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Energy transition in a lockdown: An analysis of the impact of COVID-19 on changes in electricity demand in Lagos Nigeria

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Abstract

In this study, we analyse the role of forced lockdowns on electricity consumption behaviour and its effect on momentary transition in electricity use. Electricity consumption data for residential, commercial and industrial consumers within the Lagos metropolis representing 259 electrical feeder locations were collected and analysed under three scenarios: first, we analyse a business-as-usual scenario without a lockdown; secondly, we analyse the case of a partial lockdown; and finally, we analyse the case of a total lockdown. The study revealed that aside government announcement of the lockdown, certain social practices triggered changes in electricity consumption and use leading to momentary energy transition. Within the residential sector, increased cooking, home laundry, showering, and some professional practices that moved to the homes impacted on higher electricity consumption. Reduced manufacturing practices limited to those involved in food, personal care and pharmaceutical products led to a reduction in electricity use within the industrial sector, while reduced electricity use in the commercial sector was triggered mainly by a scaling down of trading services to essentials. The study concludes by highlighting the impact of changes in electricity demand and consumption under these scenarios and its implications for energy transition and electricity planning.

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1. Introduction

The coronavirus disease 2019 (COVID-19) is an acute respiratory disease caused by another novel coronavirus (SARS-CoV-2, previously known as 2019-nCoV) [1]. The virus has spread worldwide leading to a global pandemic [2]. As of April 7, 2020, over 1.3 million people have been infected with the virus, with over 75,000 deaths recorded [3,4]. The virus has grounded economic activities globally. Livelihoods have been disrupted, economies affected and health facilities stretched globally. Indeed, this pandemic has revealed some salient lapses and non-resilience in the design of our economic and social systems [5].

Arguably, the coronavirus pandemic has revealed weak socio-economic systems resilience to economic shocks in several countries and across several regions of the world. There are increasing cases of job loses globally [6]. Consequently, the global pandemic has forced organizations to seek different ways of working and continuing various forms of economic activities which has changed the way people use energy in a considerable way. The pandemic have seen a sharp increase in residential energy consumption across several regions of the world owing to the global shift to remote working and learning from home. Most educational institutions have shifted teaching and learning to online distance learning modes while some non-essential and critical services are now done remotely from home. Practices play a vital role in energy use (in general) and in electricity use (in particular) [7,8]. Theories of practices (or social practice theory) help us to understand how the things we do, and the way we go about doing them, impact on energy and electricity use [9]. Shove argues that the quest for increased levels of cleanliness, comfort and convenience are the foundations that underpin increased energy use in the fulfilment of different practices [10]. Professional practices such as commuting, showering, cooking, etc., have become energy intensive over time [11,12].
that manifest itself in various diverse forms such as trade and different forms of professional practices have also evolved over time [13]. Indeed, policy making, and all its associated services, is also a practice [14].

The international Energy Agency (IEA) argues that the residential sector accounts for over 25% of global electricity consumption [15]. Arguably, with the COVID-19 pandemic, most commercial and professional services are shifting to the homes. While this shift impact on lower electricity consumption in commercial and public services sector, a shift in the location of such services to residences may have impacted on a surge in residential electricity use for various energy services. What impact does this shift have (on-the-ground) on electricity demand? What are the implications of this shift and consequent increase in residential electricity consumption for energy security and safety? In what ways are the effects of the lockdown impacting on energy transition and electricity use? In this paper, we examine and analyse the impact of COVID-19 on changes in energy (electricity) demand using Lagos Nigeria as a case study [16].

In this paper, we provide some methodological considerations, materials and methods in section 2. In section 3, we present the important findings. The implications of the changes in electricity demand owing to the COVID-19 pandemic and what it means for an eventual transition in energy systems and use, and a transition towards a more sustainable and a less energy intensive consumption lifestyle are presented in section 4.

2. Materials and methods

In this study, we adopted the use of exploratory research tools to examine various scenarios of electricity demand and use in the residential, commercial and industrial sectors of a large segment of the Lagos metropolis.

This study was conducted in Lagos Nigeria. Lagos is a fast growing megacity located in south-west Nigeria with a population of about 20 million people. It was once the capital city of Nigeria until 1991 and it still remains the commercial capital of Nigeria [17]. Lagos, as a city, records the highest electricity demand and consumption in Nigeria with over 800 MW of the 4000 MW average national electricity generation output [18,19]. The city is served by two of the eleven electricity distribution companies in Nigeria which are the Eko Distribution Company (EKEDC) and the Ikeja Distribution Company (IKEDC). Fig. 1 shows the distribution companies in Nigeria and their geographical regions of coverage.

Average hourly instantaneous electricity demand was obtained for a five week period (starting from 1st March to April 5, 2020) to observe the changing dynamics of electricity demand and consumption patterns within the residential, commercial and industrial sectors in a large segment of the Lagos metropolis covered by one of the distribution companies. We choose not to reveal the particular distribution company where data collection was done as we do not have the permission to reveal their identity. Indeed, data collection of electricity demand and consumption and subsequent analysis was done under three scenarios as stated below:

- Business-as-usual scenario when there was no lockdown as a result of the COVID-19 pandemic
- Partial lockdown scenario resulting from a call for action to limit the spread of the COVID-19 virus
- Total lockdown scenario resulting from a need for more stringent measures to curb the spread of the COVID-19 virus

The detailed weekly average electricity demand (in megawatts) is shown in appendix 1 based on data collected from 259 feeder locations across Lagos for each of the five weeks under study. The details in appendix 1 are a summary based on a detailed hourly data for the 259 locations over the five week period. In the next section, we present the salient findings based on data collected and subsequent analysis carried out.

3. Findings: comparing the effect of COVID-19 response on electricity demand and consumption

In this section, we present the findings of the analysis of electricity consumption within the residential, commercial and industrial sectors of a large segment of the Lagos metropolis under three different scenarios as defined in the preceding section. First, we define the characteristics of the three lockdown scenarios (in section 3.1) and then present the electricity consumption dynamics under the various lockdown scenarios (in section 3.2). In section 3.3, we present those services and practices that impacted on changes in electricity use under various lockdown scenarios.

3.1. Defining the lockdown scenarios within the Lagos context

In various parts of the world, it can be observed that lockdown scenarios vary greatly depending on the services impacted. Indeed, what does the various lockdown scenarios mean within the Lagos context? What services were impacted that defined or characterized the different lockdown scenarios? Table 1 provides a summary of the three lockdown scenarios and the services that impacted or characterized each lockdown scenario.

3.2. Electricity consumption within the different lockdown scenarios

Changes in electricity consumption dynamics leading to the total lockdown were highly impacted by the stepwise announcement by the Lagos state government (effecting a partial lockdown from March 23, 2020) and the federal government of Nigeria (effecting a total lockdown from March 30, 2020). A five week dataset of electricity consumption by sector and within each scenario analysed is presented in Table 2. The summarized dataset upon which Table 2 is based are presented in appendix 1.

From Table 2, it can be observed that there was a gradual increase in electricity consumption in all three (residential, commercial and industrial) sectors in the three weeks preceding the lockdown as energy consumers envisaged that a lockdown was inevitable. The increase in electricity consumption was prompted by a certain fear of a possible lockdown based on the observations of many countries already implementing some form of lockdown to contain the spread of the COVID-19 virus. Businesses were ramping up services and industries were ramping up production in preparation for a possible inevitable lockdown. Residents were stocking up gradually. More refrigerators and deep freezers were in use as more items needed safe storage. Within the third week of the business as usual scenario, some businesses were already contemplating and implementing the policy of allowing some staff work from home, or work in the office on some predetermined days.
based on a shift arrangement. This is what explains the increase in absolute amount of electricity consumed across sectors within the first three weeks as observed in Table 2 and in Fig. 2.

At the end of the third week of the business as usual scenario, the Lagos state government announced some steps leading to a partial lockdown as defined in Table 1. This impacted on electricity consumption in the fourth week under observation (under partial lockdown scenario). From Table 2 and the corresponding Fig. 2, it is observable that average commercial sector electricity consumption dropped from 3.07 MW in week 3 (business as usual) to 2.81 MW in week 4 (partial lockdown). There was also a corresponding drop in electricity consumption in the industrial sector from 2.54 MW to 2.02 MW under the same conditions. However, for the residential sector, there was not much change in electricity consumption from week 3 (3.72 MW) to week 4 (3.72 MW) representing business as usual and partial lockdown scenarios respectively. Energy consumers in the residential sector needed time to adjust to their new realities. This is the main reason for the almost constant electricity consumption in the sector in weeks 3 and 4 as observed in Fig. 2.

Transiting from week 4 (partial lockdown) to week 5 (total lockdown), we observe that within the commercial sector, electricity consumption dropped from 2.81 MW to 2.63 MW. The industrial sector experienced a drop in electricity consumption from 2.02 MW to 1.41 MW while the residential sector experienced an increase in electricity consumption from 3.72 MW to 3.87 MW. From the data, it was also observed that there was an increase in total electricity consumption in the three weeks preceding the lockdown (under the business as usual scenario) from 3.37 MW through to 3.50 MW at the end of the third week. Changes in practices during the partial lockdown scenario led to a decline in
total electricity consumption to 3.40 MW as shown in Table 2. The week of the partial lockdown was also a transitional for many electricity users as they were trying out different things to know what professional practices can be moved to the homes. This explains why there was no increase in residential electricity consumption from week 3 (business as usual scenario) to week 4 (partial lockdown scenario) as shown in Table 2.

Fig. 2. Hourly average instantaneous electricity demand by sector (1st Mar – Apr 5, 2020).

Fig. 3 shows the average hourly instantaneous electricity demand for the residential, commercial and industrial sectors under the business-as-usual, partial lockdown and total lockdown scenarios. It can be observed that under the business-as-usual scenario, electricity demand for the residential sector hovered between 250 MW and 380 MW all through a 24 h period as observed in Fig. 3(a). Under the partial lockdown scenario, there was a

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Table 1
Different lockdown scenarios in Lagos and what it means on the ground.

| Scenarios               | What it means on the ground                                                                                                                                                                                                 |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 Business as usual (no lockdown) | - All educational institutions at all levels (primary, secondary and tertiary) are in operation  
- Religious institutions and places of worship are operational  
- Commercial and business activities are open  
- Government services are open  
- Industrial processes, manufacturing and supply chain operations are open for business |
| 2 Partial lockdown     | - All educational institutions at primary, secondary and tertiary levels are closed  
- All religious institutions and places of worship are closed  
- Government services scaled down (with people at certain levels required to be around). Other essential services such as waste disposal, health services, etc., remain open  
- Commercial and business activities remain open  
- Industrial processes, manufacturing and supply chain operations remain open |
| 3 Total lockdown       | - All educational institutions at primary, secondary and tertiary levels remain closed  
- All religious institutions and places of worship remain closed  
- Government services further scaled down except for essential services such as health, waste disposal, etc.  
- Commercial and business activities reduced to essentials (particularly those involved in food, personal care and pharmaceutical related businesses).  
- Industrial processes, manufacturing and supply chain operations were reduced to those involved in Fast Moving Consumer Goods (FMCG) producing food, personal care and pharmaceutical related products. |

Table 2
Summary of hourly average electricity demand from 259 electricity feeders in Lagos over a 5 week period.

| Electricity consumer categories | Ave Week 1 - Business as usual (MW) | Ave Week 2 - Business as usual (MW) | Ave Week 3 - Business as usual (MW) | Ave Week 4 - Partial lockdown (MW) | Ave Week 5 - Total lockdown (MW) |
|---------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|----------------------------------|----------------------------------|
| Commercial                      | 2.81                                | 2.98                                | 3.07                                | 2.81                             | 2.83                             |
| Industrial                      | 2.47                                | 2.49                                | 2.54                                | 2.02                             | 1.41                             |
| Residential                     | 3.59                                | 3.66                                | 3.72                                | 3.72                             | 3.87                             |
| Grand Total                     | 3.37                                | 3.44                                | 3.50                                | 3.40                             | 3.42                             |
Fig. 3. Hourly average instantaneous electricity demand pattern under various scenarios.

Fig. 4. Percentage change in electricity demand and consumption under various scenarios.
considerable variation in hourly average electricity demand for the residential sector as observed in Fig. 3(b). Under the total lockdown scenario, the hourly average electricity demand for the residential sector surged by crossing the 400 MW mark for most part of the day as observed in Fig. 3(c). The graphs also show the hourly instantaneous electricity demand pattern for the commercial and industrial sectors. It should be noted that some commercial and industrial electricity consumers maintained a 24 h operation. This explains why there seem to be a flattening of the line across a 24 h period.

Fig. 4 shows the percentage change in electricity demand and under the various scenarios studied. Under the business-as-usual scenario, it is observed that about 43% of total electricity demand comes from the residential sector, with corresponding demand from the commercial and industrial sectors accounting for 33% and 24% of total electricity demand respectively. However, no change was observed in the percentage electricity demand by sector under a partial lockdown scenario. Under a total lockdown scenario, we observed a sharp increase in residential electricity demand which accounted for 49% of total electricity demand and consumption. There was also a corresponding decline in industrial electricity demand and consumption from 24% under a partial lockdown scenario to 18% under a total lockdown scenario. No change was observed in the percentage electricity demand for the commercial sector.

3.3. Services and practices impacting on changes in electricity use within the different sectors

The different lockdown scenarios impacted on changes in social practices in different ways which in turn had a corresponding impact on electricity use. Changes in load profile in the residential sector were impacted by two main practices.

- **Cooking as a practice**, with increased use of hotplates/electric cookers, electric boilers and other kitchen equipment (including refrigerators) for storing food items for the lockdown. Since entire households were in their homes, more cooking and eating occurred.

- **Professional practices**, which spurred the increased use of electricity for working from home. This impacted on greater use of electricity for air conditioning during the day and for powering basic office devices.

Other practices which contributed to increased electricity use within the residential sector, but not as significantly as the aforementioned practices, includes: **laundry** services (requiring greater use of washing machines in the homes rather than outsourcing to laundry services companies); **showering** (which increased with more people at home and considering that the lockdown occurred during the hot season) which means regular pumping of water from decentralized borehole systems; and **entertainment** (through increased use of television and video games in homes).

Within the industrial sector, **manufacturing practices** for non-essential and non-food products were ground to a halt during the total lockdown scenario which explains the reason for the decline in both absolute amount and percentage of total electricity consumed within that sector.

In the commercial sector, there was a gradual shift of some professional services to the homes during the announcement of the partial lockdown measures which did not primarily affect them. Some businesses envisaged that there would be an eventual announcement of a total lockdown. This impacted on increased electricity use in the residential sector and reduced electricity use in the commercial sector (as shown in Table 2) as we transit from one lockdown scenario to another. However, there was a reduction in **trading practices** and the diverse forms of **professional practices** that occurs within the commercial sector during the shift from business as usual to partial lockdown and the eventual shift to a total lockdown scenario. Table 3 shows a summary of social practices that impacted on electricity consumption in each sector under the various scenarios.

### 4. Discussion: lessons of the current lockdown for a future energy transition

The findings of this study shows that energy transition occurs in various ways with respect to speed of change, degree of permanence and temporality. Indeed, we argue that energy transition can manifest itself under three contexts:

1. **Momentary energy transition** that last for a short time owing to some imposed rules that leads to momentary behavioural change towards energy use. After some time, the energy consumers go back to business as usual scenario if there are no intrinsic motivations for change. This type of energy transition usually last for less than a year.
2. **Temporary energy transition** occurs owing to some intentional buy-in of energy users and other stakeholders leading to behavioural change in energy use which does not yet have regulatory backing. This type of energy transition can last for some years.

3. **Permanent energy transition** is caused by wilful behavioural change or technology adoption backed by regulations. The type of energy transition can last for decades.

In this study, we see how lockdowns can lead to **momentary energy transition** which is characterized by a change in the energy consumption patterns forced by the lockdown scenario. The results show that under lockdown scenarios, imposed rules can pave the way for momentary energy transitions which only last for a short time (mostly less than one year). Indeed, a major challenge still exists. How do we effect a movement from momentary energy transition through to a permanent energy transition drawing from lessons from the lockdown?

From the findings, we observe that certain professional practices can be carried out from home which can shape working patterns and an eventual change in energy consumption patterns. Organizations are already seeing the possibilities and learnings provided by the lockdown and how this can shape future work and related professional practices.

Consumer behaviour plays a very vital role in electricity consumption patterns [8]. The quest for convenience, cleanliness and comfort has considerable impact on energy use [10]. Indeed, behavioural change in energy and electricity use (as observed in this study) cannot occur without some external policy influence driven by some national or regional energy strategies [21,22]. This is evident as observed in the changes that occurred from the partial lockdown to the total lockdown scenario.

Energy transition during the lockdown period leading to changes in electricity consumption patterns tells us that there might still be many unexplored scenarios that can help cities, countries and regions to achieve their energy transition goals. Indeed, the partial and total lockdown scenarios necessitated by the global COVID-19 pandemic have shown that there is a need to explore more scenarios in our electricity and energy systems design and planning.

This study brings to mind the need for electricity systems planners to include resilience in the design and implementation of electricity systems [23,24]. The task of effecting behavioural change in electricity consumption cannot be left to energy consumers alone. Increasing electricity bills has not proven effective in effecting behavioural change. This is because electricity consumption pattern is something habitual and it has been argued that cost benefit analysis cannot change automatic behaviour [25]. Indeed, behavioural change is important for a successful energy transition.

5. Conclusion

In this study, we have shown how a forced lockdown due to the COVID-19 global pandemic can lead to a momentary transition in energy use and changes in electricity demand patterns. We also see how a forced lockdown impacts on momentary behavioural change in energy use. Indeed, it is important for governments and communities to re-evaluate the policy levers used in directing, managing and shaping changes in energy systems that can lead to a more permanent energy transition in energy consumption patterns. There is need to incorporate measures to improve systems resilience in responding to shocks caused by unforeseen adverse scenarios such as natural disasters, diseases and other forms of epidemic and pandemics while considering the learnings they present in effecting energy systems change.

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**CRediT authorship contribution statement**

Norbert Edomah: Writing - original draft. Gogo Ndulue: Data curation, Formal analysis, Writing - original draft.

**Declaration of competing interest**

The author declare no conflict of interest.

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**Appendix 1**

Average maximum electricity demand (in Megawatts) from 259 11 KV feeders representing different electricity consumer locations in Lagos, Nigeria

| Anonymized Feeder Nomenclature (representing different feeder locations) | Feeder Classification | Ave Week 1 - Business as usual | Ave Week 2 - Business as usual | Ave Week 3 - Business as usual | Ave Week 4 - Partial lockdown | Ave Week 5 - Total lockdown |
|---|---|---|---|---|---|---|
| 1 | Residential | 4.11 | 4.10 | 4.04 | 4.27 | 4.40 |
| 2 | Residential | 2.71 | 1.69 | 1.70 | 1.67 | 1.70 |
| 3 | Residential | 3.74 | 3.90 | 4.06 | 4.09 | 4.10 |
| 4 | Residential | 3.46 | 3.86 | 3.70 | 3.66 | 3.86 |
| 5 | Residential | 4.69 | 4.96 | 4.97 | 4.93 | 3.90 |
| 6 | Residential | 1.61 | 1.76 | 2.16 | 1.87 | 1.80 |
| 7 | Residential | 4.81 | 4.26 | 5.00 | 4.86 | 4.96 |
| 8 | Residential | 4.19 | 5.00 | 4.97 | 4.89 | 4.88 |
| 9 | Residential | 1.93 | 2.20 | 2.96 | 2.69 | 2.80 |
| 10 | Commercial | 3.20 | 3.64 | 3.54 | 3.54 | 3.34 |
| 11 | Residential | 4.03 | 3.89 | 4.04 | 3.83 | 4.10 |
| 12 | Residential | 4.67 | 4.53 | 4.80 | 4.67 | 4.76 |
| 13 | Residential | 4.96 | 4.74 | 4.61 | 4.64 | 4.94 |
| 14 | Residential | 4.39 | 4.89 | 4.94 | 4.90 | 5.00 |
| 15 | Residential | 4.86 | 4.79 | 4.86 | 4.87 | 4.94 |
| 16 | Residential | 1.80 | 1.91 | 1.89 | 1.81 | 2.04 |
| 17 | Residential | 3.09 | 3.33 | 3.19 | 3.14 | 3.32 |
| 18 | Residential | 1.56 | 1.13 | 1.70 | 1.70 | 1.84 |
| 19 | Residential | 0.41 | 0.30 | 0.50 | 0.47 | 0.46 |
### Appendix 1 (continued)

| Anonymized Feeder Nomenclature (representing different feeder locations) | Feeder Classification | Ave Week 1 - Business as usual | Ave Week 2 - Business as usual | Ave Week 3 - Business as usual | Ave Week 4 - Partial lockdown | Ave Week 5 - Total lockdown |
|---|---|---|---|---|---|---|
| 20 | Residential | 4.29 | 4.50 | 4.77 | 4.91 | 4.94 |
| 21 | Residential | 4.14 | 4.67 | 4.74 | 4.96 | 5.00 |
| 22 | Residential | 3.74 | 4.50 | 4.53 | 4.59 | 4.58 |
| 23 | Residential | 4.09 | 4.91 | 4.74 | 4.91 | 4.94 |
| 24 | Residential | 3.73 | 4.63 | 4.61 | 4.43 | 4.56 |
| 25 | Residential | 2.49 | 3.46 | 2.90 | 2.90 | 2.98 |
| 26 | Industrial | 2.67 | 2.87 | 2.60 | 2.40 | 1.14 |
| 27 | Residential | 4.93 | 4.87 | 4.93 | 4.90 | 5.00 |
| 28 | Residential | 3.63 | 3.99 | 4.00 | 4.00 | 4.14 |
| 29 | Residential | 1.57 | 1.20 | 1.50 | 2.00 | 2.00 |
| 30 | Residential | 0.86 | 1.31 | 0.89 | 0.93 | 1.38 |
| 31 | Residential | 1.13 | 1.21 | 0.53 | 1.19 | 1.56 |
| 32 | Residential | 1.06 | 1.04 | 1.11 | 1.10 | 1.22 |
| 33 | Industrial | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 34 | Premium | 1.99 | 2.00 | 2.09 | 2.03 | 1.88 |
| 35 | Commercial | 3.93 | 3.91 | 3.66 | 3.54 | 3.50 |
| 36 | Residential | 4.07 | 4.06 | 4.11 | 3.81 | 3.98 |
| 37 | Premium | 1.56 | 1.67 | 1.71 | 1.56 | 1.54 |
| 38 | Residential | 3.23 | 3.34 | 3.17 | 3.09 | 3.10 |
| 39 | Residential | 2.66 | 2.57 | 2.29 | 2.30 | 2.34 |
| 40 | Residential | 2.84 | 2.93 | 3.07 | 2.90 | 2.90 |
| 41 | Residential | 1.74 | 1.70 | 1.70 | 1.67 | 1.58 |
| 42 | Residential | 4.69 | 4.59 | 4.60 | 4.77 | 4.72 |
| 43 | Commercial | 1.61 | 1.69 | 1.69 | 1.59 | 1.70 |
| 44 | Residential | 4.59 | 4.71 | 4.76 | 4.83 | 4.86 |
| 45 | Residential | 4.70 | 4.71 | 4.53 | 4.71 | 4.80 |
| 46 | Residential | 2.36 | 2.33 | 2.31 | 2.34 | 2.72 |
| 47 | Residential | 4.14 | 4.21 | 4.43 | 4.36 | 4.28 |
| 48 | Residential | 4.60 | 4.53 | 4.63 | 4.53 | 4.92 |
| 49 | Residential | 4.26 | 4.30 | 4.16 | 4.10 | 4.10 |
| 50 | Commercial | 3.91 | 3.49 | 2.40 | 3.61 | 3.70 |
| 51 | Residential | 3.99 | 3.53 | 2.39 | 3.89 | 3.92 |
| 52 | Commercial | 3.23 | 3.43 | 3.30 | 2.57 | 2.18 |
| 53 | Residential | 4.19 | 3.80 | 3.34 | 3.84 | 4.00 |
| 54 | Residential | 3.90 | 3.40 | 2.40 | 4.11 | 4.36 |
| 55 | Residential | 3.37 | 3.40 | 1.97 | 3.46 | 3.68 |
| 56 | Residential | 4.01 | 3.99 | 2.37 | 3.84 | 4.12 |
| 57 | Industrial | 2.90 | 3.19 | 3.69 | 2.66 | 1.42 |
| 58 | Commercial | 2.61 | 2.69 | 2.70 | 2.39 | 2.02 |
| 59 | Industrial | 3.31 | 3.64 | 3.67 | 2.73 | 2.66 |
| 60 | Residential | 4.24 | 4.23 | 4.29 | 3.69 | 3.92 |
| 61 | Residential | 3.94 | 3.73 | 3.51 | 3.63 | 3.80 |
| 62 | Commercial | 1.97 | 2.14 | 2.09 | 1.63 | 1.22 |
| 63 | Residential | 4.76 | 4.61 | 4.87 | 4.36 | 4.62 |
| 64 | Residential | 4.20 | 4.14 | 4.00 | 3.40 | 3.70 |
| 65 | Commercial | 4.31 | 3.86 | 4.27 | 4.04 | 4.16 |
| 66 | Commercial | 1.64 | 1.40 | 1.64 | 1.57 | 1.42 |
| 67 | Residential | 2.50 | 2.21 | 2.80 | 2.26 | 2.26 |
| 68 | Residential | 2.64 | 2.23 | 2.73 | 2.49 | 2.76 |
| 69 | Premium | 2.16 | 2.59 | 2.53 | 2.23 | 2.24 |
| 70 | Premium | 2.43 | 2.43 | 2.41 | 2.27 | 2.46 |
| 71 | Premium | 2.29 | 2.71 | 2.74 | 2.51 | 2.70 |
| 72 | Residential | 1.83 | 1.79 | 1.74 | 1.70 | 2.02 |
| 73 | Premium | 1.93 | 1.14 | 1.34 | 1.07 | 1.92 |
| 74 | Residential | 1.76 | 2.37 | 2.39 | 2.29 | 2.72 |
| 75 | Residential | 4.19 | 4.46 | 4.23 | 4.37 | 4.88 |
| 76 | Residential | 3.27 | 3.73 | 3.67 | 3.47 | 3.76 |
| 77 | Commercial | 4.64 | 4.01 | 4.77 | 4.80 | 4.66 |
| 78 | Residential | 3.44 | 3.16 | 3.87 | 3.96 | 4.20 |
| 79 | Industrial | 3.50 | 3.49 | 3.51 | 2.61 | 1.88 |
| 80 | Residential | 3.94 | 4.10 | 4.10 | 3.36 | 3.22 |
| 81 | Residential | 3.67 | 3.64 | 3.47 | 3.70 | 4.10 |
| 82 | Residential | 3.83 | 4.10 | 4.20 | 4.11 | 4.38 |
| 83 | Residential | 2.74 | 2.24 | 2.61 | 2.54 | 2.72 |
| 84 | Residential | 2.41 | 2.26 | 2.81 | 2.61 | 2.74 |
| 85 | Residential | 2.34 | 2.74 | 2.74 | 2.70 | 3.00 |
| 86 | Residential | 3.30 | 4.80 | 4.77 | 4.86 | 4.96 |
| 87 | Residential | 3.50 | 3.69 | 3.67 | 4.00 | 4.14 |
| 88 | Residential | 4.30 | 4.16 | 4.07 | 3.61 | 3.60 |
| 89 | Commercial | 4.71 | 4.83 | 4.83 | 4.83 | 4.83 |
| 90 | Residential | 4.64 | 4.81 | 4.76 | 4.83 | 4.58 |
| 91 | Industrial | 0.09 | 0.10 | 0.09 | 0.08 | 0.04 |
| 92 | Residential | 4.79 | 4.74 | 4.30 | 4.29 | 4.92 |
| 93 | Residential | 2.43 | 2.67 | 2.44 | 2.43 | 2.38 |
Appendix 1 (continued)

| Anonymized Feeder Nomenclature (representing different feeder locations) | Feeder Classification | Ave Week 1 - Business as usual | Ave Week 2 - Business as usual | Ave Week 3 - Business as usual | Ave Week 4 - Partial lockdown | Ave Week 5 - Total lockdown |
|---|---|---|---|---|---|---|
| 94 | Commercial | 3.90 | 4.70 | 4.71 | 4.41 | 4.36 |
| 95 | Residential | 3.87 | 4.66 | 4.77 | 4.29 | 4.60 |
| 96 | Residential | 4.29 | 4.16 | 3.83 | 4.10 | 3.92 |
| 97 | Commercial | 3.40 | 3.59 | 4.37 | 4.14 | 3.78 |
| 98 | Residential | 3.00 | 2.54 | 4.09 | 3.16 | 3.46 |
| 99 | Residential | 2.63 | 2.60 | 2.70 | 2.41 | 3.16 |
| 100 | Industrial | 4.07 | 4.00 | 4.03 | 3.27 | 2.76 |
| 101 | Industrial | 3.56 | 3.39 | 3.33 | 3.01 | 2.20 |
| 102 | Residential | 1.49 | 1.34 | 1.40 | 1.67 | 1.72 |
| 103 | Residential | 4.24 | 4.29 | 4.36 | 4.63 | 4.66 |
| 104 | Residential | 3.50 | 4.07 | 3.93 | 4.17 | 4.22 |
| 105 | Residential | 4.16 | 4.59 | 4.66 | 4.24 | 4.54 |
| 106 | Residential | 2.71 | 4.66 | 4.71 | 4.94 | 4.90 |
| 107 | Residential | 2.91 | 4.24 | 4.00 | 3.97 | 3.98 |
| 108 | Residential | 3.23 | 4.66 | 4.54 | 4.64 | 4.94 |
| 109 | Commercial | 0.00 | 2.74 | 3.93 | 3.97 | 3.92 |
| 110 | Residential | 3.40 | 3.41 | 3.30 | 3.21 | 3.30 |
| 111 | Residential | 4.24 | 4.43 | 4.49 | 4.17 | 4.82 |
| 112 | Commercial | 1.97 | 1.93 | 2.14 | 1.83 | 1.60 |
| 113 | Residential | 4.66 | 4.66 | 4.53 | 4.47 | 4.88 |
| 114 | Residential | 4.90 | 4.84 | 5.00 | 4.91 | 4.84 |
| 115 | Residential | 4.54 | 4.70 | 3.76 | 4.56 | 4.78 |
| 116 | Residential | 4.80 | 4.76 | 4.66 | 4.63 | 5.04 |
| 117 | Residential | 4.79 | 4.73 | 4.49 | 4.69 | 4.44 |
| 118 | Residential | 3.00 | 3.64 | 3.80 | 3.81 | 3.80 |
| 119 | Residential | 4.54 | 4.67 | 4.81 | 3.24 | 4.66 |
| 120 | Residential | 3.83 | 3.84 | 4.06 | 3.99 | 3.94 |
| 121 | Residential | 4.39 | 4.43 | 4.67 | 4.73 | 4.80 |
| 122 | Residential | 3.51 | 3.59 | 4.67 | 4.36 | 4.84 |
| 123 | Residential | 3.90 | 4.46 | 4.66 | 4.49 | 3.86 |
| 124 | Residential | 3.26 | 3.23 | 3.20 | 1.81 | 2.66 |
| 125 | Residential | 3.69 | 4.54 | 3.79 | 3.71 | 4.38 |
| 126 | Residential | 4.54 | 4.09 | 3.83 | 4.57 | 4.76 |
| 127 | Residential | 3.03 | 2.87 | 2.86 | 3.47 | 4.40 |
| 128 | Residential | 3.27 | 4.33 | 4.66 | 4.74 | 4.28 |
| 129 | Residential | 2.49 | 3.89 | 4.07 | 4.30 | 4.84 |
| 130 | Residential | 3.51 | 4.31 | 4.39 | 4.20 | 4.50 |
| 131 | Residential | 3.20 | 3.41 | 3.21 | 2.96 | 3.54 |
| 132 | Residential | 3.44 | 3.16 | 3.46 | 3.69 | 4.08 |
| 133 | Industrial | 4.00 | 3.84 | 3.86 | 2.64 | 1.76 |
| 134 | Commercial | 3.99 | 4.07 | 4.06 | 3.64 | 3.74 |
| 135 | Residential | 0.51 | 0.46 | 0.16 | 0.39 | 0.36 |
| 136 | Industrial | 4.26 | 3.49 | 4.21 | 3.43 | 1.80 |
| 137 | Industrial | 2.71 | 2.47 | 2.71 | 2.09 | 1.44 |
| 138 | Industrial | 2.14 | 2.39 | 2.33 | 2.04 | 0.96 |
| 139 | Residential | 3.91 | 3.77 | 4.17 | 3.80 | 4.04 |
| 140 | Commercial | 2.86 | 2.74 | 2.69 | 2.00 | 1.72 |
| 141 | Industrial | 3.36 | 3.70 | 3.67 | 2.69 | 1.56 |
| 142 | Industrial | 0.61 | 0.59 | 0.61 | 0.26 | 0.22 |
| 143 | Residential | 1.76 | 1.70 | 2.01 | 1.41 | 1.02 |
| 144 | Residential | 2.91 | 3.01 | 2.93 | 2.59 | 2.60 |
| 145 | Industrial | 1.09 | 1.17 | 1.07 | 0.91 | 0.62 |
| 146 | Industrial | 2.63 | 2.34 | 2.53 | 2.01 | 1.14 |
| 147 | Industrial | 2.97 | 2.73 | 2.84 | 2.26 | 1.80 |
| 148 | Commercial | 2.44 | 2.33 | 2.50 | 1.96 | 1.80 |
| 149 | Commercial | 2.49 | 2.53 | 2.51 | 2.04 | 1.68 |
| 150 | Industrial | 2.89 | 2.90 | 2.81 | 2.44 | 1.80 |
| 151 | Commercial | 3.74 | 3.86 | 3.76 | 3.27 | 2.80 |
| 152 | Industrial | 0.59 | 0.50 | 0.59 | 0.49 | 0.26 |
| 153 | Industrial | 2.50 | 2.66 | 2.83 | 1.83 | 1.44 |
| 154 | Industrial | 3.34 | 3.59 | 3.51 | 3.19 | 2.10 |
| 155 | Commercial | 2.56 | 2.71 | 2.76 | 1.94 | 1.46 |
| 156 | Commercial | 3.21 | 3.36 | 3.17 | 2.71 | 2.22 |
| 157 | Industrial | 3.73 | 3.63 | 3.76 | 3.50 | 2.56 |
| 158 | Industrial | 4.27 | 4.60 | 4.57 | 3.90 | 2.70 |
| 159 | Industrial | 2.30 | 2.30 | 2.67 | 1.76 | 0.98 |
| 160 | Premium | 3.60 | 3.54 | 3.19 | 2.33 | 1.90 |
| 161 | Commercial | 2.26 | 3.69 | 3.91 | 3.11 | 2.78 |
| 162 | Premium | 4.54 | 4.57 | 4.47 | 3.73 | 3.58 |
| 163 | Premium | 1.61 | 1.67 | 1.66 | 1.11 | 1.28 |
| 164 | Premium | 2.34 | 2.46 | 2.51 | 1.91 | 1.34 |
| 165 | Premium | 2.99 | 3.10 | 3.23 | 2.24 | 1.64 |
| 166 | Premium | 1.86 | 1.59 | 1.59 | 1.37 | 1.90 |
### Appendix 1 (continued)

| Feeder Classification | Ave Week 1 - Business as usual | Ave Week 2 - Business as usual | Ave Week 3 - Business as usual | Ave Week 4 - Partial lockdown | Ave Week 5 - Total lockdown |
|-----------------------|--------------------------------|--------------------------------|--------------------------------|-------------------------------|----------------------------|
| 167                   | Commercial                     | 1.41                           | 1.40                           | 1.33                          | 1.08                        |
| 168                   | Industrial                     | 1.60                           | 1.84                           | 1.86                          | 1.57                        |
| 169                   | Industrial                     | 1.53                           | 1.61                           | 1.69                          | 1.00                        |
| 170                   | Industrial                     | 1.60                           | 1.90                           | 1.77                          | 1.01                        |
| 171                   | Industrial                     | 0.11                           | 0.13                           | 0.10                          | 0.10                        |
| 172                   | Commercial                     | 2.26                           | 2.33                           | 2.27                          | 1.96                        |
| 173                   | Residential                    | 2.54                           | 1.91                           | 1.04                          | 3.43                        |
| 174                   | Residential                    | 4.00                           | 3.94                           | 4.30                          | 4.07                        |
| 175                   | Commercial                     | 3.61                           | 3.53                           | 3.71                          | 3.30                        |
| 176                   | Residential                    | 4.61                           | 4.26                           | 4.46                          | 4.31                        |
| 177                   | Residential                    | 4.17                           | 4.24                           | 4.24                          | 3.77                        |
| 178                   | Residential                    | 4.11                           | 4.09                           | 4.47                          | 2.93                        |
| 179                   | Residential                    | 2.16                           | 2.30                           | 2.20                          | 2.19                        |
| 180                   | Residential                    | 2.19                           | 2.30                           | 2.31                          | 2.20                        |
| 181                   | Residential                    | 3.86                           | 3.91                           | 4.10                          | 3.86                        |
| 182                   | Residential                    | 3.56                           | 3.49                           | 3.61                          | 3.30                        |
| 183                   | Residential                    | 1.66                           | 1.60                           | 1.61                          | 1.74                        |
| 184                   | Residential                    | 3.44                           | 3.34                           | 3.46                          | 3.27                        |
| 185                   | Commercial                     | 1.57                           | 1.60                           | 1.67                          | 1.24                        |
| 186                   | Industrial                     | 3.07                           | 3.47                           | 3.27                          | 2.64                        |
| 187                   | Residential                    | 3.80                           | 3.33                           | 4.06                          | 3.87                        |
| 188                   | Residential                    | 3.37                           | 3.31                           | 3.29                          | 3.33                        |
| 189                   | Residential                    | 3.49                           | 3.67                           | 3.23                          | 3.69                        |
| 190                   | Residential                    | 1.09                           | 1.09                           | 1.01                          | 0.99                        |
| 191                   | Residential                    | 3.53                           | 3.43                           | 3.53                          | 3.51                        |
| 192                   | Residential                    | 4.97                           | 5.00                           | 5.00                          | 4.90                        |
| 193                   | Residential                    | 4.50                           | 4.77                           | 4.91                          | 4.89                        |
| 194                   | Residential                    | 4.90                           | 5.17                           | 5.01                          | 5.14                        |
| 195                   | Residential                    | 4.93                           | 4.61                           | 5.06                          | 5.11                        |
| 196                   | Residential                    | 2.90                           | 3.26                           | 3.17                          | 3.41                        |
| 197                   | Residential                    | 4.14                           | 4.50                           | 4.50                          | 4.56                        |
| 198                   | Residential                    | 3.33                           | 3.37                           | 4.26                          | 3.90                        |
| 199                   | Residential                    | 4.96                           | 2.94                           | 4.87                          | 4.64                        |
| 200                   | Residential                    | 4.07                           | 4.43                           | 4.19                          | 3.64                        |
| 201                   | Residential                    | 4.01                           | 4.46                           | 4.40                          | 4.30                        |
| 202                   | Residential                    | 4.07                           | 3.43                           | 4.21                          | 4.00                        |
| 203                   | Residential                    | 2.79                           | 2.43                           | 2.76                          | 2.01                        |
| 204                   | Residential                    | 4.06                           | 4.03                           | 4.11                          | 4.19                        |
| 205                   | Residential                    | 2.06                           | 1.99                           | 1.90                          | 2.14                        |
| 206                   | Residential                    | 3.71                           | 3.94                           | 3.57                          | 4.03                        |
| 207                   | Residential                    | 3.01                           | 4.23                           | 4.07                          | 4.20                        |
| 208                   | Residential                    | 4.37                           | 3.83                           | 4.01                          | 4.79                        |
| 209                   | Residential                    | 2.06                           | 2.03                           | 2.06                          | 2.09                        |
| 210                   | Residential                    | 4.17                           | 3.79                           | 4.33                          | 4.50                        |
| 211                   | Residential                    | 2.86                           | 3.03                           | 2.70                          | 2.83                        |
| 212                   | Residential                    | 3.93                           | 3.87                           | 3.70                          | 3.74                        |
| 213                   | Residential                    | 4.63                           | 4.24                           | 4.43                          | 4.69                        |
| 214                   | Residential                    | 3.77                           | 4.24                           | 4.21                          | 4.36                        |
| 215                   | Residential                    | 4.10                           | 4.23                           | 4.23                          | 4.07                        |
| 216                   | Residential                    | 4.20                           | 4.20                           | 4.28                          | 4.19                        |
| 217                   | Residential                    | 4.17                           | 4.39                           | 4.49                          | 4.59                        |
| 218                   | Residential                    | 3.59                           | 3.69                           | 3.60                          | 3.59                        |
| 219                   | Residential                    | 4.51                           | 4.57                           | 4.64                          | 4.79                        |
| 220                   | Residential                    | 4.49                           | 4.57                           | 4.53                          | 4.39                        |
| 221                   | Industrial                     | 4.27                           | 4.04                           | 3.84                          | 3.31                        |
| 222                   | Residential                    | 1.27                           | 3.23                           | 4.56                          | 4.69                        |
| 223                   | Residential                    | 4.04                           | 4.43                           | 4.33                          | 4.26                        |
| 224                   | Residential                    | 4.16                           | 3.37                           | 4.40                          | 4.03                        |
| 225                   | Residential                    | 4.74                           | 3.90                           | 4.77                          | 4.96                        |
| 226                   | Residential                    | 4.17                           | 4.17                           | 4.50                          | 4.44                        |
| 227                   | Residential                    | 4.37                           | 4.54                           | 4.43                          | 4.67                        |
| 228                   | Residential                    | 3.46                           | 3.07                           | 3.46                          | 3.63                        |
| 229                   | Residential                    | 3.80                           | 3.84                           | 3.79                          | 3.96                        |
| 230                   | Residential                    | 3.30                           | 3.54                           | 3.44                          | 3.33                        |
| 231                   | Residential                    | 4.41                           | 4.06                           | 4.16                          | 4.30                        |
| 232                   | Commercial                     | 1.33                           | 1.19                           | 1.63                          | 2.03                        |
| 233                   | Residential                    | 4.53                           | 4.50                           | 4.37                          | 4.16                        |
| 234                   | Residential                    | 4.40                           | 3.54                           | 4.46                          | 4.49                        |
| 235                   | Residential                    | 3.97                           | 4.10                           | 4.27                          | 4.19                        |
| 236                   | Residential                    | 4.36                           | 4.36                           | 4.50                          | 4.40                        |
| 237                   | Residential                    | 3.27                           | 3.36                           | 3.50                          | 3.51                        |
| 238                   | Residential                    | 4.64                           | 4.61                           | 4.70                          | 4.50                        |
| 239                   | Residential                    | 4.07                           | 4.11                           | 4.14                          | 4.40                        |
| 240                   | Residential                    | 3.14                           | 3.19                           | 3.20                          | 3.44                        |
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