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Potential Rebound Effects of 1.5° Lifestyles

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Abstract:

Understanding how lifestyles should and could change to meet the terms of the Paris Agreement is the aim of the project 'EU 1.5° Lifestyles'. It focuses on lifestyle options compatible with a 1.5°C target and explores the structural barriers and enablers to implementing these. Many of these lifestyle options relate to circular strategies such as sharing, reusing and repairing products. However, even if lifestyle changes are achieved, there is a risk of rebound and negative side effects that can undermine the intended outcomes. While rebound effects have been studied, particularly regarding energy and economic mechanisms, less attention was paid to other environmental effects and social mechanisms. A systematic literature review was conducted for rebound effects of sustainable lifestyles more generally and more specifically in the consumption domains: nutrition, housing, mobility, and leisure. This contribution maps the potential rebound effects of lifestyle changes and the different mechanisms by which these effects occur. It gives an overview of the literature on rebound effects related to sustainable lifestyle strategies for households. The results indicate some domain areas are more studied than others, but also a gap in understanding rebound effects empirically and holistically.

Introduction

There is broad agreement that lifestyles changes are needed to meet the terms of the Paris Agreement (Akenji et al., 2021). Many of these lifestyle options relate to circular strategies such as sharing, reusing and repairing products. However, even if lifestyle changes are achieved, there is a risk of rebound effects that can undermine the intended outcomes (Koide et al., 2019). Understanding of rebound effects related to lifestyle changes, their possible mechanisms, and ways to address them is key to realising the full potential of behavioural change mitigation strategies.

Research Approach and Method

The objective of this research was to understand how rebound effects have been studied in relation to sustainable lifestyles.

A structured literature review was conducted first for research on rebounds (searching the Scopus database for titles and key words for "rebound effect" + "sustainable" + "household OR individual" + "lifestyle". In addition, specific searches for rebound and particular lifestyle changes were also conducted. This yielded 108 articles. The abstracts of these were reviewed for relevance, yielding 82 articles. These articles were read and coded for types of rebounds, magnitude, domain of consumption, specific lifestyle options considered and measures to address rebound effects. In addition, 28 more articles were added through snowballing. This paper focuses on the studies that categorised rebound, measured its magnitude in key consumption domains and/or suggested strategies to mitigate rebound.

Rebound Effects

There was a variety of different categorisations of rebound effects related to lifestyles in the literature. Here we give an overview of the main mechanisms and types of rebounds.

Economic mechanisms

Direct rebound effects typically relate to an increase in demand for or usage of a product or service, which could be induced by improved material, energy or production efficiency, which in turn can lower the life cycle costs of products. For example, a consumer installing energy-saving lamps at home, however, then they might use them more intensively or buy and

install more lamps than they had before, which would undermine the energy savings.

Indirect rebound effects most often refer to a secondary effect from re-spending of monetary savings towards the consumption of other goods and services, with an associated environmental impact (Gillingham et al., 2016). For example, a consumer may change to more energy-saving lamps and use the savings for consumption of another good or service, with its associated environmental impact, e.g. a vacation ("lights to flights" - see Chitnis et al., 2013). The economic savings is often referred to as the "income effect" while there is also a "substitution effect" in that there will be relatively less expenditure on lighting and more on another good or service (Reimers et al., 2021). In addition, increased efficiency, savings, and changes in demand can lead to economy-wide effects, i.e. lower costs lead to additional output (Jenkins et al., 2011).

Psychological mechanisms

There are also studies exploring psychological mechanisms of rebound effects. An important theory is moral licensing, essentially that after doing a good deed (moral action), e.g. buying a more efficient product or reducing consumption in one area, an individual may feel they can then compensate with a less good or even "bad" behaviour or action (Bauer & Menrad, 2020; Burger et al., 2022). While the subsequent behaviour is the same as in the examples of economic rebound, the mechanism is different.

Whether moral licensing occurs is also related to moral consistency and moral balancing (Cornelissen et al., 2013). Moral balancing is when people consider trade-offs and consequences while moral consistency is when people are guided by rules and integrity. The former is associated with moral licensing while the latter generally inhibits it for individuals with strong environmental values and a rule-based mindset, e.g., see Bauer & Menrad (2020).

Adding to the complexity, the triggering behaviour itself can influence subsequent behaviour. This is often referred to as a 'spillover effect'". After making one behaviour change, a person might make similar changes in the same or other domains (Seebauer, 2018). Bauer and Menard (2020) found that this is only the case for individuals with environmental values guided by rules.

Other rebound effects

Rebound effects can be studied not just in how consumers spend money, but also on what consumption activities they choose to spend their available time (Jalas, 2002). Time use rebound research shows that increasing efficiencies and speeds of transport have enabled longer distances and increased travel overall (Font Vivanco et al., 2022; S. Kim et al., 2020). Studies have also focussed on the environmental impacts of activities and how changing allocation of time use for different consumption activities can change overall environmental impacts (Bieser & Hilty, 2020).

Hertwich (2005) argues that the focus in research on economic rebound effects is too narrow and that any analysis of rebounds should be extended to both behavioural and systems responses. While these effects may be unintended, they are not always negative (for example, positive health effects). The term ´ripple effects´ is suggested for conceptualising rebound effects more broadly.

Lifestyle Rebounds

Here we focus on the specific rebounds from studies specific to lifestyle domains.

Transport

Many studies on rebound effects examined ridesharing/carpool and car sharing services. Coulombel et al. (2019) argue that the savings from sharing costs can induce fewer vehicles and less congestion; which, in turn, can cause more use of car transport and driving longer distances. The authors estimate size of the rebound effect is between 68% and 77% in terms of GHG reductions, in line with earlier research (Shaheen et al., 2016; Xu et al., 2015)

Rebound estimates for carsharing vary significantly. (Chen & Kockelman, 2016)found rebound effects of just 2%, Vélez (2023) found as high as 70%- 85%, and Font Vivanco et al. Font Vivanco et al., 2015) found between 40% in the EU, They find an indirect environmental rebound effect of 135% due to re-spending with higher environmental intensities (e.g. flying). This is in line with earlier studies (Hertwich, 2005; Briceno et al., 2005))

Ottelin et al. (2017) found reducing driving results in a rebound between 11-41%, with an average of 23% (in line with Chitnis et al., 2014; Druckman et al., 2011). The same study estimates even higher rebound effects (68%) for an average middle-income Finnish person who gives up a car (Ottelin et al., 2017). It is assumed that savings are re-spent on average consumption and that other travel, in particular flying, is a large driver of rebound. Similarly, Vita et al. (2019) find if savings from cycling re-spent on flying offset the emissions saved.

Teleworking can potentially reduce commutes and distances travelled (Caldarola & Sorrell, 2022; Shabanpour et al., 2018); however, a growing number of studies show that telework may encourage longer distances from work if people do not need to commute to work every day ((Cerqueira et al., 2020; de Vos et al., 2018; Zhu, 2012). People may switch to teleworking, but also shift to less sustainable transport modes (Ceccato et al., 2022; Hensher et al., 2021). In addition, the energy efficiency of workplaces versus homes affects the total impacts and rebounds from teleworking (Guerin, 2021). Teleworkers may also have more non-work-related travel (de Abreu e Silva & Melo, 2018) and families with at least one teleworker tended to travel more per week (Caldarola & Sorrell, 2022; Kim et al., 2015).

Housing

Chitnis et al (2013) estimated the rebound effect connected to reducing indoor temperatures 1 degree C to be only 7% while other heating and energy efficiency measures resulted in a rebound of around 12-13%. They found even higher effects if the embodied energy of the efficient technologies is also considered (e.g. up to 67% for solar thermal). Bardsley et al. (2019) found a direct rebound effect up to 40% with thermal upgrades to housing in the UK.

In terms of households adopting renewable energy such as solar photovoltaics, several studies have estimated rebound effects: 5-8% in California, USA ((Kim & Trevena, 2021); 7% in Dutch households (Aydın et al., 2023); 5-33% in Germany (feed-in tariffs were associated with higher rebound – see Galvin et al., 2022), 15%-20% in Australian households (see (Deng & Newton, 2017). Galvin et al. (2022) in particular note that policies like feed-in-tariffs can undermine their own goals through rebound.

Sorrell et al. (2020) note the high potential for rebounds in response to energy sufficiency related behaviour changes. In particular, Große et al. (2019) also find flying as a potential rebound action associated with urban and smaller living spaces.

Food

Reducing food waste has potential for a significant rebound effect, with the magnitude differing in studies; e.g., 57% (Hagedorn and Wilts, 2019), 77% (Chitnis et.al., 2014), 23%-59% (Salemdeeb et al., 2017) and 68%-100% (Bjelle et al., 2018). Again, assumptions about re-spending are key. If savings from avoidance of food waste go into energy-intensive categories, such as air travel and heating of space, the environmental benefits of avoiding food waste can be completely negated (Martinez-Sanchez et al., 2016). WRAP (2014), however, observe that when avoiding food waste people often purchase food of higher quality and cost, such as buying local food, better quality meat or switching to higher-cost food categories.

Reducing meat consumption at home (50%) and in restaurants could result in a 25% rebound effect ((Wood et al., 2018). These rebound effects were caused by the increased demand for non-meat products and increased consumption of other products triggered by savings from the no-meat diet. A study of vegetarianism by Grabs (2015) shows significant rebound effects: 76-130% for energy use and 25-88% for greenhouse gas (GHG) emissions. They indicate that higher-income groups show lower rebound effects and lower-income groups have higher rebound effects because they tend to spend savings on more environmentally intensive goods.

An interview study by Dreijerink et al. (2021) explored awareness about the moral licensing effects of Dutch consumers who already follow a vegetarian diet. 5 out of 26 interviewed consumers demonstrated moral licensing behaviour, ranging from eating meat after several days of following a vegetarian diet (direct rebound) to having fewer hesitations when considering buying a less fuel-efficient car (indirect rebound).

Challenging previous studies, Andersson & Nässén (2023) show that a vegan diet has a positive spill-over effect on other consumption domains, reducing overall impacts. This is explained by vegans having pro-environmental values that prevent them from re-spending in categories with high environmental impacts. Lower rebound is also supported by an earlier study where 'green' consumers were assumed to re-spend on organic products (Carlsson-Kanyama et al., 2005).

According to Bjelle et.al. (2018), eating an organic green diet leads to between -47% and -68% rebound effects. When other measures are added, such as local products and composting, the negative rebound effects increase to -91%-134%, due to the high costs of implementing both of these actions.

Leisure and Goods

The rebound effect studies of transport for holidays and leisure largely overlapped with the transport studies already mentioned. Carlsson Kanyama et al., 2021 specifically consider train holidays, versus driving, flying or staycations. The choices results in a shift in GHG effects, but the savings, or lack thereof, depend on the assumptions made.

Wood et al. (2018)) investigate reductions in demand for apparel and textiles and found a high (75%) rebound due to the low carbon intensity of the clothing sector compared to other consumption categories to which consumption shifted. On the other hand, Kawajiri et al. (2015) explicitly refer to buying higher quality and more expensive goods such as clothing could actually reduce both climate impacts and decrease rebound effects.

Makov & Font Vivanco (2018) looked at the rebound effects of smartphone reuse, finding a range of effects between 27-46%, with an average of 29%. The rebound effect is mainly from the re-spending of savings (mostly on food, non-durable goods and transport) and the authors note that the relatively low GHG savings from purchasing a secondhand phone versus alternatives also results in a rebound from imperfect substitution. The authors also find the reuse is not a direct substitute for buying new, which was also a finding of Ottelin et al. (2017), who also found repairing associated with an increased material footprint.

Measures for Avoiding Rebound

It is important to note that rebound effects are also associated with development and wellbeing (Makov & Font Vivanco, 2018). Lower income households may not be consuming at levels desirable for their wellbeing. For example, heating can be associated with positive health impacts from allowing energy-poor households to heat to their preferred temperature (Seebauer, 2018). In addition, some of the highest rebound effects for energy efficiency lighting and solar PV, e.g. up to 200% in India (see Chakravarty & Roy, 2021) are associated with meeting unmet demand as households have increased access to services and technologies. It is suggested that rebound measures should first and foremost target high income households (Murray, 2013).

The more general suggestions for addressing rebound effects in the literature varied. Seebauer (2018) found that higher education levels reduces rebounds and suggest education helps individuals better understand aims, e.g. of renovations and their own impact.

How savings are re-spent is also key to limiting rebound. As much as possible, savings should be directed towards low-impact categories such as health, education and cultural activities and these consumption categories also have positive social impacts (Albizzati et al., 2022).

Wiedenhofer et al. (2018) considered that income remains a driver of overall carbon footprints and that less work with less income can reduce carbon footprints and rebounds due to reduced spending and shifts in consumption patterns. The authors suggest more time could be spend on lower carbon well-being activities such as care and community activities.

There are also specific suggestions to avoid rebound effects in the consumption areas. In transport, these include improving public transport, reducing road capacity, and increasing the cost of travelling by car solo (Coulombel et al., 2019). In the food domain, organic food is often mentioned as an example

of a re-spending category of goods that helps avoid rebound effects due to higher prices of organic products (Hertwich, 2005). When efficiency measures lead to cost savings, the savings should be spent on higher-quality goods with lower sustainability impacts.

Claudelin et al. (2020) find that reinvesting saved money from one low carbon lifestyle change (e.g. reduction of meat or flights) into a low-carbon investment (e.g. a solar energy or carbon sequestration project – i.e. "impact investing") can be an effective measure to reduce rebound. It has the added benefit of increasing the GHG mitigation potential of the first action (e.g. a negative rebound effect).

Broadening Rebound Research

Our systematic literature review revealed that rebound effects related to sustainable lifestyles have been primarily studied by examining economic mechanisms, associated with savings, income, spending. Studies have been mostly quantitative (Figge & Thorpe, 2019) and focussed in the energy domain (Reimers et al., 2021; Vita et al., 2019; Wood et al., 2018).

The narrow conceptualisation of rebound effects so far does not address the complexity of consequences of low-carbon behaviour changes (cf. Font Vivanco et al., 2022). However, a broadening of the conceptualisation of rebound effects also results in boundaries of the concept becoming less defined.

Echoing Castro et al., (2022)'s findings of rebound effects of the circular economy we also find a need to further study the human behaviour aspects of rebound effects. Some studies, e.g. Andersson & Nässén (2023) find strong environmental awareness and attitudes result in spillover rather than rebound effects; however, the conditions and generalisability for this are not clear (see e.g. Sorrell, 2018) and should be explored further. Both broad consideration of rebound effects as well as a focus on empirical studies should be part of a future research agenda.

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