

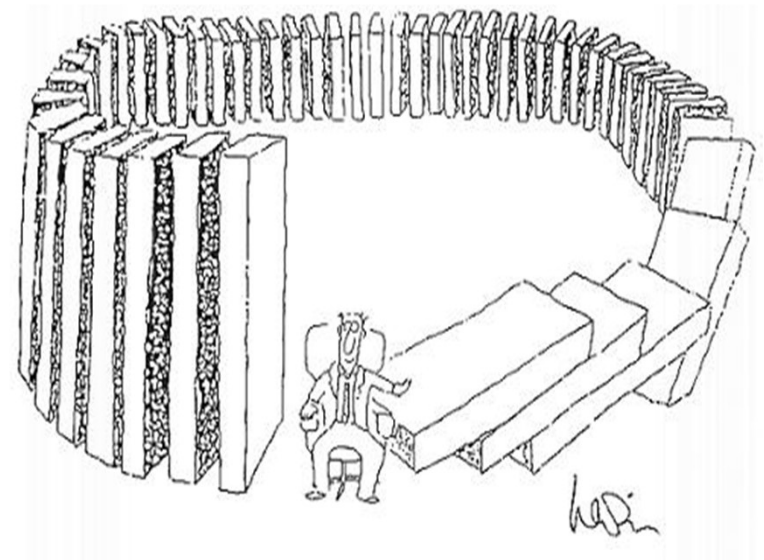
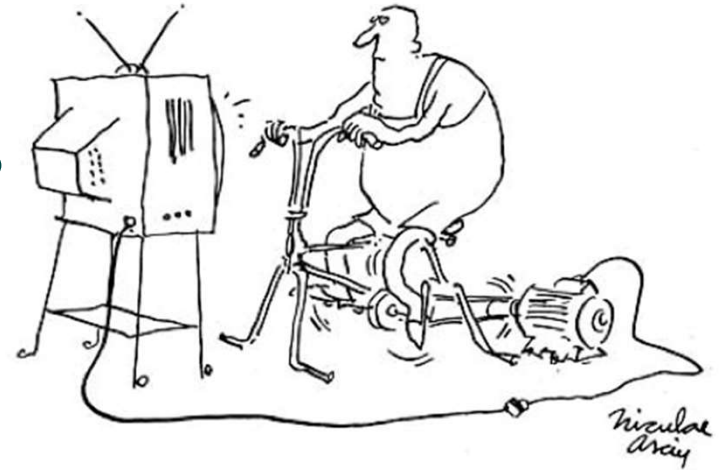
Energy sufficiency and rebound effects

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Outline

- Rebounds and spill-overs
- Sufficiency rebounds
- Sufficiency spill-overs
- Downshifting



Rebounds and spillovers

Energy sufficiency

Actions that reduce the consumption of energy services, with the aim of reducing the environmental impacts of that consumption

- Challenges in defining energy services
- Single versus multiple energy services
- Environmental versus other motivations
- Direct versus indirect impacts
- Voluntary versus incentivised/enforced



Rebounds and spill-overs

Economic and behavioural responses to either improved energy efficiency or energy sufficiency that act to offset the associated environmental benefits

Economic:

- 'Rational' decision-making
- System-wide **impacts** of decisions
- Econometric analysis and modelling
- Relevant concept: **rebound effects**

Psychological:

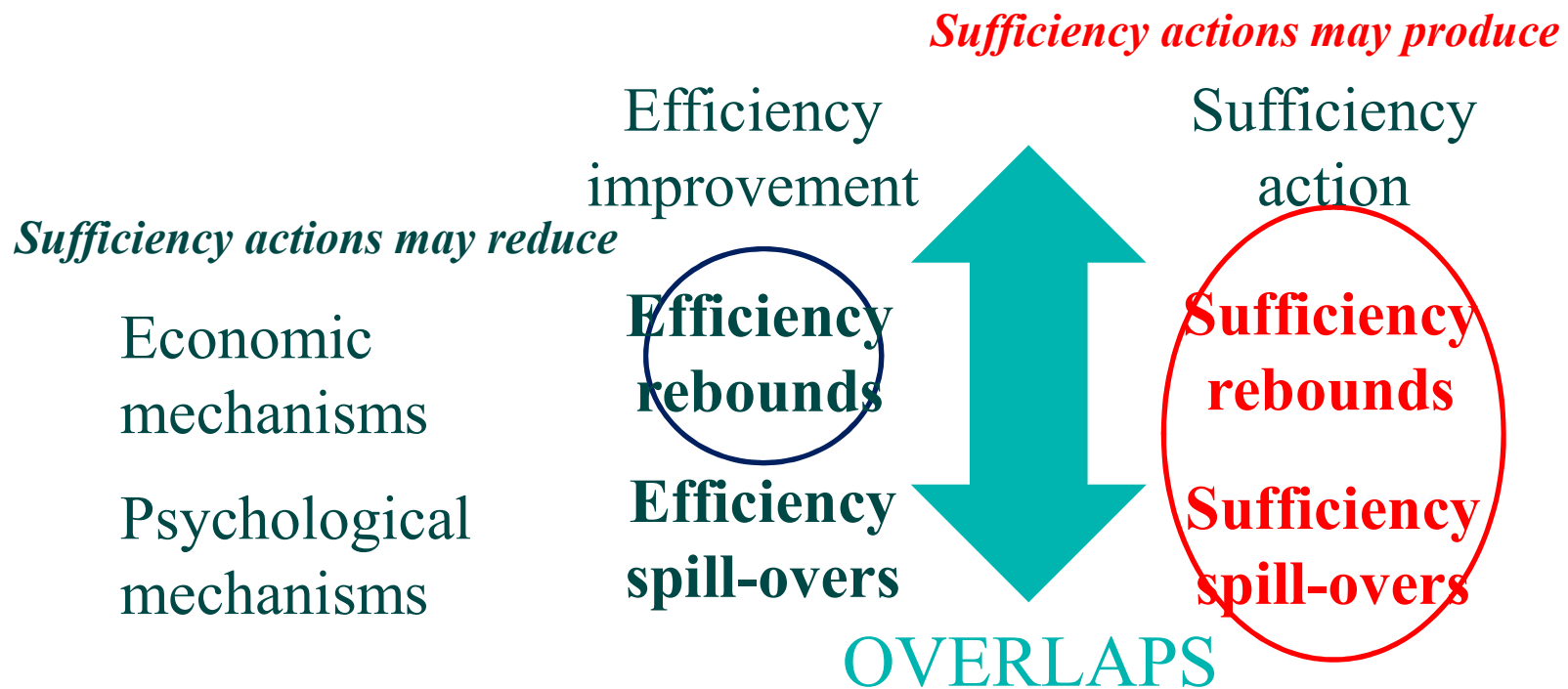
- Multiple models of decision-making
- Psychological **determinants** of decisions
- Experiments and surveys
- Relevant concept: **spill-overs**

OVERLAPS



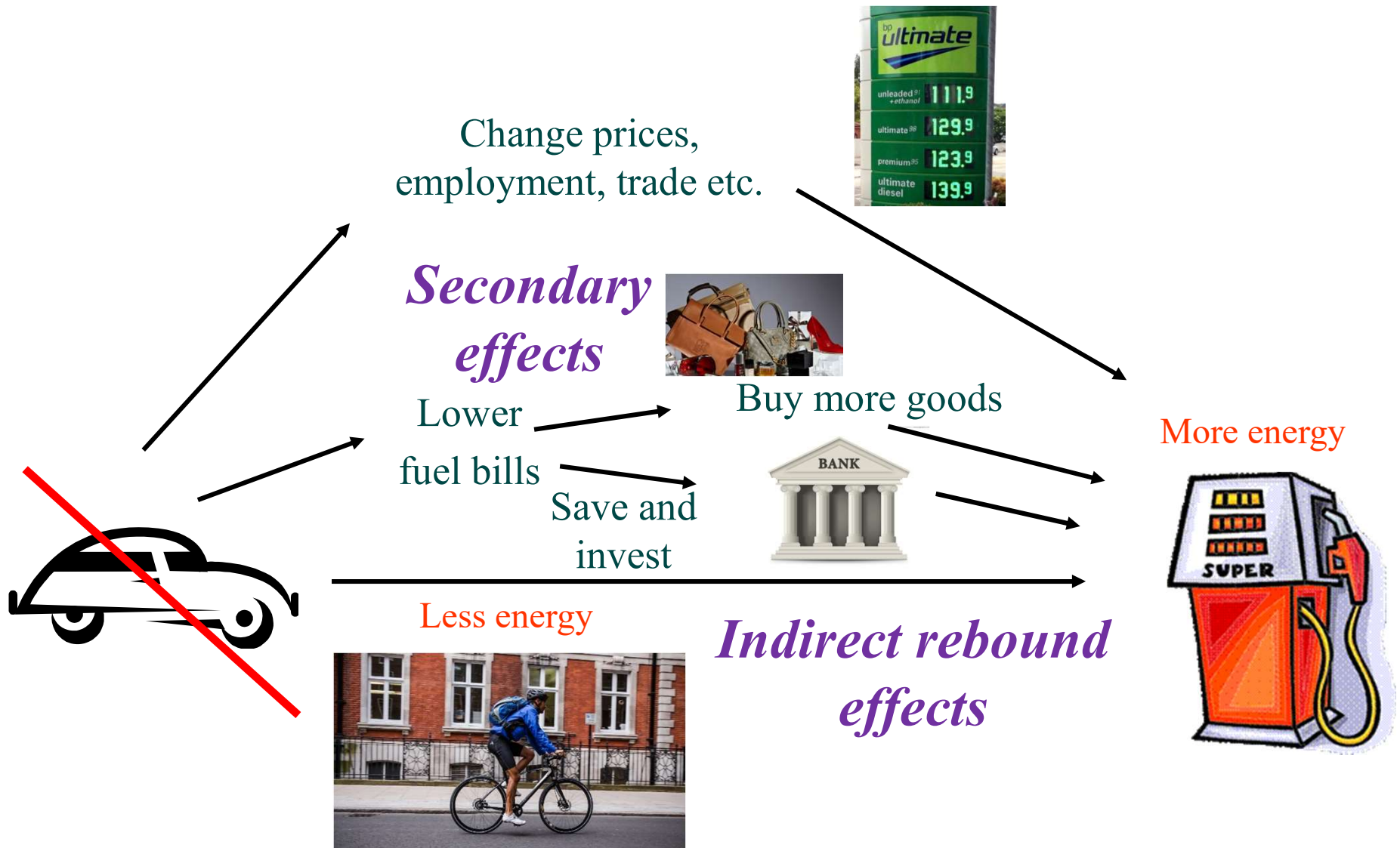
Rebounds and spill-overs

Economic and behavioural responses to either improved energy efficiency or energy sufficiency that act to offset the associated environmental benefits



Sufficiency rebounds

Sufficiency rebounds - Consumers



Sufficiency rebounds – empirical estimation

- **Indirect rebound effects** can be estimated by combining statistical analysis of consumer expenditure data with multiregional input-output models – **modest** evidence base
- **Secondary effects** can be estimated from macroeconomic models – **minimal** evidence base
- Energy versus emissions
- Direct versus embodied
- Narrow versus wide
- Short- versus long-term



Sufficiency rebounds

- indirect rebound effects

- Sufficiency actions lead to **indirect rebound effects**

Sufficiency actions save consumers money that they can either re-spend or save. Both have direct or indirect environmental impacts

The size of those impacts will depend on the **distribution** of re-spending between different goods and services and the energy/emission **intensity** of those goods and services (tCO₂/£) **relative** to the energy service

The distribution of re-spending can be **estimated** from aggregate data but will vary widely between individual households

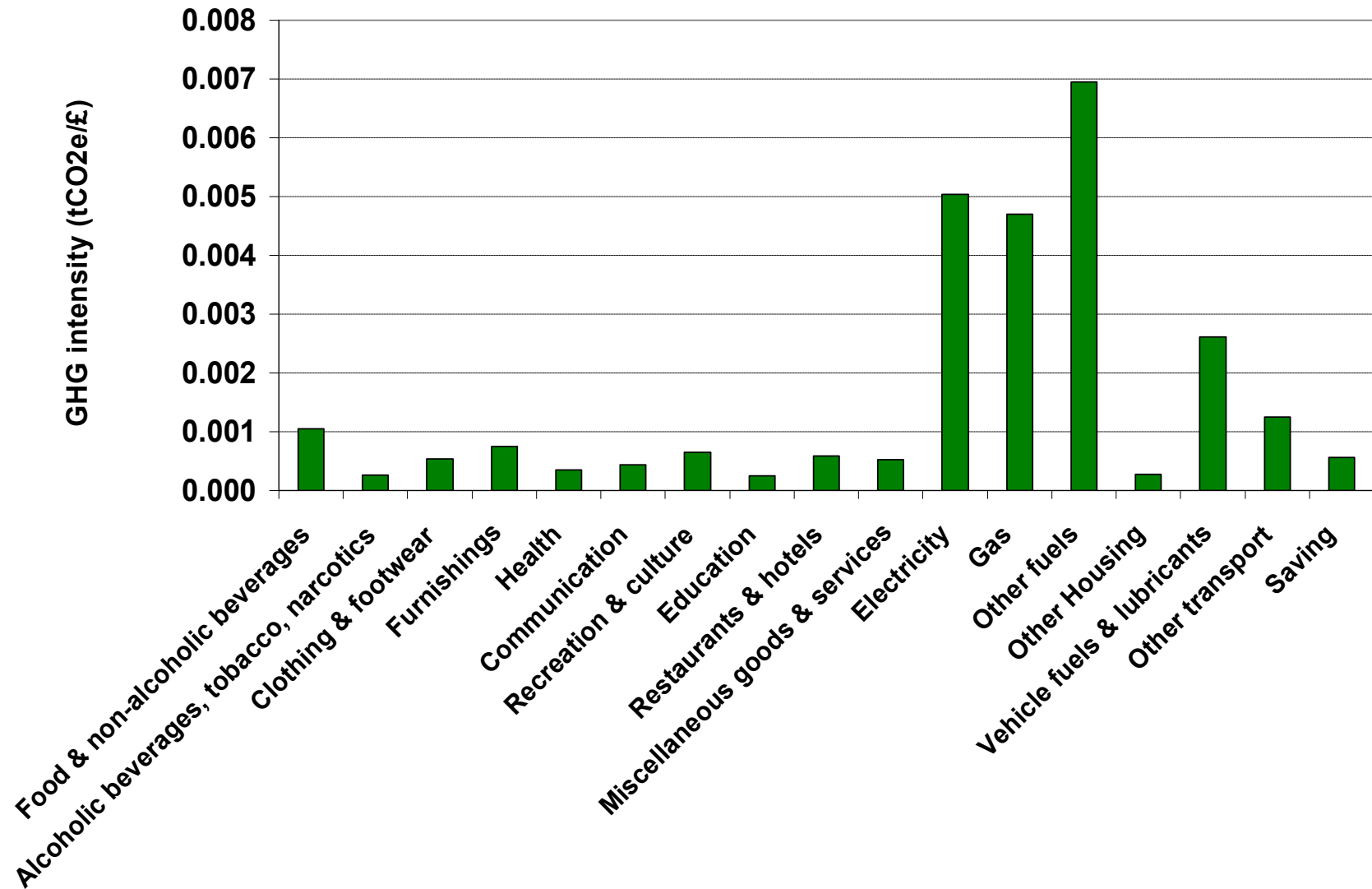
*The larger the economic benefit from the sufficiency action,
the **larger** the rebound*



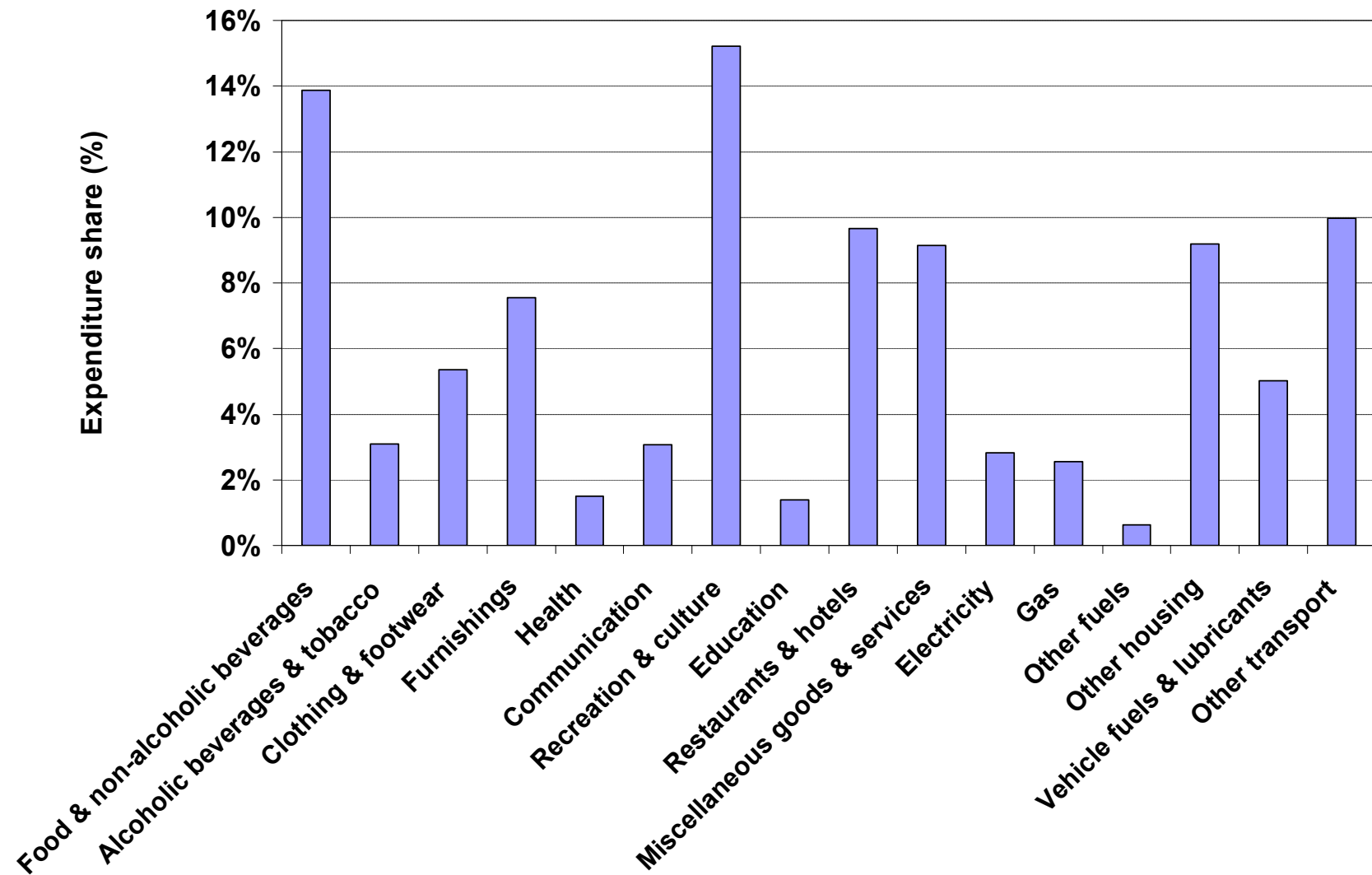
Expenditure categories

1. **Food and non-alcoholic beverages**
2. **Alcoholic beverages, tobacco, narcotics**
3. **Clothing & footwear**
4. **Electricity**
5. **Gas**
6. **Other fuels**
7. **Other housing**
8. **Furnishings, household equipment & routine household maintenance**
9. **Health**
10. **Vehicle fuels and lubricants**
11. **Other transport**
12. **Communication**
13. **Recreation and culture**
14. **Education**
15. **Restaurants and hotels**
16. **Miscellaneous goods and services**
17. ***Savings***

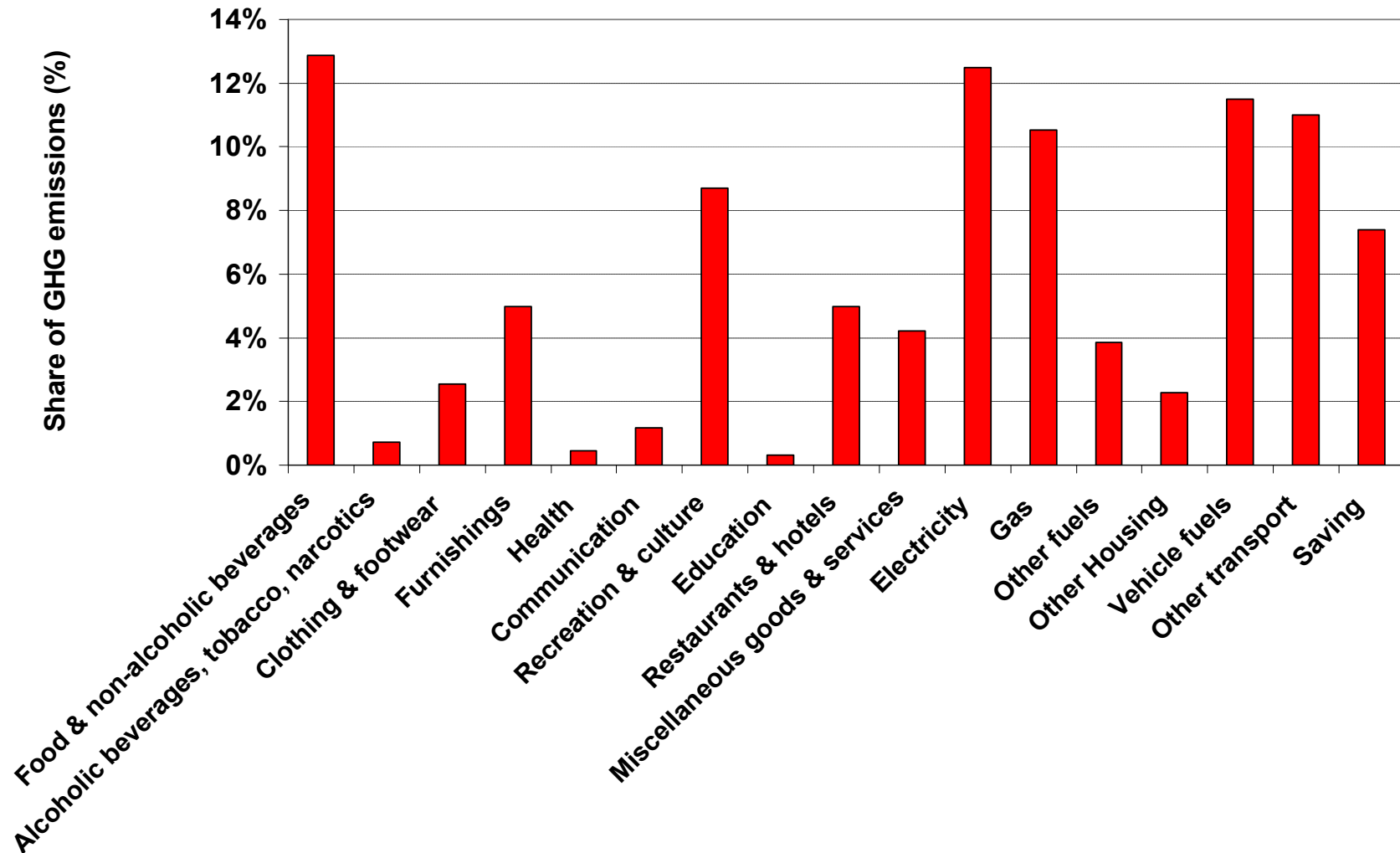
GHG intensity of expenditure (tCO_{2e}/£)



Expenditure shares (%)

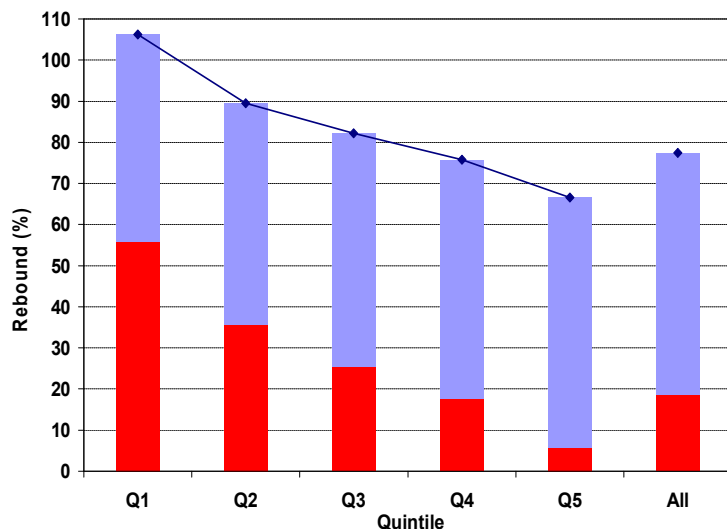


GHG emission shares (%)



GHG footprint of average UK household: ~28 tCO_{2e}/year

Illustration - indirect rebound effects from reducing food waste and car use in the UK



Reducing food waste

Mean = 77%

Reducing car use

Mean = 28%

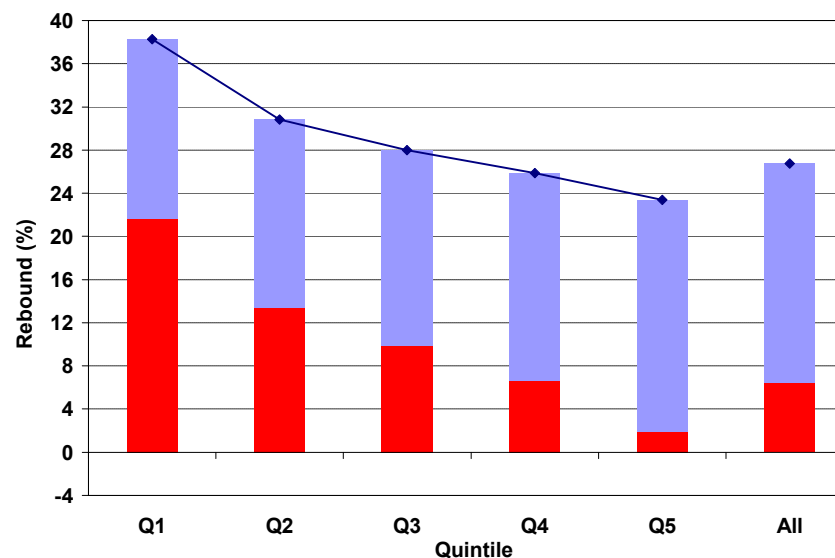


Illustration – estimates of efficiency and sufficiency rebounds for UK households

- Rebound effects are **modest (0-32%)** for measures affecting domestic energy use, **larger (25-65%)** for measures affecting vehicle fuel use and **very large (66-106%)** for measures that reduce food waste
- Results insensitive to key assumptions – except for the carbon intensity of electricity generation
- Rebound effects are **larger for low income groups** since carbon-intensive ‘necessities’ (e.g. food, heating) form a larger proportion of total (re)spending

Illustration – estimates of sufficiency rebounds

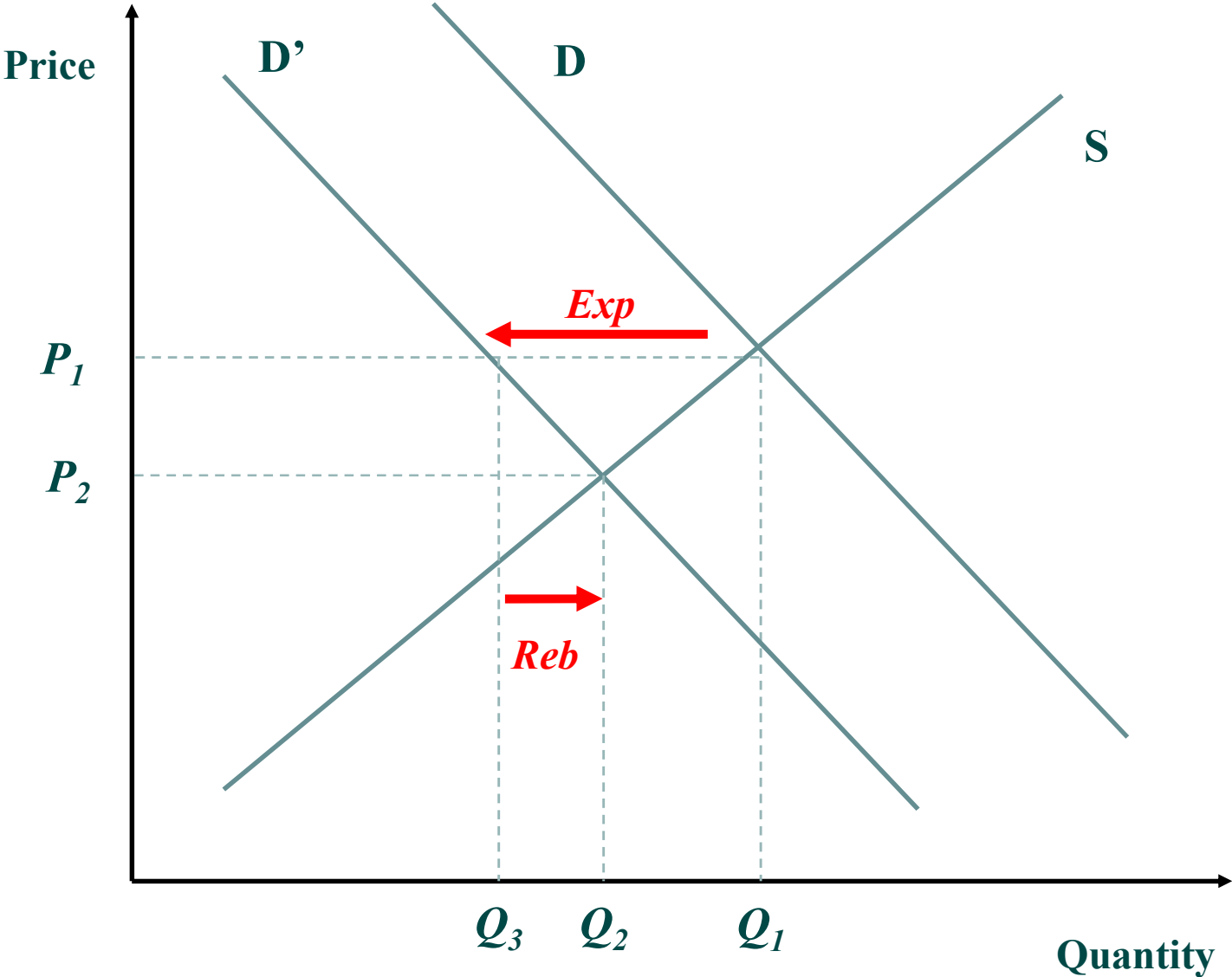
Authors	Region	No. of categories	Measures	Metric	Estimated rebound effect (%)
Alfreddson (2004)	Sweden	300	Food, transport, utilities	CO ₂	Food: 200% Travel: 35% Utilities: 20%
Lenzen and Day (2002)	Australia	150	Food	Energy and GHG's	Energy: 112-113% GHGs: 49-56%
Grabs (2015)	Sweden	117	Food	Energy and GHG's	Energy: 95-104% GHGs: 49-56%
Murray (2013)	Australia	36	Transport, electricity	GHGs	Transport: 15-17% Electricity: 4.5-6.5%
Druckman et al (2011)	UK	17	Heating, transport, food	GHGs	Heating: 7% Transport: 25% Food: 51%
Chitnis et al (2014)	UK	20	Eating, transport, food	GHGs	Heating: 12-17% Transport: 25-40% Food, 66-106%

Sufficiency rebounds - secondary effects

- Sufficiency actions can lead to additional **secondary effects** – changes in prices and quantities in domestic and international markets (not captured by simple I-O models)
- One of the biggest impacts may be through the market for **energy** commodities
- Choice of some people use **less** energy (services) leads to price reductions that encourage other (or the same) people to use **more** energy (services)



Illustration of secondary effects – energy markets



Sufficiency spill-overs

Pro-environmental behaviour

Behaviour that consciously seeks to minimise the negative impact of one's actions on the natural environment

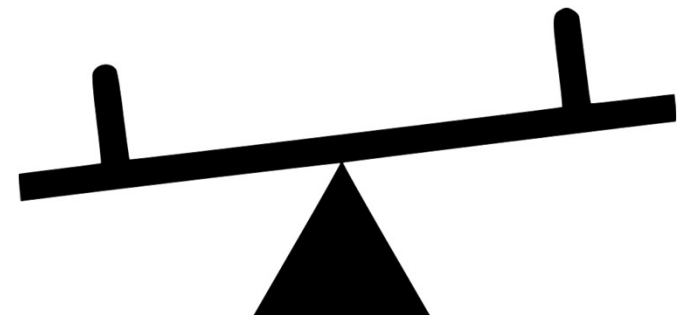
- Extensive research in environmental psychology on **pro-environmental behaviour** (PEB)
- Focus upon **intentions** and **actions** rather than impacts
- Focus on the effect of **interventions** on actions

Energy sufficiency is a type of pro-environmental behaviour



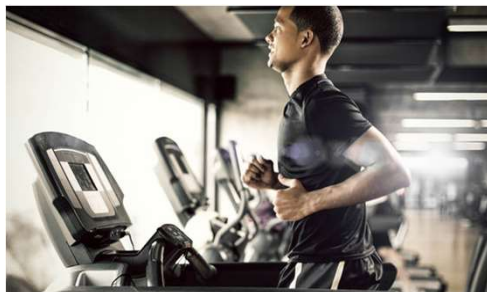
Extent to which engaging in one behaviour changes the probability of engaging in another

- Across behaviours ($A \rightarrow B$), across time ($A_{t1} \rightarrow A_{t2}$) and across contexts ($A_{c1} \rightarrow A_{c2}$)
- **Positive spill-overs:** partly explained by consistency and identity effects
- **Negative spill-overs:** partly explained by **moral licensing**
- Depends upon **drivers** of decisions, **difficulties** of behaviours, and **similarities** of behaviours and **contexts**



Examples of negative spill-overs

- Tiefenback *et al* (2013): interventions to encourage households to use less water led to them to use more energy
- Klockner *et al* (2013): electric car owners drive more than conventional car owners
- Jacobsen *et al* (2007): households who joined a green power program increased their electricity consumption
- Wefel (2017): households who were randomly assigned to report energy saving actions were less likely to support a carbon tax



Positive or negative spill-over

Positive spill-over more likely when:

- Behaviour driven by environmental identity
- Initial behaviour is costly (reinforces identity)
- Subsequent behaviour is similar



Negative spill-over more likely when:

- Behaviour driven by affect (e.g. guilt)
- Subsequent behaviour is costly
- Subsequent behaviour is different

*Larger cost savings lead to larger rebounds AND
emphasising cost savings encourages negative spill-over*

Impacts of negative spill-over

- Most people have only **limited understanding** of the relative environmental impact of different activities
- They may see sufficiency actions with only marginal emission savings as providing a **moral licence** for more emission-intensive actions
- Few psychological studies analyse **total** direct emissions, and even fewer include **indirect** emissions
- The few that do find **little correlation** between total emissions and either environmental values or pro environmental behaviours (e.g. Bleys *et al.*, 2018; Kennedy *et al.*, 2013)

Values-action gap reinforced by action-impact gap

Summary

- Important to consider the **rebounds and spill-overs** from
- energy sufficiency
- **Growing understanding** of both the size and determinants of those effects
- Rebounds and spill-overs can be both **positive and negative** and vary widely in size between different behaviours and contexts
- Rebounds **unlikely to outweigh** the climate benefits of sufficiency actions, but negative spill-overs may do in some instances
- Psychological research provide insights into how negative spill-overs may be mitigated, but rebounds are hard to avoid
- Highlighting the cost-saving benefits of energy sufficiency may be **counter-productive**