The impact of COVID-19 lockdown restrictions on domestic energy consumption in GB

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1. Introduction

Reducing building energy demand is key to achieving the UK's Net Zero emissions target. Buildings (homes, schools, offices, shops, etc.) currently account for 29% of carbon emissions. It is one of the most challenging sectors as it drives peak energy demand in the UK, and is an area where the government is planning to invest billions of pounds to reduce its emissions. One of the key building blocks in the plans to tackle 'net zero' is having a good understanding of where and how we use energy; the main source of carbon emissions.

COVID-19 is impacting, and will continue to impact building energy demand in both the short and long term. In the short term, lockdown restrictions around the world caused huge changes in daily routines, such as the near 24/7 occupancy of homes and the closing of schools and businesses. This resulted in very significant changes in energy use [1]. These changes have come at the cost of massive social and economic impact; unsustainable in the long term. Post COVID-19 a 'new normal' energy use will result. Carbon reduction plans will need to be rapidly changed to take account of this 'new normal' following the initial global disease outbreak. This paper aims to understand the changes in domestic energy consumption patterns in GB during the first few months of lockdown. In doing so we consider how these changes may persist beyond the end of COVID-19 lockdown restrictions.

The research presented here uses half-hourly electricity and gas data for around 1700 households in England and Wales from before, during and after the core lockdown period in GB. These are used in combination with survey data from September 2019 about each

household and dwelling, a survey from May 2020 about changes to the household and its activities during the lockdown period, and contextual data such as local weather data and Energy Performance Certificate [2] (where available).

2. Background and Methodology

The Smart Energy Research Lab (SERL) [3] was established to provide university researchers with access to residential half-hourly gas and electricity smart meter data from randomly-selected consenting households in Great Britain (GB). The first wave of approximately 1700 participants was recruited in September 2019. All participants provided consent for SERL to access their smart meter data for research in the public interest, and most completed a survey (approximately 40 questions) about their household and dwelling. SERL has permission to link these data with contextual data such as local weather data and Energy Performance Certificate (EPC) data. In May 2020 these participants were invited to complete a second survey, specifically on the impact of the COVID-19 lockdown restrictions on their household's circumstances and behaviours.

The combination of the longitudinal smart meter data and the contextual data provided by the surveys, weather reports and EPCs allows us to analyse how the energy consumption patterns changed for the ~1700 households in the study and to attempt to explain these changes. We are able to ask how the lockdown affected different types of households and offer potential explanations. For example, households with children, elderly couples, those in flats or detached houses may have different energy needs. Many households gained or lost members for the lockdown period. Many people started working from home, while many key workers continued to work outside the home. By capturing this type of information, we gain unique insights into how changes (or no change) in circumstances translate to changes (or no change) in energy use.

3. Results and Findings

1711 households signed up for their smart meter data collection in September 2019, of whom 1673 completed/partially completed the survey at the time, and 1084 completed our survey in May 2020 on the impacts of COVID-19. Our analysis compares energy consumption during the first lockdown (23rd March to 10th May 2020) with a period with similar degree days (8th September to 27th October 2019). Preliminary results indicate that gas consumption increased significantly ($p < 0.05$) by 38% during lockdown compared to the comparable earlier period (N = 993 households). Electricity consumption was 12% higher during lockdown, increasing on average from 8.3 kWh/day to 9.3 kWh/day (N = 1107 households, statistically significant for $p < 0.05$). These results are preliminary and analysis is ongoing – more detailed, rigorously checked results that build on these initial findings will be presented at the conference.

4. Discussions and Conclusions

Other studies have shown significant changes in energy use in the UK during the lockdown period, but lack the contextual data to explain their drivers, and how different groups of the population are affected. With longitudinal data from before, during and after the core lockdown period in GB, we have the potential to understand how energy use may continue to change going forward beyond the peak of COVID-19. Preliminary results show that energy use rose significantly during the first national lockdown in the UK. Further analysis will build on these results for presentation at the conference.

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