COVID-19 lockdowns in the United Kingdom: Exploring the links between changes in time use, work patterns and energy-relevant activities

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Abstract

Restrictions on movement and the imposed social distancing and work-from-home rules due to the recent global pandemic have sparked an interest in understanding changes in the timing, duration and sequencing of daily activities. In this paper, we investigate how working from home during the various stages of COVID-19-induced lockdowns in the United Kingdom influenced the timing of in-home, energy-related activities. We present findings from the analysis of data collected during the first and second UK lockdowns using an online diary instrument developed by the UK Centre for Time Use Research. Based on a weighted average index we show that there were noticeable changes in the start times of energy-relevant activities between the pre- and mid-lockdown periods. Both lockdowns showed a substantial variation in start times of laundering compared to the reference period. The food preparation activities start times varied more during the second lockdown depending on the time of the day. TV watching activities started later and lasted longer relative to the pre-pandemic reference period. We conclude by discussing how we can account for the associations we have identified between changing energy-relevant activities over the different phases of the lockdown periods.

Keywords: time-use research, energy-relevant practices, COVID-19 lockdowns

Introduction

The COVID-19-induced national lockdowns offer an unprecedented opportunity to explore the changes in everyday life triggered by disruptions to the deeply embedded institutional rhythms that shape to a large extent our everyday lives. While there are numerous consequences to these disruptions (e.g. increased remote work and learning; decreased social interaction; or mental health consequences), little attention has been paid to how these influenced daily routines and practices within the home environment. Everything from when and who performs activities at home (for example, food preparation, work, or leisure) to the intensity, duration, or timing of activities was bound to experience some changes. These changes in activity patterns, particularly those involving the use of devices or appliances, have the potential to significantly alter energy usage patterns in the home; perhaps even in ways that will persist even after the pandemic is over. The present work aims to explore the impact of working from home on in-home, energy-relevant activities in the United Kingdom.

In the United Kingdom, the national lockdowns had a significant impact on electricity consumption. The measures implemented to contain the pandemic, including restrictions on movement and working from home appear to have reduced energy demand overall (Bahmanyar et al. 2020, Sovacool et al. 2020). To illustrate this, Figure 1 compares the total electricity consumption profiles in the UK as recorded by National Grid during a week in April 2020, after the lockdown measures were imposed, and a reference week in April 2019. What this comparison reveals is the fact that overall national demand decreased considerably during weekdays, and that the 'typical' weekday demand profile started to look more like the 'typical' weekend profile. Therefore, it is clear that the timing of energy-demanding activities changed as a result of the imposed restrictions. However, the question of how exactly these changed remains.

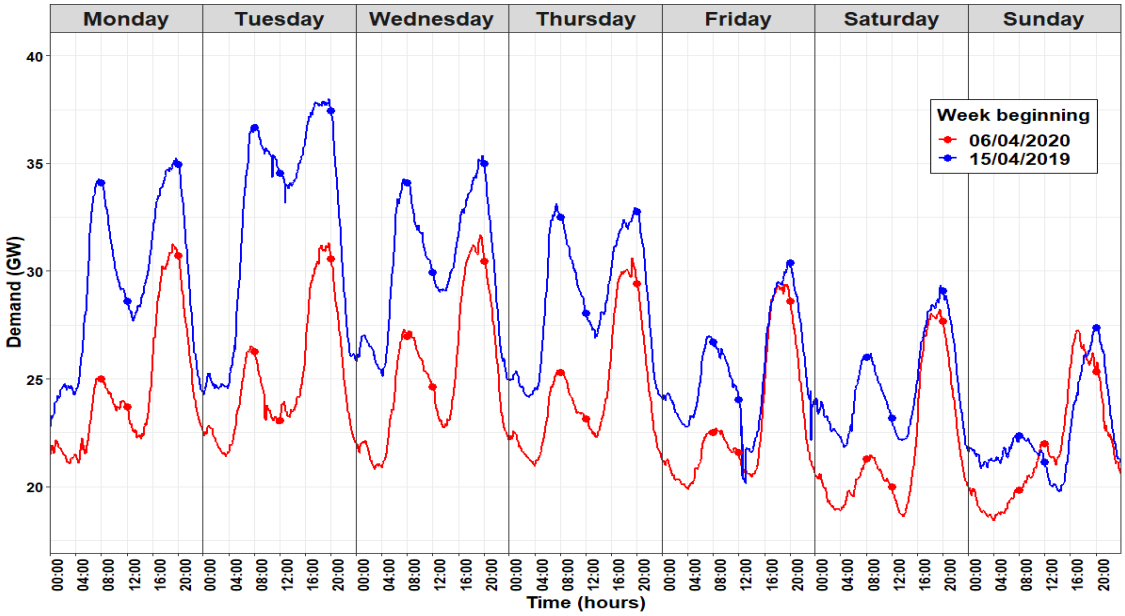

Figure 1 - Weekly load profile comparison for the second week of April 2020 (in red) and a reference week in 2019 (in blue). The markers highlighted along the profiles indicate three key times: 8am, 12pm and 6pm.

As is widely argued by researchers looking at incorporating theories of social practice into the study of the temporal patterns of energy demand, it is sometimes necessary to take a step back from the energy demand itself and pay a closer look at what gives rise to said patterns; that is, how individuals engage in those activities that result in demand for energy, how daily routines are shared, and how these change and in response to what (Walker, 2021). As studies on the relation between time-use and demand for energy point out, peaks in demand occur when many individuals engage in energy-intensive practices at the same time of day (Torriti, 2017, Anderson et al., 2018).

These strong collective timings result from institutionally timed events (such as work or school schedules) that act to coordinate and organise the temporal rhythm of daily activities. For instance, Lőrincz et al. (2021) provide evidence on how different work schedules have a strong shaping influence over our daily and weekly time-use patterns. In Lőrincz et al. (2022) we argue that understanding societal temporalities requires understanding how work time is scheduled on a daily basis. Through the comparison between "fixed" and "flexible" work schedules, we show that work arrangements can create stable practices that serve as stone pillars of daily routines. Taking away (or "unlocking") stable practices during these time periods could result in a small amount of decongestion of routine practices.

This paper focuses on identifying those changes in the temporalities of everyday in-home activities as a result of the pandemic-induced restrictions. In particular, we focus on the impact of working practices taking place at home over some of the most common activities with substantial impacts in terms of demand for energy, such as food preparation, TV watching and laundering practices.

Disruptions and changes in time-use during COVID-19 lockdowns

Given that COVID-19 lockdowns were a prime example of large-scales disruptions to everyday life, it is not surprising that these sparked a huge amount of interest across the research community and beyond. And the time-use research community was arguably the best suited to this task, as data collection on time-used continued throughout most of the first year of the pandemic, which afforded researchers the opportunity to look into whether there had been any significant changes in time-use patterns, relative to previous years where time-use data had been collected.

For instance, based on total time estimates and location data, Gershuny et al. (2020) compare the infection risk level of activities that individuals engaged in during the UK lockdown (May-June 2020) to 'pre-lockdown' periods (namely, in 2016). Given the legal restrictions in place, it is no surprise that people significantly reduced activities associated with a high risk of infection, such as meeting with non-household members in public places, in favour of activities associated with a lower risk of infection, such as spending time at home alone or with household members. Nevertheless, their analysis allowed for quantifying the impact of the disruptions.

School closures caused an additional disruption to normal routines for workers with children. Andrew et al. (2020) investigated the impact of UK school closures on households with at least one child, finding an additional 4 hours per day (per parent) devoted to childcare, accompanied by a reduction in leisure time. Approximately half of the parents surveyed had stopped working during the lockdown due to job loss or being furloughed, while among those who remained employed, the average time spent working decreased by 3.5 hours, with approximately one-third of working hours spent multitasking between work and childcare.

Our analysis focuses on the impact of these changes in everyday activity schedules on the timing of what we refer to as energy-relevant activities; that is, activities with a substantial impact on observed demand patterns. As we pointed out above, there were significant changes in the overall demand loads observed during lockdown periods, relative to what was observed in previous years. However, it is definitely worth diving deeper into this subject and hopefully identify what exactly changed so that we observed such reductions in (peak) energy demand loads. A preliminary analysis by Huebner et al. (2021) showed that self-reported heating behaviours did not change significantly during lockdown. In terms of appliance use, the duration of use for TVs and computing equipment has increased and spread more throughout the day. Being less able to manage finances was associated with increased use of the smart-meter in-home display, and greater effort to save energy was associated with increased use of the in-home display, though correlations were small.

Table 1 offers a brief summary of some of the work that has arisen with a view to answer questions such as the ones posed in this paper. We contribute to the literature on time-use research by looking at variation in the timing of energy-relevant social practices through the lens of a non-energy relevant disruption. Our starting point is the assumption that various lockdown measures had an effect on the timing of energy-related practices. The main research questions that guide our analysis is what was the impact of the various lockdowns on the timing of energy-related practices?

Table 1. UK time-use diary studies that analyzed changes in social practices during the COVID-19 lockdowns

Author	Data	Lockdown periods
Gershuny et al. 2020	In all 2,202 individuals were surveyed during the 4 period of lockdowns	UK lockdown (May-June 2020) in comparison to 2016 (‘pre-lockdown’).
Andrew et al. 2020	4,915 parents with their children in England through an online time-use diary, reporting what activities they did during each hour of the day.	Between 29 April and 15 May 2020
Adams-Prassl et al. 2020	Data on large geographically representative samples of individuals in the United States, the United Kingdom and Germany. In the US and the UK, we collected two waves of survey	In the UK, the first wave (N = 3, 974) was collected on March 25-26, 2020, while the second wave (N = 4, 931) was collected on April 9-14,2020

	data, while in Germany we collected one wave of data.	
Lee et al. 2021	Time-use diary data with a demographically diverse sample of over 760 UK adults.	The first national lockdown (May 2020) and the third national lockdown (March 2021).
Bu et al. 2020	Panel study of the psychological and social experiences of over 50,000 adults.	11-week lockdown period from 21st March to 31st May 2020.
Felstead et al. 2020	Understanding Society COVID-19 Study	Three months of lockdown: April, May and June 2020
Etheridge et al. 2020	UK Household Longitudinal Survey-COVID-19 module.	Three months of lockdown: April, May and June 2020
Huebner et al. 2021	Survey study of 1016 participants about heating behaviours during the first UK lockdown in March 2020.	The first lockdown of the pandemic, from 23 March to 11 May 2020

Research framework and method

The severity of the UK's response to the COVID-19 pandemic varied throughout the year, as well as the scope of the imposed measures, ranging from local measures only to national lockdowns. Table 2. shows the 2020 timeline base on these different measures. In this paper we focus on the 1st and 2nd national lockdowns.

Table 2. Timeline of responses to COVID-19 pandemic in the UK

	Start date	**End date**
Before pandemic restriction	01 January	22 March
1st national lockdown	23 March	18 June
Local measures	19 June	04 November
2nd national lockdown	05 November	01 December
Local measures	02 December	31 December

Data

Over the course of the first year of the pandemic, four small-scale, but nationally representative, quota-based time-use surveys were carried out in the UK. The data was collected via an online tool referred to as Click and Drag Diary Instrument (CaDDI), which was developed by the UK Centre for Time Use Research. For the first lockdown, time-use diaries were collected in late May/early June 2020 (n=1007 diary days), and for the second lockdown, in late November 2020 (n=1358 diary days).

In addition to the time-use data collected throughout the pandemic months, we also make use of the UK 2014-15 Time Use-Survey (Gershuny et al. 2017) so that we can establish a pre-pandemic baseline. This UKTUS 2015 data was collected between April 2014 and December 2015 from a nationally representative sample of the British population using a multi-stage stratified probability sampling. The sample size consists of 9,388 individuals in 4,238 households who completed 16,550 time-use diaries and 3,523 week-long work schedules. The time-use diaries provide 10 minutes information about what, where and with whom individuals are during one weekday and one weekend day.

Method

Energy-relevant activities

As we mentioned earlier, a practice is deemed energy-relevant if it can be reasonably expected that the performance of this practice might entail the use of energy-consuming appliances. In this paper we focus on the following energy relevant activities: preparing food, washing clothes and watching TV during. For the sake of clarity, we also restrict the analysis to the discrepancies between weekdays, as these are bound to exhibit the most noticeable changes. To better compare the change in time use between the different lockdowns, a weighted average index (Ramírez-Mendiola et al. 2022) is used to determine the time of day where the start of periods of engagement in particular activities is more likely to occur, expressed mathematically as:

$$\text{Avg}_{\text{W}} = \frac{\sum_i^n (w_i * t_i)}{\sum_i^n (w_i)}$$

Were:

- t_i denotes a 10 minute interval along the 24h-long time-use diaries ;
- w_i is a weight that captures the relative frequency of the energy-relevant activity in question at the corresponding time-step *i* and
- *n* is the number of time-use diaries.

Exploring changes in the timing and duration of work schedules

For the purposes of our analysis, survey respondents were considered to be working whenever they reported engaging in 'paid work' in their time-use diaries. Figure 2 shows the distribution of daily total work time prior to and during lockdowns for weekdays. In general, it appears that prior to the lockdown, people tended to work longer hours than the 8hr/day typically expected. However, during the first lockdown, the distribution shows a considerable shift towards the left, meaning that more people reported working less than 8 hours. During the second lockdown, it would appear that things start to returning to 'normal' in terms of the amount of time most people spent working, but the distribution is a much narrower one than the one observed pre-pandemic, which means those who still had to work from home were a lot more strict about sticking to their contractual hours relative to the reference period.

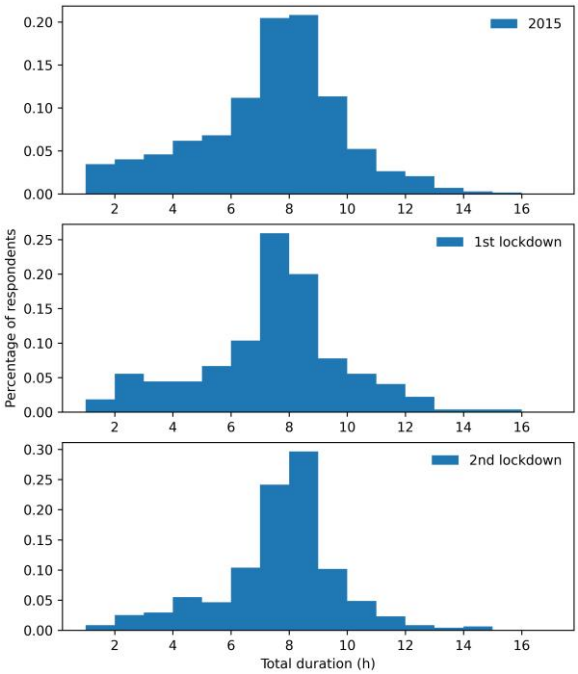

Figure 2 - Comparison of the distribution of the overall duration of daily work time for weekdays.

Workers in the first lockdown appear to prioritise their time differently, as evidenced by their shorter workdays. However, while the distributions of the daily totals of time spent working shed some light onto this, a closer inspection of the distribution of the reported start times of the periods of work allows us to better estimate this.

Figure 3 shows the distributions of the start times of periods of work during weekdays. As the distributions show, the most likely start time of the periods of work started to shift to later times in the morning; while the most likely start time pre-pandemic was about 8:20, by the second lockdown this had shifted to 8:40. In contrast, the most likely times for resuming work after lunch remained remarkably consistent. This essentially means that people were spending less time working overall in the first half of the day. In addition, during the lockdowns the afternoon relative frequencies are smaller suggesting that smaller amount of people returned to work after the mid-day break.

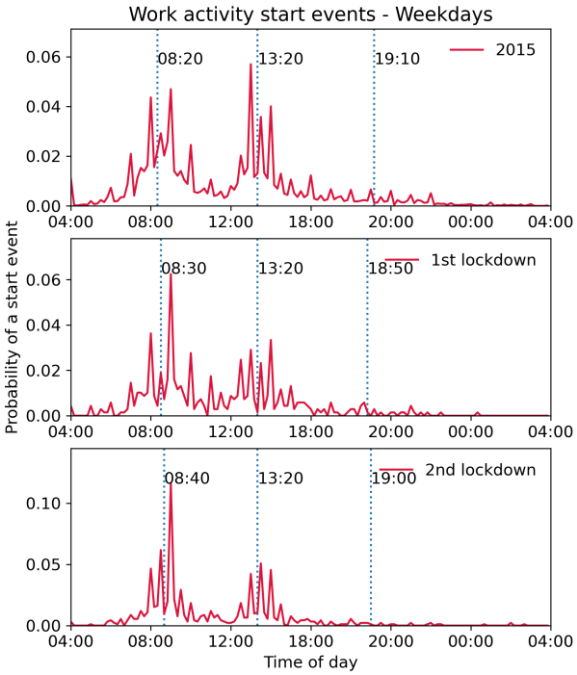

Figure 2 - Distributions of the start times of episodes of engagement in work-related activity in 2015 (reference year), first and second national UK COVID-19 lockdowns, from top to bottom, respectively. The vertical dotted lines correspond to the weighted positional averages for the three time windows considered: 4:00-11:00, 11:00-16:00 and 16:00-24:00.

Figure 1 highlighted the fact that, despite the substantial overall reductions in energy demand, the evening peak loads prevailed even during the lockdowns, and they experienced proportionally smaller reductions relative to what was observed at other times of day. Most likely, this was due to the fact that the evening peak is heavily influenced by temporally-fixed household energy-using practices (Torriti 2017). Many household activities, such as food preparation, media consumption, and lighting-intensive activities, are carried out during this time period and it was expected that people would spend more time at home as a result of the imposed lockdowns. In the next section, we explore how the timing of the energy-relevant activities (such as food-preparation, laundering and television watching) changed during the lockdowns, relative to the pre-pandemic baseline.

Exploring the variation in the timing of energy-relevant activities during the pandemic

Food preparation activities

Figure 4 depicts the distribution of start times of episodes of food preparation activity in 2015 (reference year) compared to the first and second national UK COVID-19 lockdowns. Based on these distributions, it is clear that the start times of food preparation activities changed as result of the national lockdowns. The greatest levels of engagement in food preparation activities are observed during the late afternoon-evening period, both pre- and mid-lockdown. However, as the weighted averages show, people were more likely to start their food preparation activities about half-an-hour earlier during lockdowns, relative to the most likely start time in pre-pandemic times (18:30).

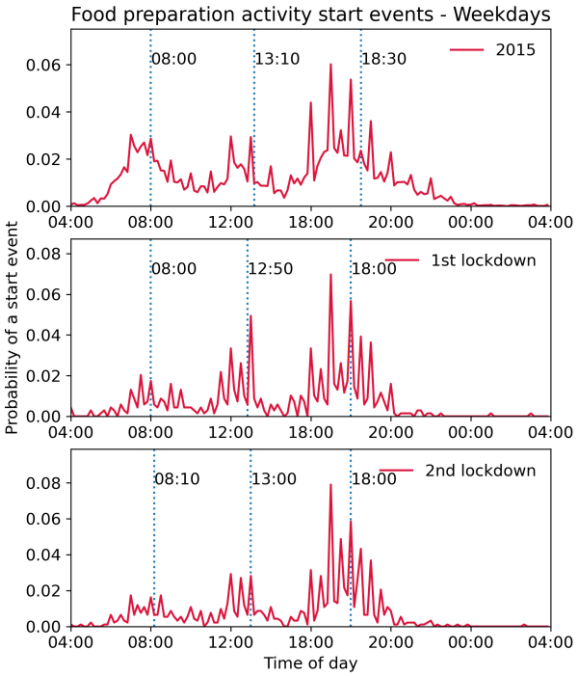

Figure 3 - Distributions of the start times of episodes of engagement in Food preparation activity in 2015 (reference year), first and second national UK COVID-19 lockdowns, from top to bottom, respectively. The vertical dotted lines correspond to the weighted positional averages for the three time windows considered: 4:00-11:00, 11:00-16:00 and 16:00-24:00.

Laundering activities

Figure 5 shows the distributions of start times of episodes of laundering activity in 2015 (reference year) compared to the first and second national UK COVID-19 lockdowns. We can observe that there was a lot of variation in the start of laundering activities during the lockdowns when people had more time at home. Laundry begins in large numbers during lockdowns in the mornings and middays periods. On the contrary, during the pre-lockdown period a higher number of start event are recorded in the evening after 6pm.

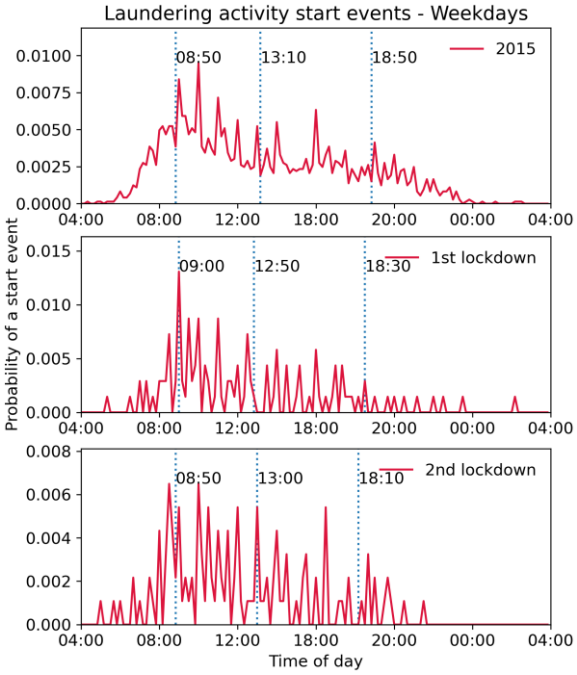

Figure 4 - Distributions of the start times of episodes of engagement in laundering in 2015 (reference year), first and second national UK COVID-19 lockdowns, from top to bottom, respectively. The vertical dotted lines correspond to the weighted positional averages for the three time windows considered: 4:00-11:00, 11:00-16:00 and 16:00-24:00.

TV watching activity

Figure 6 shows the distribution of the television watching start times before and during the COVID-19 lockdowns. Based on the observed distributions, it is clear that the most likely start time for TV watching pre-pandemic was around 7:50pm, whereas during lockdowns the most likely time shifted to 7:20pm; that is, people tended to start watching TV about half an hour earlier in the evenings, which is perhaps a clear indication that the periods of relaxation and unwinding were being carried forward.

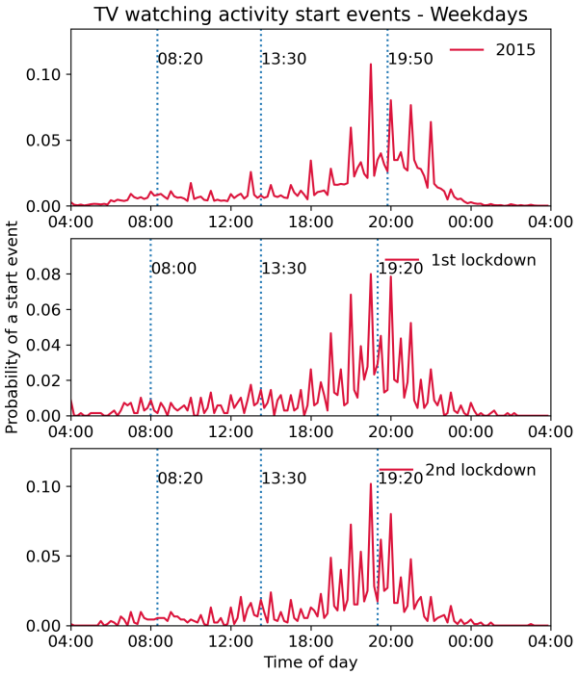

Figure 6 - Distributions of the start times of episodes of engagement in TV watching activitiy in 2015 (reference year), first and second national UK COVID-19 lockdowns, from top to bottom, respectively. The vertical dotted lines correspond to the weighted positional averages for the three time windows considered: 4:00-11:00, 11:00-16:00 and 16:00-24:00.

Discussion and Conclusions

The onset of nationwide lockdowns in an attempt to curb the spread of COVID-19 was bound to have substantial implications for everyday life. Not surprisingly, people started referring to the situations induced by such lockdowns as 'the new normal'. And while we were certain that things were different, relative to the way we were used to going about our everyday lives, it was still not very clear the extent to which this 'new normal' had reshape our daily activity patterns.

The analysis reported in this paper was motivated by the interest in trying to quantify this impact in terms of the shifts in the timing of certain activities. In particular, our study focuses on the impacts of the work-from-home mandates on other activities that are relevant in terms of their associated demand for energy such as food preparation, TV watching and doing the laundry. As the result of the analysis show, there were significant changes, both in terms of the daily totals of time spent on tasks related to paid employment, and in terms of the start times of such periods of paid work and other energy-related activities in the United Kingdom. In general, it is observed that people worked shorter periods during the first period of restrictions compared to the pre-pandemic reference period (2015). Nevertheless, both lockdown periods showed substantial variations in the distribution of start times of the energy-relevant activities.

As the calculated distributions of start times show, the most likely start time of the periods of work shifted to later times of day, whereas the most likely start times of food preparation activities and TV watching shifted to earlier times. At first glance, this might appear unsurprising as, arguably, the newly found spare time freed up by taking work commutes out of the 'daily scheduling equation' was swiftly taken over by other activities. What strikes us

as surprising, however, is the extent to which the overall patterns of activity prevailed. Previously, it has been argued that allowing for the kind of flexibility afforded by extended periods of remote working would allow for the emergence of more 'balanced' energy demand patterns; that is, overall daily demand loads would feature lesser peaks or not peaks at all. The reasoning behind this idea is that by allowing the opportunity to distribute energy-related activities throughout the day, the associated demand would follow suit. It is remarkable, however, that despite the fact that the shaping influence of institutional rhythms such as office and school opening hours were severely compromised during the pandemic-induced lockdown periods, the overall patterns of activity remained largely unchanged.

These findings have concrete implications for policy, with the key message being that removing constraints alone is not going to bring about the desired changes in daily patterns of demand on its own. It is clearly necessary to also implement (dis)incentive mechanisms through which the public can be steered into the direction that would allow for a better utilisation of clean energy sources (e.g. shifting the time of laundering practices from the morning to the middle of the day).

As with any other complex problem, there are many other factors that need to be taken into account when it comes to estimating the extent to which this steering of practices can be effective. For example, Adams-Prassl et al. (2020), suggest that female workers report a lower ability to work from home, primarily due to the existing imbalances in household caring and upkeeping responsibilities. Lee et al. (2021) finds similar evidence of a gender gap in the amount of time spent on household activities, though men experienced a larger absolute increase during the lockdown, which helped to close the pre-lockdown gap.

In addition to the impacts of working-from-home mandates on the temporalities of activity and energy demand patterns, it is also important to pay attention to other, rather positive side-effects of the flexibility afforded by them. For instance, tracking time-use during the early months of lockdown, Bu et al. (2020) found that having more flexibility for engaging in work, housework, gardening, exercising, reading, hobbies, communicating with friends/family, and listening to music were all associated with improvements in mental health and wellbeing. These benefits, however, were partly offset by the impact of watching the news on COVID-19, and overall excessive TV watching, which were associated with declines in mental health and wellbeing.

The preliminary results presented in this paper offer some insight into the changes observed in a rather limited set of practices, but there is clearly scope for more in-depth analyses comprising larger sets of practices, as well as more comprehensive analyses of the impacts across different sectors of the population, regions, or even across countries. We hope that the analysis presented in this paper leads to further research into these potential avenues.

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