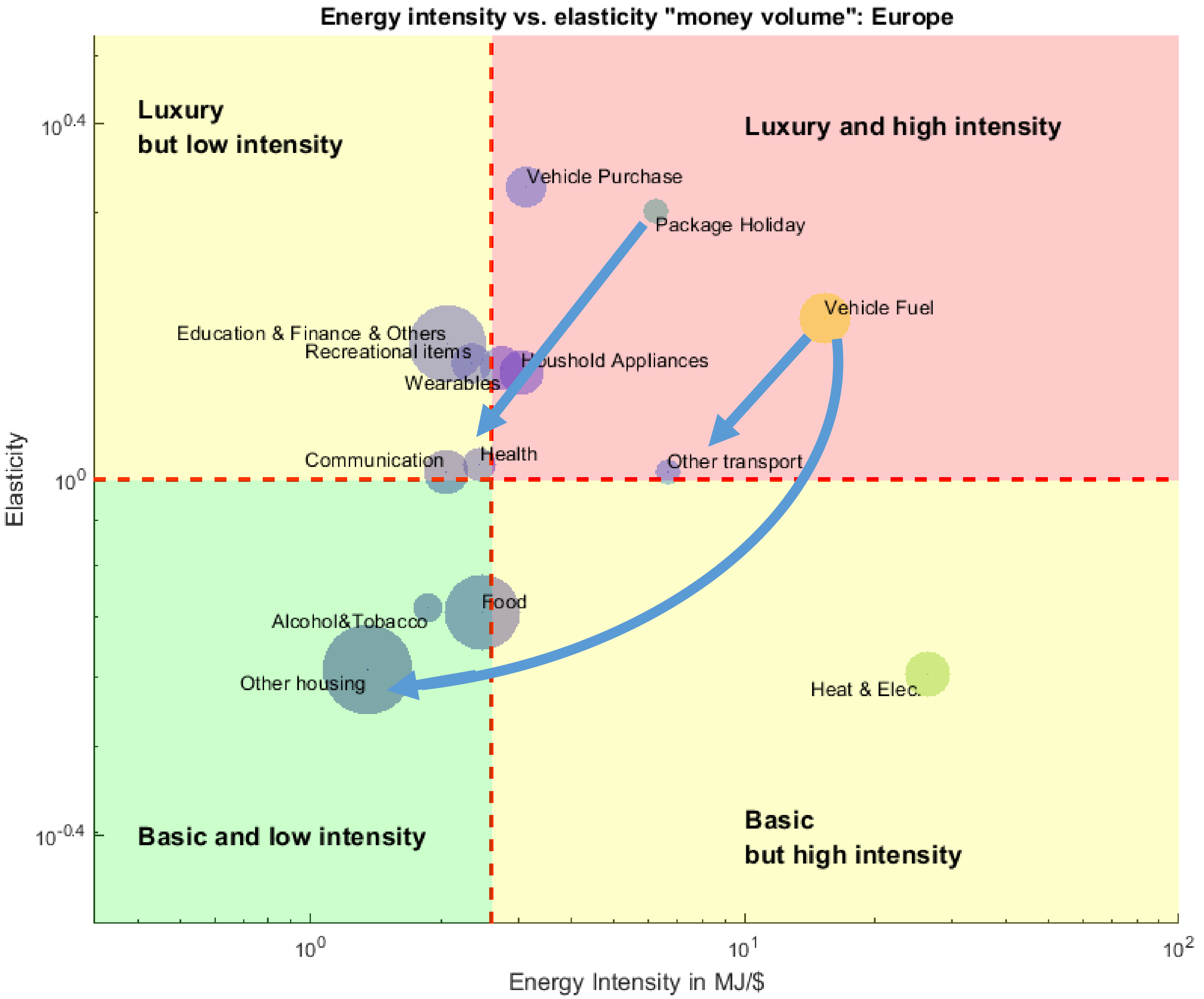

Income Inequality vs. Energy Inequality 2011
Linear fit
y = -0.09 + 1.25x
R2= 0.57
East Asia
South Asia
Latin America
Europe
Eastern Europe
Middle East and NA
SS Africa
Energy Gini = Income Gini
Linear Fit
Gini Coefficient of Energy Footprint
Gini Coefficient of Income
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1

Equal we stand, unequal we fall?

Next Steps

Computational experiments:

Shifting and altering expenditure patterns e.g.



Thank you!

Yannick Oswald

E-mail: eeyo@leeds.ac.uk

Main references/inspirations:

Chakravarty, S., Chikkatur, A., Coninck, H. De, Pacala, S., Socolow, R., Tavoni, M., 2009. Sharing global CO 2 emission reductions among one billion high emitters. Proc. Natl. Acad. Sci. U. S. A. 106, 1–5.

Goldemberg, J., 1985. Basic Needs and Much More With One Kilowatt Per Capita Royal Swedish Academy of Sciences Basic Needs and Much More with One Kilowatt per Capita. A J. Hum. Environ. 14.

Hubacek, K., Baiocchi, G., Feng, K., Patwardhan, A., 2017a. Poverty eradication in a carbon constrained world. Nat. Commun. 8. https://doi.org/10.1038/s41467-017-00919-4

Hubacek, K., Baiocchi, G., Feng, K., Sun, L., Xue, J., 2017b. Global carbon inequality. Energy, Ecol. Environ. 2, 361–369. https://doi.org/10.1007/s40974-017-0072-9

Ivanova, D., Stadler, K., Steen-olsen, K., Wood, R., Vita, G., Tukker, A., Hertwich, E.G., 2015. Environmental Impact Assessment of Household Consumption. J. Ind. Ecol. 20. https://doi.org/10.1111/jiec.12371

Oxfam, 2018. Reward work , not wealth.

Piketty, T., 2017. Capital in the 21st century.

Shue, H., 1993. Subsistence Emissions and Luxury Emissions. Law Policy 15, 39–59

Shove, E., Walker, G., 2014. What Is Energy For? Social Practice and Energy Demand. Theory, Cult. Soc. 31, 41–58. https://doi.org/10.1177/0263276414536746

Steinberger, J.K., Krausmann, F., Eisenmenger, N., 2010. Global patterns of materials use: A socioeconomic and geophysical analysis. Ecol. Econ. 69, 1148–1158. https://doi.org/10.1016/j.ecolecon.2009.12.009

Steinberger, J.K., Krausmann, F., 2011. Material and Energy Productivity 1169–1176. https://doi.org/10.1021/es1028537

Further used in presentation

Anand, S., Segal, P., 2008. What Do We Know about Global Income Inequality ? 46, 57–94.

Fanning, A.L., Neill, D.W.O., 2019. The Wellbeing e Consumption paradox : Happiness , health , income , and carbon emissions in growing versus non-growing economies. J. Clean. Prod. 212, 810–821. https://doi.org/10.1016/j.jclepro.2018.11.223

Lehfeldt, R.A., 1914. The Elasticity of Demand for Wheat 24, 212–217.

Leontief, W., 1936. Quantitative input and output relations in economic system of the US. Rev. Econ. Stat. 18, 105–125.

Liberati, P., 2015. The World distribution of income and its inequality 1970-2009. https://doi.org/10.1111/roiw.12088

Max-neef, M., 1995. Economic growth and quality of life" a threshold hypothesis. Ecol. Econ. 15, 115–118.

Miller, R.E., Blair, P.D., 2009. Input-output analysis: Foundations and extensions. Second edition. https://doi.org/10.1017/CBO9780511626982

Statista 2019. Annual growth in global air traffic passenger demand from 2006 to 2019 https://www.statista.com/statistics/193533/growth-of-global-air-traffic-passenger-demand/ , Accessed 03.05.2019

Wu, X.D., Guo, J.L., Meng, J., Chen, G.Q., 2019. Energy use by globalized economy : Total-consumption-based perspective via multi-region input-output accounting. Sci. Total Environ. Energy use 662, 65–76. https://doi.org/10.1016/j.scitotenv.2019.01.108

Data

Eurostat, 2015. HBS - Household consumption expenditure surveys. URL https://ec.europa.eu/eurostat/cache/metadata/en/hbs_esms.htm (accessed 1.9.18).

World Bank, 2018a. Global Consumption Database. URL http://datatopics.worldbank.org/consumption/

UK Data Service, 2018. IEA energy balances. URL https://ukdataservice.ac.uk/ (accessed 1.10.18).

Peters, G.P., Andrew, R., Lennox, J., 2011. Constructing and environmentally-extended multi-regional input-output table using the GTAP database. Econ. Syst. Res. 23, 131–152. https://doi.org/10.1080/09535314.2011.563234