

# Individual drivers for direct and indirect rebound effects

A survey study of electric vehicles and building insulation in Austria

Sebastian Seebauer

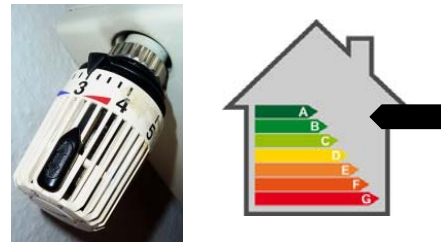
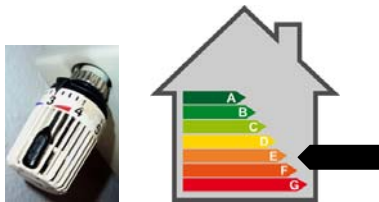
25th IAPS Conference

Rome, 11 July 2018

# What is rebound?

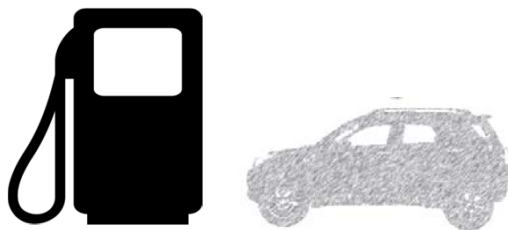
2

As heating becomes more efficient...



... we turn up the room temperature.

As cars consume less fuel...

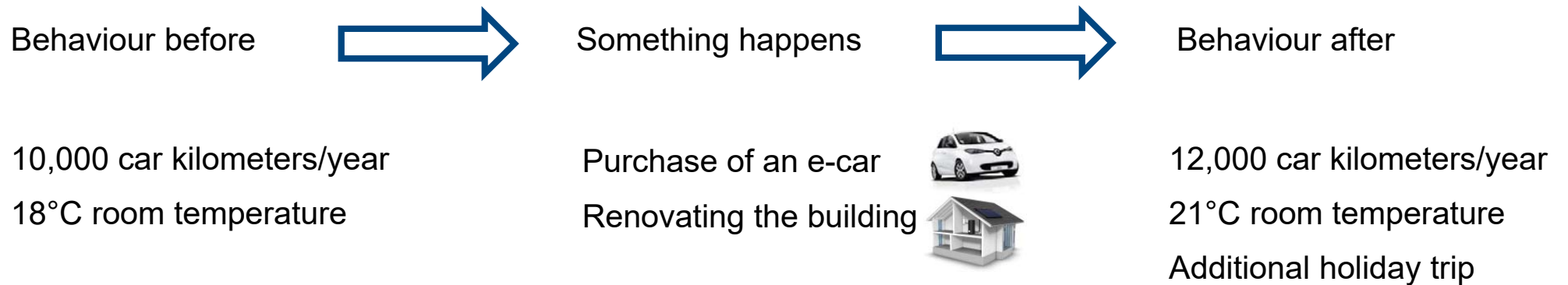


... we drive more.

... and we spend the savings in other consumption domains.



# Concepts similar to rebound



	Something happens	Impact on behaviour
<b>Direct rebound</b> Sorrell 2007, Santarius 2014	Adoption of an energy efficient technology	Similar behaviours in related consumption domains
<b>Negative spillover</b> Crompton & Thogersen 2009, Nash et al. 2017	Behavioural change? Intervention?	
<b>Compensatory behaviours</b> Bratt et al. 2015, Byrka & Kaminska 2015		
<b>Indirect rebound</b> Peters et al. 2012, Gillingham et al. 2016	Adoption of an energy efficient technology	Behaviours in other domains
<b>Mental accounting</b> Tiefenbeck et al. 2013, Friedrichsmeier & Matthies 2015	Behavioural change?	

# Drivers of rebound

## Control variables

Level of education, household size, change of heating system, technical faults

### Pro-environmental values

Kaklamanou et al. 2015, Otto et al. 2014

Acting consistently, environmental literacy on carbon footprint

### Personal norms

Nash et al. 2017, Steinhorst et al. 2015

### Social norms

Peters et al. 2012, Truelove et al. 2014

Observing role models, accordance to social conventions

Fulfilling social expectations so to act unconstrained

### Habits

Klöckner & Matthies 2004, Verplanken 2006

Maintaining previous consumption patterns

Automaticity makes less aware for gradual changes

### Frugality

Boulangier et al. 2013, Peters et al. 2012

Self-restraint and voluntary moderation, lifestyles of sufficiency

Forced thriftiness

### Income, energy poverty

Gillingham et al. 2016, IEA 2014

Satisfying hitherto unfulfilled needs

## Rebound behaviour

Direct rebound

Indirect rebound / mental accounting

Compensatory behaviours

Förderungsinformationen  
e-Mobilität  
mehrspurige KFZ  
für Private

KLIMA + ENERGIE  
2050



LAND  
SALZBURG

www.salzburg2050.at

**Förderschwerpunkt "e-mobil in  
niederösterreich"**

**Elektro-Kraftwagen-Förderung für Privatpersonen**

Eine Initiative von:

**bmwfw**  
Bundesministerium für  
Wissenschaft, Forschung und Wirtschaft





**Förderungsantrag**

Sanierungsscheck für Private 2016

Ein-/Zweifamilienhaus/Reihenhaus

Befristete Förderungsaktion im Rahmen der Sanierungsinitiative

- Comprehensive survey among all applicants
- Distribution by the funding agencies

	E-cars 	Building insulation 
Region	Salzburg Lower Austria	Austria
Funding period	2012-2016	2011-2014
Survey period	Jan-Feb 2017	Feb-Mar 2017
Survey method	postal, online	online
Return rate	54% 74%	11%
Sample size	575	1,455

# Rebound measures



## Direct rebound

With the e-car, I cover more mileage in my daily routine than I did previously with the car.

4 items  
Loadings .66-.82

Prior to the retrofit, I put on a sweater when I was cold. Now, I turn up the heating instead.

2 items  
Loadings .59-.66

## Indirect rebound







Thanks to the savings from the [e-car] [retrofit], I am entitled to consume more in other areas.





3 items  
Loadings .46-.63

## Compensatory behaviours

[I did the retrofit] [I use a car] so it doesn't matter much if I also use bigger or older electric household devices.

4 items  
Loadings .59-.77

	Direct rebound		Indirect rebound		Compensatory behaviours	
						
Personal norms	.10	<b>-.21</b>	.06	<b>-.02</b>	<b>-.03</b>	<b>-.17</b>
Pro-env. values	<b>-.24</b>	<b>-.22</b>	<b>-.62</b>	<b>-.71</b>	<b>-.50</b>	<b>-.28</b>
Social norms friends	.06	<b>.32</b>	<b>.31</b>	<b>.18</b>	<b>.32</b>	<b>.13</b>
Habits	.09	<b>.09</b>	.02	<b>.20</b>	.01	<b>.11</b>
Frugality	.14	<b>.16</b>	<b>-.10</b>	<b>.10</b>	<b>-.06</b>	<b>.08</b>
Household income	.04	<b>-.04</b>	<b>-.13</b>	<b>-.14</b>	.02	<b>-.08</b>
Energy poverty		<b>.30</b>		<b>.17</b>		<b>.10</b>
$R^2$	13%	36%	47%	70%	31%	21%

 Rebound → Act consistently  
 Rebound → Gain in prestige entitles to consume more  
 Rebound → Less aware of changes in practices  
 Rebound → Catch up to common level

Standardised path coefficients; p<.05 printed in bold.

# Discussion

8

- Conduct longitudinal studies with high granularity
  - Tracking of gradual changes in behaviour
  - Causal attribution to the energy efficient technology
  - Two-wave study on 111 e-bike users yields similar results
- Measure absolute consumption instead of dimensionless, retrospective self-reports
- Control for external factors underlying observed behavioural changes over time
  - Heating degree days, fuel prices, ...
  - Changes in household structure, employment, ...
- Confirm for other energy efficient technologies



# Conclusions

9

- Dominant impact of pro-environmental values
  - Remind consumers that they made a commitment when purchasing the technology
  - Do not crowd out value orientations by monetary benefits
- Make consumers aware of tiny changes in use
  - Feedback via smart metering etc.
  - Automated heating control
- Social norms may backfire, as they legitimise additional consumption
- (Energy) poor consumers catch up to common levels
  - Balance targets in the energy and social policy arenas



# References

- Seebauer S. (2017). Individual Drivers for Direct and Indirect Rebound Effects: A Survey Study of Electric Vehicles and Building Insulation in Austria, FCN Working Paper No. 17/2017, Institute for Future Energy Consumer Needs and Behavior, RWTH Aachen University; <http://www.fcneonerc.rwth-aachen.de/cms/E-ON-ERCFCN/Forschung/~emvl/Arbeitspapiere/>
- Boulanger, P.-M., Couder, J., Marenne, Y., Nemoz, S., Vanhaverbeke, J., Verbruggen, A., Wallenborn, G. (2013). Household energy consumption and rebound effect. Final report to the Research Programme Science for a Sustainable Development, Brussels: Belgian Science Policy.
- Bratt, C., Stern, P., Matthies, E., Nenseth, V. (2015). Home, car use, and vacation: The structure of environmentally significant individual behavior. *Environment and Behavior*, 47(4), 436-473. doi:10.1177/0013916514525038.
- Byrka, K., Kaminska, K. (2015). Can recycling compensate for speeding on highways? Similarity and difficulty of behaviors as key characteristics of green compensatory beliefs. *Polish Psychological Bulletin*, 46(3), 477-487. doi:10.1515/ppb-2015-0054.
- Crompton, T., Thøgersen, J. (2009). Simple & painless? The limits of spillover in environmental campaigning. WWF-UK.
- Friedrichsmeier, T., Matthies, E. (2015). Rebound effects in energy efficiency – an inefficient debate? *GAIA*, 24(2), 80-84. doi:10.14512/gaia.24.2.3.
- Gillingham, K., Rapson, D., Wagner, G. (2016). The rebound effect and energy efficiency policy. *Review of Environmental Economics and Policy*, 10(1), 68-88. doi:10.1093/reep/rev017.
- IEA International Energy Agency (2014). Capturing the multiple benefits of energy efficiency. Paris: OECD/IEA.
- Kaklamanou, D., Jones, C., Webb, T., Walker, S. (2015). Using public transport can make up for flying abroad on holiday: Compensatory green beliefs and environmentally significant behaviour. *Environment and Behavior*, 47(2), 184-204. doi:10.1177/0013916513488784.
- Klöckner, C., Matthies, E. (2004). How habits interfere with norm-directed behaviour: A normative decision-making model for travel mode choice. *Journal of Environmental Psychology*, 24, 319-327. doi:10.1016/j.jenvp.2004.08.004.
- Nash, N., Whitmarsh, L., Capstick, S., Hargreaves, T., Poortinga, W., Thomas, G., Sautkina, E., Xenias, D. (2017). Climate-relevant behavioural spillover and the potential contribution of social practice theory. *Wiley Interdisciplinary Reviews: Climate Change*, e481. doi:10.1002/wcc.481.
- Otto, S., Kaiser, F., Arnold, O. (2014). The critical challenge of climate change for psychology: Preventing rebound and promoting more individual irrationality. *European Psychologist*, 19(2), 96-106. doi:10.1027/1016-9040/a000182.
- Peters, A., Sonnberger, M., Dütschke, E., Deuschle, J. (2012). Theoretical perspective on rebound effects from a social science point of view: Working Paper to prepare empirical psychological and sociological studies in the REBOUND project. Working Paper Sustainability and Innovation, S 2/2012, Fraunhofer ISI.
- Santarius, T. (2014). Der Rebound-Effekt: Ein blinder Fleck der sozial-ökologischen Gesellschaftstransformation. [Rebound effects: Blind spots in the socio-ecological transition of industrial societies]. *GAIA*, 23(2), 109–117. doi:10.14512/gaia.23.2.8.
- Sorrell, S. (2007). The rebound effect: An assessment of the evidence for economy-wide energy savings from improved energy efficiency. UK Energy Research Centre Report.
- Steinhorst, J., Klöckner, C., Matthies, E. (2015). Saving electricity - For the money or the environment? Risks of limiting pro-environmental spillover when using monetary framing. *Journal of Environmental Psychology*, 43, 125-135. doi:10.1016/j.jenvp.2015.05.012.
- Tiefenbeck, V., Staake, T., Roth, K., Sachs, O. (2013). For better or for worse? Empirical evidence of moral licensing in a behavioral energy conservation campaign. *Energy Policy*, 57, 160-171. doi:10.1016/j.enpol.2013.01.021.
- Truelove, H., Carrico, A., Weber, E., Raimi, K., Vandenbergh, M. (2014). Positive and negative spillover of pro-environmental behavior: An integrative review and theoretical framework. *Global Environmental Change*, 29, 127-138. doi:10.1016/j.gloenvcha.2014.09.004.
- Verplanken, B. (2006). Beyond frequency: Habit as mental construct. *British Journal of Social Psychology*, 45(3), 639-656. doi:10.1348/014466605X49122.