Insights into Human Behaviour Hold the Key to the Energy Transition

Kirsty Novis[1] & Thomas A. Norton[1]

[1]Arup Group, UK

SUMMARY

The paper describes how understanding user behaviour and implementing behaviour change initiatives may be the key to changing attitudes to energy consumption and energy transition. The objective of this paper is to explore how four key factors; behaviour centred-design, preventing rebound effects, providing meaningful feedback and, understanding how behaviour scales can make an impact.

KEYWORDS

Sustainability, Energy Consumption, Net Zero, Human Behaviour, Behaviour Change

Introduction

For all the complexity of climate science, the urgent need to transition to renewable energy is widely understood. In 2021, fossil fuel combustion in the global energy sector emitted more than 33 billion tonnes of carbon dioxide – up 5.6% on 2020 (International Energy Agency, 2021), when the world's economy ground to a halt during the pandemic. At COP27, many expressed concerns over slow progress on limiting emissions, including from the energy sector. As this year's Intergovernmental Panel on Climate Change report makes clear, the technology needed to support the transition exists today (Pathak et al., 2022). It has also fallen in price as it has advanced: for example, solar energy has gone from more than three times to less than two-thirds the price of coal in a decade (Pathak et al.). The financial case for renewables is now just as compelling as the environmental one and countries from Costa Rica to Scotland are increasingly turning to renewables. However, the key to unlocking the next level of progress lies elsewhere: human behaviour.

Understanding user behaviour and how people interact with energy systems can accelerate change – failing to do so could neutralise or even reverse hard-won technological advances. For example, in 2021 global energy consumption grew 4% as countries recovered from COVID-19 (International Energy Agency, 2021). In turn, many countries looked to non-renewable energy to plug short-term supply gaps, incurring long-term environmental costs. Consumer demand is the real driver of energy-related emissions – and therefore individual behaviour can drive change across the industry. In 2021 the Office for National Statistics found consumer expenditure was the largest contributor to UK emissions (27%; Office for National Statistics, 2022), while analysis shows at least 62% of emission reductions in the UK depend on behaviour change (Climate Change Committee, 2019). However, as our demand for energy falls, questions about whether it is produced from renewables can seem less important, potentially undermining the transition. So how can a focus on human behaviour support the shift?

1. Behaviour-centred design

The best design considers user behaviours and guards against human error – with green technology in particular, by reducing consumption. For example, we can anticipate the potential for using technology inefficiently – compromising its energy-saving potential – and mitigate accordingly. Using technology energy-efficiently should also 'feel better' than the alternative. By bringing together technical expertise and behavioural insights, we can motivate users to use less energy. The problem is complex: it is more energy efficient to only light occupied rooms, but people may feel safer in a brightly lit home. Good lighting design addresses both these competing concerns, such as using motion sensors which cut usage while maintaining or even increasing safety by warning of an intruder. Additionally, making more sustainable choices can be made easier using technology. Evidence suggests automation to control laptops, monitors, phones, and desk lights helped employees reduce energy use by up to 38% (Staddon et al., 2026), while occupancy-sensitive heating systems can cut consumption by up to a quarter (de Bakker et al., 2018).

2. Preventing rebound effects

It may seem counterintuitive but switching to renewables can *increase* energy consumption. Research shows that a 'rebound effect' appears when an increase in energy efficiency leads to less energy savings than expected, due to increased usage (Colmenares, Löschel & Madlener, 2020; Dutschke, Galvin & Brunzema, 2021; Lange et al., 2021). For example, after installing solar panels consumers may increase their energy usage because they feel they have license to because it is 'clean'; or after purchasing an electric vehicle, the consumer may take advantage of the lower running cost by driving more miles, more often.

The rebound effect has serious consequences: the cost of maintaining or replacing appliances, for example, and the more harmful possibility that this attitude spills over into activity which uses non-renewable energy, like driving a fossil fuel-powered vehicle. Long-term, this attitude may be passed down from parents to their children. This concept is known as 'moral licensing' and shows how we reward ourselves for our 'good' behaviour with moral credit we then use to pay for 'bad' elsewhere, relieving the discomfort of acting against our values or worldview (Burger, Schuler, & Eberling, 2022; Lasarov, Mai, & Hoffmann, 2022). As we saw in 2021, rising demand often precipitates a turn to non-renewable energy, incurring a carbon debt that future generations must repay. This can be tackled by focussing on a higher goal across all energy use – framed as 'cutting your energy footprint' and encouraging people to adopt a low-energy lifestyle.

3. Providing meaningful feedback

Behaviour change is a learning process: feedback reinforces new behaviour. We can influence this in a number of ways: for example, domestic smart meters which show households their exact energy consumption. However, feedback must be accessible and useful – after all, how many people can tell you what a kilowatt hour is? Research shows that seeing consumption in financial terms is more powerful in reducing household energy use – by around 10% (Darby, 2006). The social dimension is also key: allowing users to compare their consumption to their neighbours and combining smart meters with goal-setting – a powerful driver of behaviour change – could cut consumption even more. Studies in the workplace have shown highlighting and rewarding energy saving behaviour can cut consumption by up to 12% (Staddon et al., 2016).

4. Understanding how behaviour scales

For the first time in human history, we can see how individual behaviour scaled across the lifetimes of billions of people has global consequences. Sustained, widespread energy efficiency happens through the accumulation of the many choices people make every day. Leaving a light on in an unoccupied room appears trivial – but how many unoccupied rooms are needlessly lit right now? Scale across a year and it is clear how seemingly small changes accumulate to create demand which remains largely satisfied through fossil fuels. Some sports teams are switching off stadium floodlights straight after a match – this might not scratch the surface yet, but what if entire leagues held fixtures an hour earlier to reduce energy consumption throughout the year? We don't perceive this intuitively: one way to help is to give consumers feedback. Several studies have shown that instant feedback via digital systems like online dashboards is effective at encouraging people to use less energy (Darby, 2016; Fischer, 2008; Yun et al., 2013). This is because this can help people evaluate their behaviour and encourage them to adapt. Government can also encourage collective change in the long-term (such as maintaining short-term reductions in consumption due to higher energy bills).

Conclusion

Centuries of human development ran on what we now know was highly-polluting energy – so shifting away from fossil fuels is a fundamental transformation. Energy consumers (or, to put it another way, every single one of us) have a key role to play in changing how we live our daily lives. Developing new technologies is critical in tackling the climate crisis but we must deploy it effectively. Human behaviour sits at the crossroads between people and technology: systems must be designed to consider the complex, changing relationship between the two. Without considering how technology helps consumers reduce their carbon footprint, we risk investing in solutions which don't deliver the change we need. The scale of the problem, the urgent need to address it and the fundamental nature of energy means neglecting this will have dire consequences – and, therefore, even more radical changes in our lives. Reducing the energy consumption we control can drive this all-important transition – otherwise our efforts to tackle climate change could be in vain.

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