

# Consumer Surplus from Energy Transitions

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## Executive summary

Energy transitions have led to major advances in human wellbeing. However, little evidence exists about the scale of the net benefits. The purpose of the paper is to estimate how consumer surplus for heating, transport, and lighting, and their associated energy technologies and sources, changed over the last two hundred years. By developing a new method to identify the demand curve, this paper indicates that the consumer surpluses (as a share of GDP) for energy services have risen from the early nineteenth century until the second-half of the twentieth century and, then, have started to decline. This suggests that, as an economy develops, consumers gain greatly from rising energy use. However, it also highlights that, at higher levels of economic development and material comfort, rising consumption brings more limited benefits.

The value of the present study is first to provide information about the magnitude of the benefits to society from particular energy transitions experienced in the nineteenth and twentieth centuries. For instance, the estimates suggest that transport and lighting technologies provided large and rising consumer surplus, until the 1960s and 1950s, respectively. For heating technologies, the rise in consumer surplus was more modest. The results indicate that not all technological innovations are equal when it comes to their potential to increase consumer surplus. Some innovations, such as buses and gas heating, merely act as substitutes, and bring little additional consumer surplus. By contrast, major potential improvements in welfare occur when goods and services, such as key transport and lighting technologies, go beyond the simple services they provide, and offer new opportunities to transform lives.

The paper also suggests the declining (relative) utility from energy consumption at higher levels of economic development signals that there may be less profits to be made by companies from new energy technologies and transitions. In this light, it offers a method for anticipating consumer benefits from future technological development and energy transitions.

Finally, an ambition of this paper is to help move forward the climate mitigation debate. Recent focus on the impacts of climate change has drawn attention to the negative aspects of energy use, overshadowing the positive benefits. In general, the dramatic gains to society from technological change and energy transitions appear to be larger than the external costs. However, growing climate-related external costs highlight the tension between victims and consumers of energy use. To push forward the debate, it might be valuable to better understand the incentives driving consumers to continue to pollute. This paper begins to investigate the 'low-hanging fruit' related to reductions in energy use and carbon dioxide that impose minimal burden on consumers.

**Keywords** Energy demand, Energy transition, Technological change, Consumer surplus.

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