ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Integration of Rebound Effects into LCA – from a static to a dynamic model for households GHG emissions

Bastien Girod

Overview on my journey

- Rebound effect and its integration into LCA
- No sustainable consumption because of rebound effects?
- Rebound effects and sustainable consumption in a dynamic perspective
- Conclusions

What is the environmental impact of a product or service?



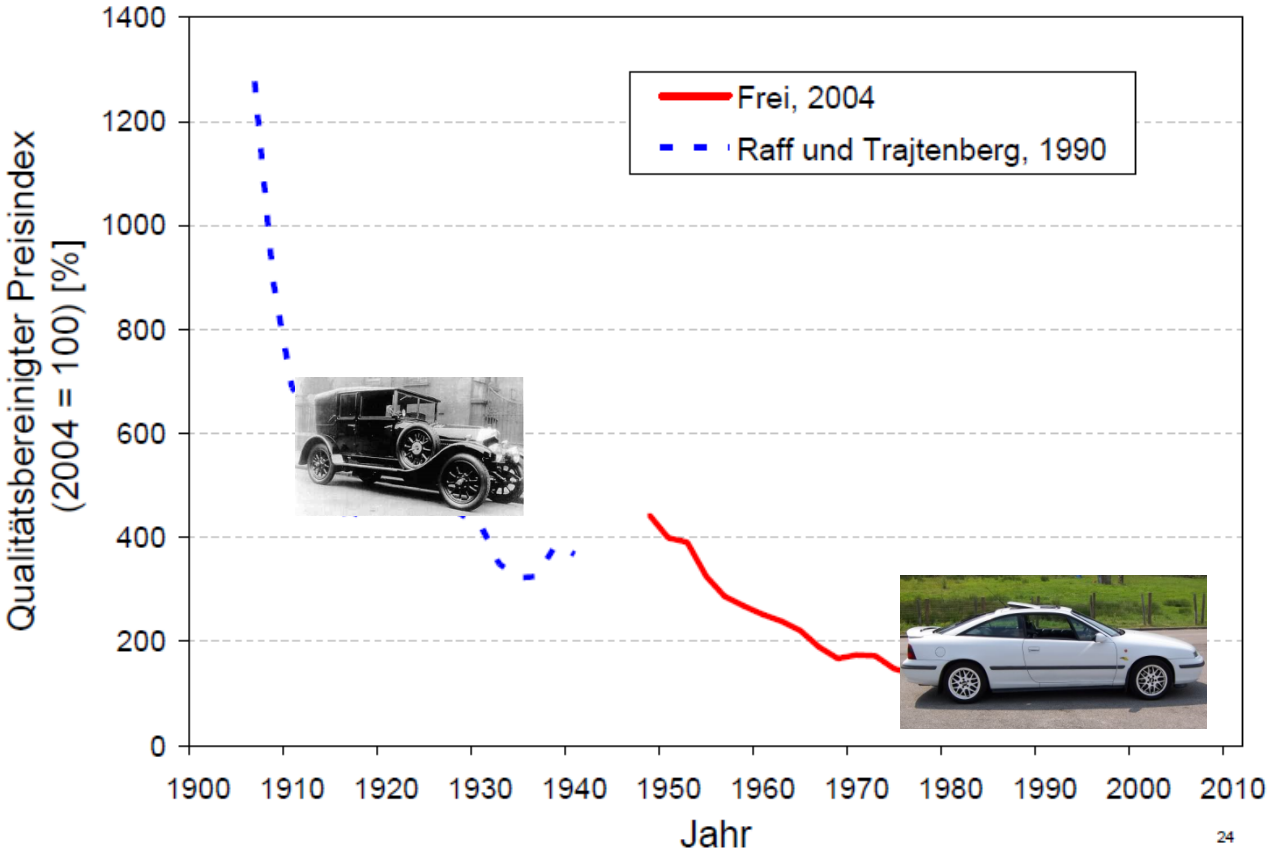


	Horse car (1900)	Car (1920)	Car (1990)	Fast train (2000)	Air plane (2000)
Efficiency [gCO2/km][1]	620	440	250	60	154
Speed km/h[2]	~10	35-40	~60	~150	~600

1: Grubler A. (1998) *Technology and global change*, Cambridge, University Press.

2: Ausubel J.H. and Marchetti C. (2001) Evolution of Transport *The Industrial Physicist*. (and own estimate for horse car)

Changing price of new car

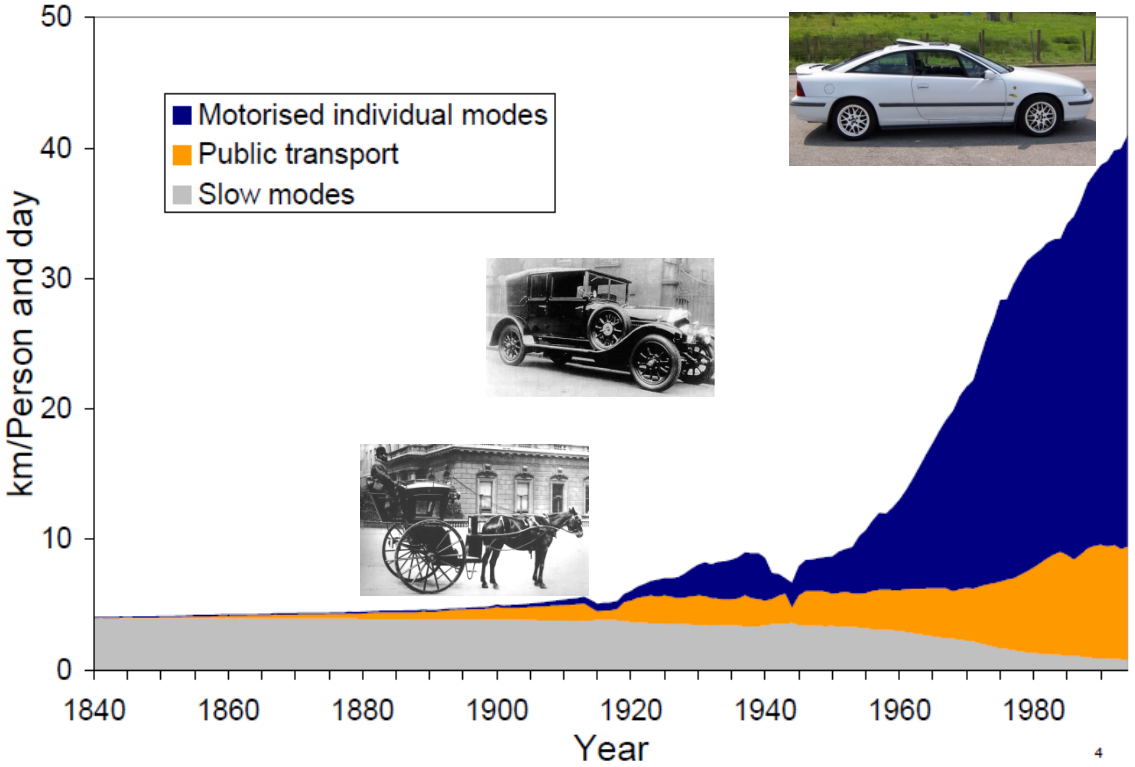


Axhausen, K.W. (2005) Mobilität im gesellschaftlichen Wandel – aktuelle Forschungen zum Verkehrsverhalten und sozialen Netzwerken, TU Graz, November 2005.

Ceteris paribus assessment

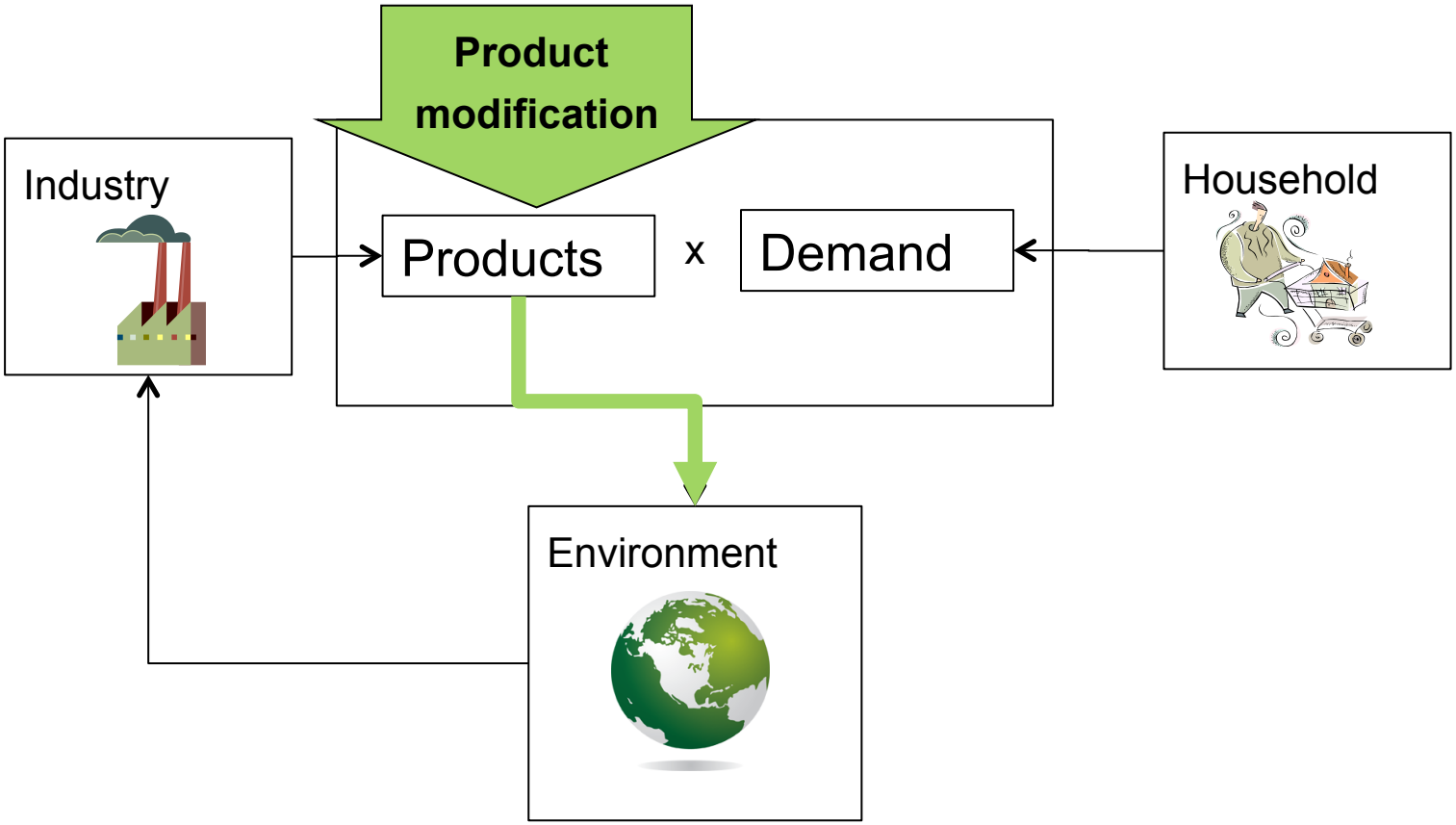
	Ceteris paribus (LCA, classical Assessment of Efficiency Potential)
Demand (pkm)	Constant
Expenditure	Decrease
Time use	Decrease

Evolution of demand

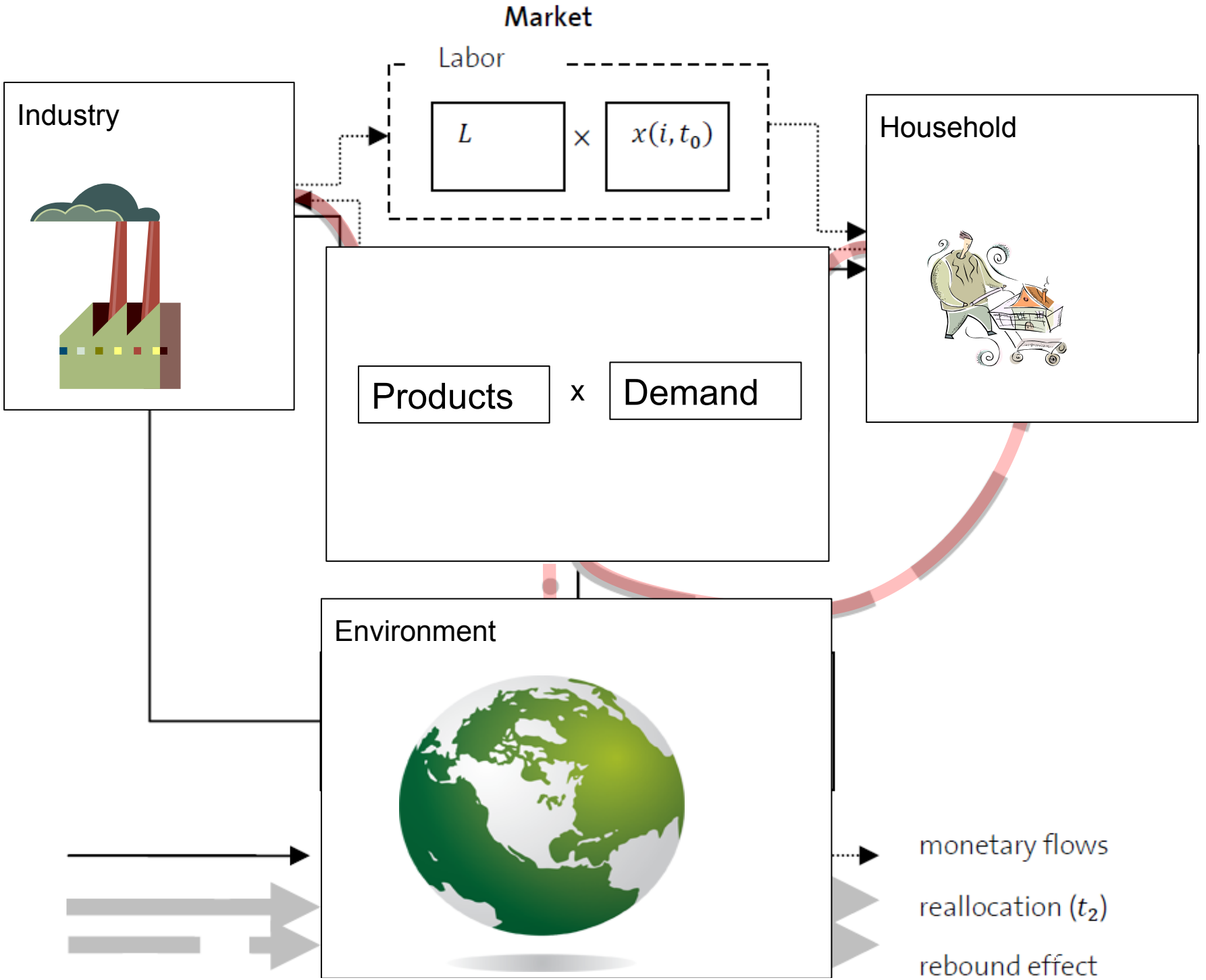


Axhausen, K.W. (2005) Mobilität im gesellschaftlichen Wandel – aktuelle Forschungen zum Verkehrsverhalten und sozialen Netzwerken, TU Graz, November 2005.

Ceteris paribus concept (LCA)



Girod, B., Haan, P., & Scholz, R. W. (2010). Consumption-as-usual instead of ceteris paribus assumption for demand. *The International Journal of Life Cycle Assessment*, *16*(1), 3–11.


Market
Labor
L
×
$x(i, t_0)$
Industry
Household
Products
x
Demand
Environment
monetary flows
reallocation (t_2)
rebound effect

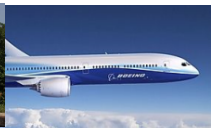
Ceteris paribus vs. consumption-as-usual assessment

	Ceteris paribus (LCA, classical Assessment of Efficiency Potential)	Consumption-as-usual
Demand (pkm)	Constant	Increase
Expenditure	Decrease	Constant
Time use	Decrease	Constant

Rebound effect (RE) of alternative travel modes







	A: Car	B: Bicycle	C: Regional train	D: ICE	E: Conv. airplane
Impact [gCO_2-eq. / pkm]	194	4	104	60	154
Reduction of impact [%]	-	98	46	69	21
Income Rebound					
Price [CHF / pkm]	0.31	0.03	0.07	0.11	0.13
Reduction [%](*more of the same*)	-	77	-135	10	-90
Time Rebound					
Speed [min/km]	1.5	3.5	1.0	0.3	0.15
Reduction [%] (*more of the same*)	-	99	20	-55	-694

Girod, B., Haan, P., & Scholz, R. W. (2010). Consumption-as-usual instead of ceteris paribus assumption for demand. *The International Journal of Life Cycle Assessment*, *16*(1), 3–11.

Implications of the consumption-as-usual concept:

Changing product characteristics:

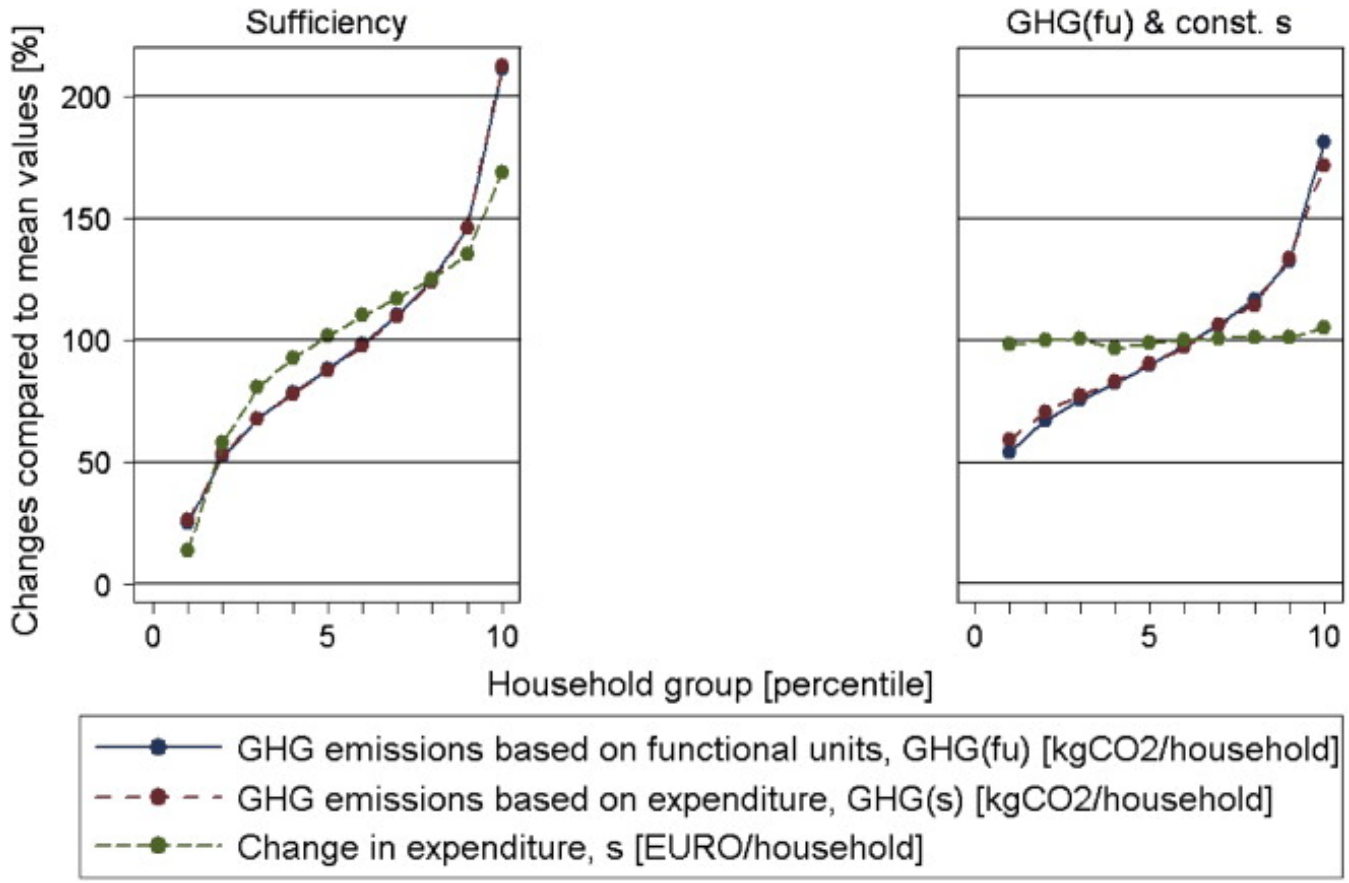
- Higher cost (CHF, hr, m^3, ...) → no or negative rebound
- Lower cost → rebound effect
- Δ Cost > Δ Env. Impact → backfire
- Increasing preference:
  - For env. impact intensive goods → rebound, backfire
  - For env. impact extensive goods → negative rebound

"Green" consumption - no solution for climate change?

- Alfredsson (2004), *Energy* **29**: 513–524

- Really?

Evidence for green consumers



Girod, B., & de Haan, P. (2009). GHG reduction potential of changes in consumption patterns and higher quality levels: Evidence from Swiss household consumption survey. *Energy Policy*, *37*(12), 5650–5661.

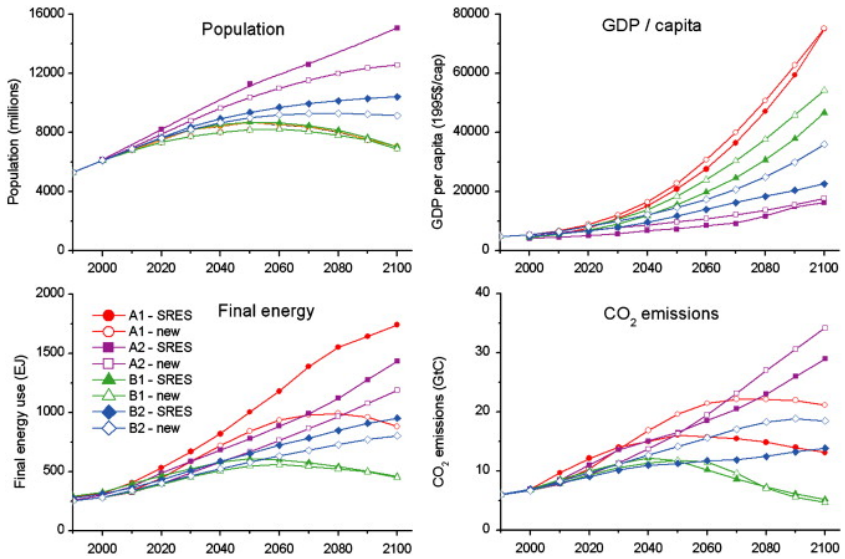
Observed strategies for "green consumption"

Category	Consumption attributes	Mean value	Low decile	High decile
			Deviation from mean for allocation… …to functional units (%)	
Better than more:				
Food	Price of cheese (€/kg)	13	2	−3
Goods	Price of shoes (€/n)	56	23	−9
Mobility	Price of car (€/n)	5176	15	−5
Leisure	Price of cultural events (€/h)	33	14	−7
	Price of accommodation (€/h)	7.4	29	−19
Preference for GHG extensive products				
Food	Meat (kg/month·pers.)	2.6	−25	27
	Organic (n/month·pers.)	3.1	32	−22
Housing	Age of building (yr)	33.5	−13	14
	Single family house (n)	0.29	−51	100
	"Green" heating (n)	0.16	183	−45
Goods	Electronics (kg/month pers.)	0.58	−68	85
Mobility	Cars (n/pers.)	0.44	−26	13
	Car use (pkm/month pers.)	842	−71	107

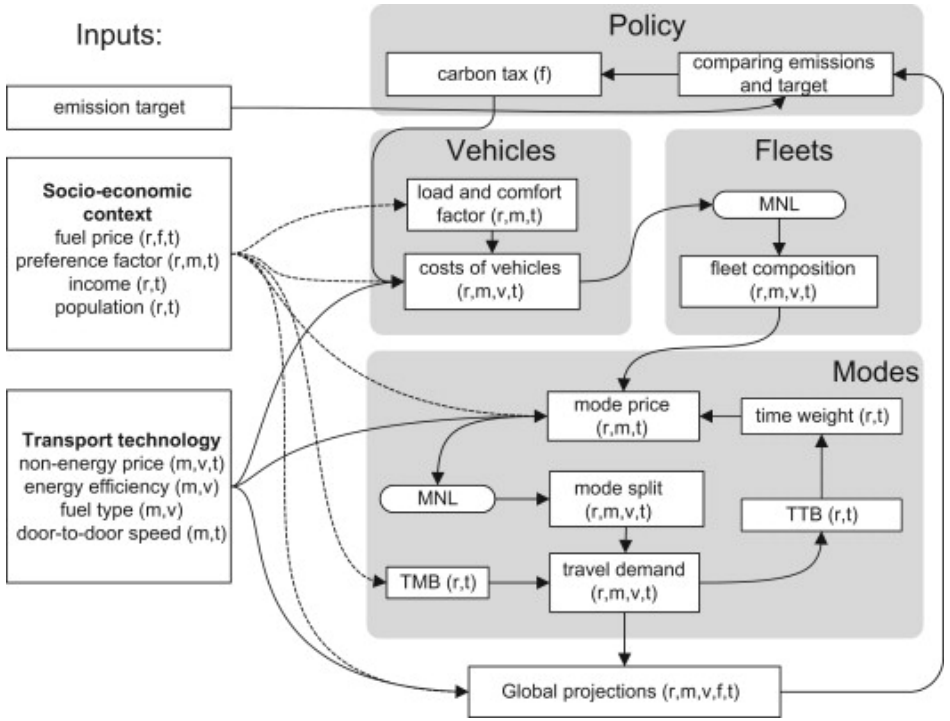
Rebound effects of future consumption?

Travel model

IMAGE-TIMER



TIMER-Travel

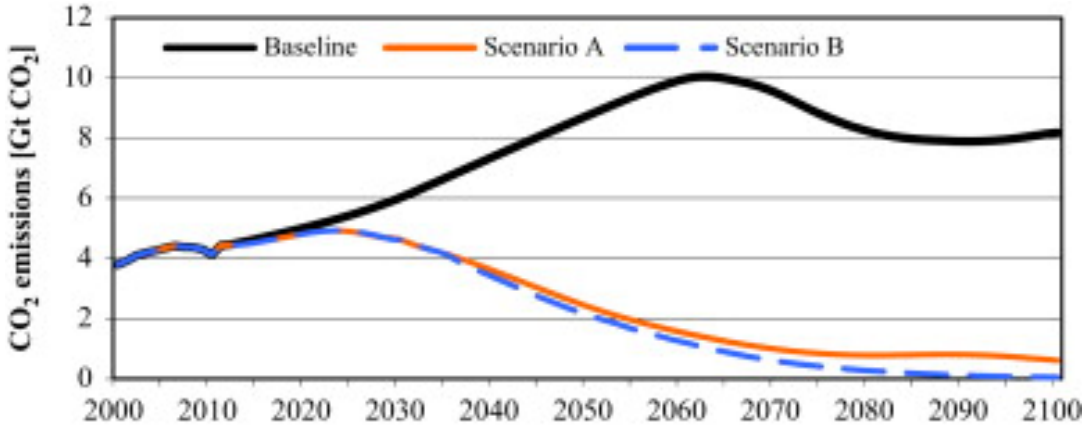


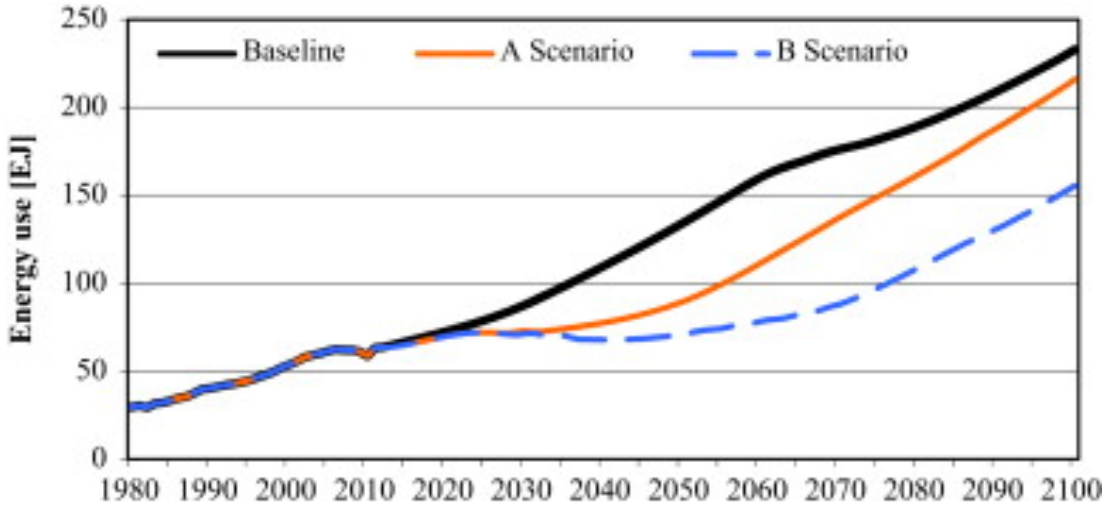
Girod, B., van Vuuren, D. P., & Deetman, S. (2012). Global travel within the 2 degree climate target. *Energy Policy*.

Rebound effects considered

- Time rebound:
  - Travel time budget per capita is the same across the scenarios.
- Income rebound:
  - Travel money budget per capita (in share of income) is the same across the scenarios.
- Resource depletion price effect:
  - Lower depletion of fossil resources results in lower fossil fuel prices in policy scenarios.

Resulting carbon emissions and energy use



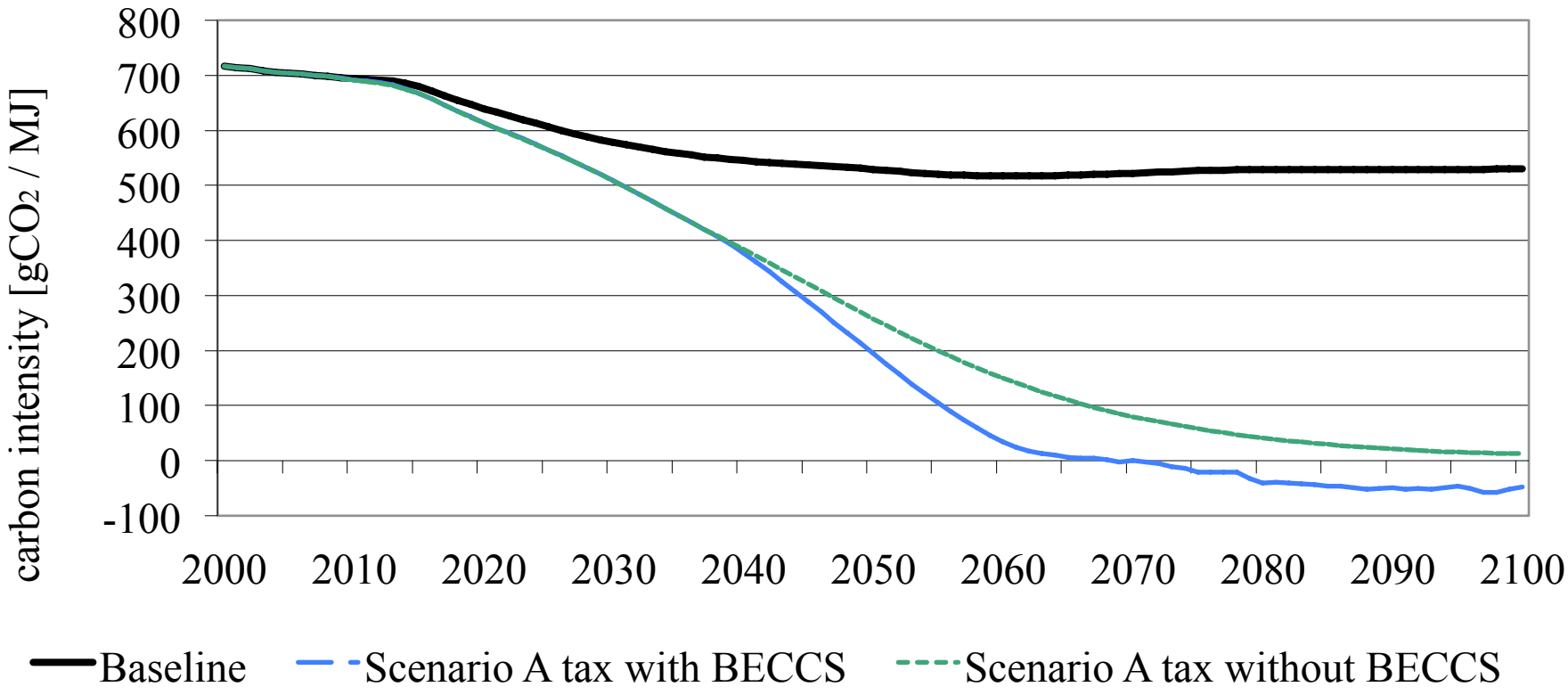


Scenario A: Zero emission biofuels

Scenario B: 35gCO2/MJ for biofuels

- Rebound effects exists, but can be mitigated with carbon tax (policy effort)
- 2 ºC target can be reached…

Changing embodied emissions if same efforts (carbon tax) are conducted in the power sector



Conclusion

- Rebound effects can and should be integrated into LCA
- Still: Green consumption is possible (in theory and practice), by
  - shifting to less GHG intensive consumption
  - going for better (or more expensive) instead of more
- For long term environmental assessment LCA need to be combined with dynamic models, which address…
  - …demand side rebound (e.g. income, time)
  - …production side rebound (e.g. fuel price)
  - …decreasing embodied emissions

THANK YOU FOR YOUR ATTENTION

Hintergrund: Schweizer Zü

www.tagesanzeiger.ch/wissen/technik/Schweizer-Zuege-sollen-schneller-fahren/story/2843315

rosenlaw.com/Defi data Annuity Method - e... diner Import to Mendeley destruct

This page is in German Would you like to translate it? Translate Nope Options

ZÜRICH SCHWEIZ AUSLAND WIRTSCHAFT BÖRSE SPORT KULTUR PANORAMA

Medizin & Psychologie Natur **Technik** Geschichte Weiterbildung Bildstrecken

Schweizer Züge sollen schneller fahren

Aktualisiert vor 15 Minuten 2 Kommentare

Von Bern nach Zürich in 30 Minuten: Westschweizer Fachleute fordern mehr Tempo für Schweizer Züge. Ihr Ziel: Die Schweiz soll eine «echte» Integration ins europäische Hochgeschwindigkeitsnetz erfahren.