

Impact of the COVID-19 Lockdown on Electricity Demand: Global Insights and Implications for Saudi Arabia

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Instant Insight

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The impact of curfews and lockdowns on total electricity demand as a result of the spread of COVID-19 depends on many factors. This insight provides a summary of the immediate demand impacts in selected regions around the world due to lockdown measures. We will follow this up with a second insight, presenting several scenarios for the evolution of electricity demand in Saudi Arabia for the rest of 2020.

As of April 2020, COVID-19 had been reported in 188 countries and regions. European governments implemented national lockdowns throughout March. Italy began its lockdown in the second week of March, France and Spain began theirs in the third week of March, and the United Kingdom (U.K.) began its lockdown in the fourth week of March. The governments of these four countries ordered the confinement of around 324 million people and the shutdown of non-essential businesses, placing industrial and commercial activities on hold. Following the implementation of the lockdown measures, these countries saw their electricity demand fall. We compare the electricity demand in gigawatts (GW) between the last week of March 2020 (March 23-27), the lockdown reference week, with pre-lockdown and no lockdown references.¹ We use the first week of March 2020 (March 2-6) and the last week of March 2019 (March 25-29) as references to derive the demand variations caused by the lockdown.

Figure 1 shows demand variations across five European countries. Between the fourth week of March 2019 and the same period in 2020, Italy's electricity demand fell by 24%. Between the first week and fourth week of March 2020, it fell by 27%. This significant drop in demand could be due to the high share of industry (40%) and services (38%) in Italy's total electricity demand. The lockdown in Italy started in the Lombardy province in the north of the country. This is the most populous province and is the engine of Italian industry.

The Spanish government ordered a national lockdown in mid-March. In the fourth week of March, weekly Spanish electricity demand fell by 9% year-on-year and 12% from pre-lockdown levels. Likewise, France implemented its lockdown in the third week of March. In the following weeks, the weekly electricity demand in France fell 11% year-on-year, and 23% compared with the pre-lockdown period. Germany began its lockdown measures in the third week of March. However, its state-level measures were less strict than in neighboring countries. As such, German weekly electricity demand fell by only 6% year-on-year and 8% compared with pre-lockdown levels. The U.K. was the last European country to introduce lockdown measures. During the last week of March, when it was in lockdown, electricity demand dropped 15% from its pre-lockdown level and 8% year-on-year.

In Japan, total power demand in the first two weeks of March 2020 was 1.7% lower than in the same period in 2019. Most regions across the United States (U.S.) experienced declines in power demand, with total demand in the U.S. declining by around 4%-5% in March and April 2020 year-on-year.

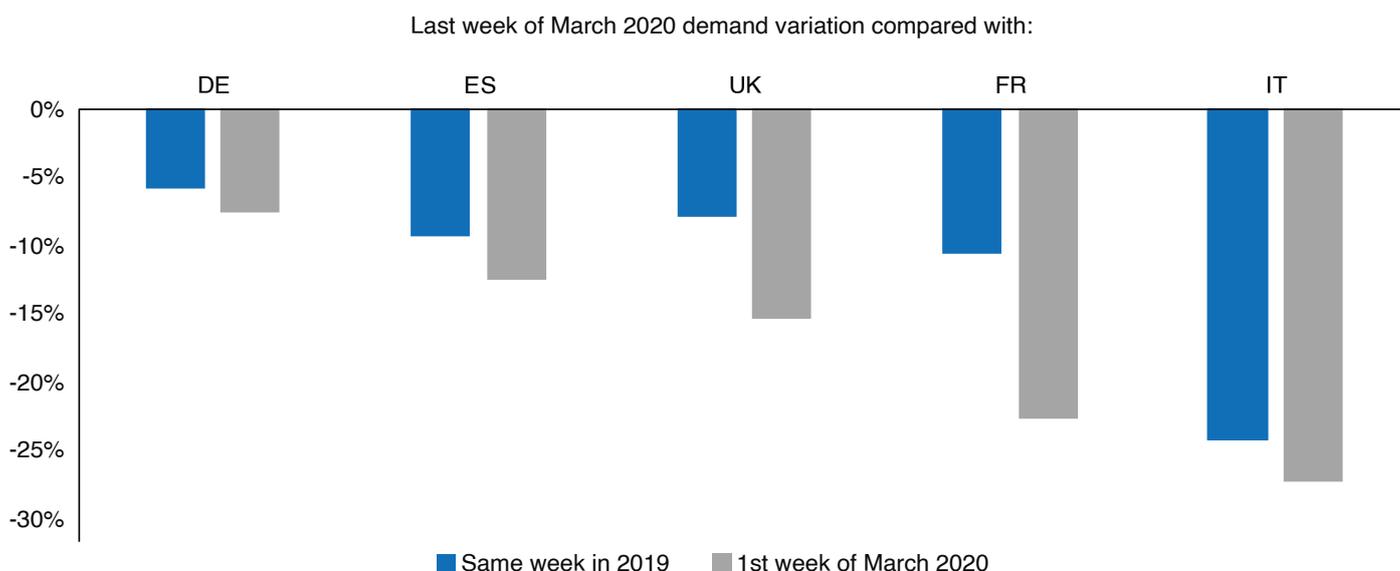
Although the lockdown measures are the primary cause of this unprecedented drop in electricity demand, they are not the only cause. For example, during the 2008-2009 financial crisis, European electricity demand dropped by only around 5%. Weather conditions are an important driver of electricity demand, especially in countries where heat supply is highly electrified (e.g., France). A deeper analysis requires

¹ Daily demand data is taken from the European Network of Transmission System Operators for Electricity (ENTSOE) platform: <https://transparency.entsoe.eu/>

a correction for weather effects, but this would require an analysis beyond the scope of this insight. Recent figures show that demand variations corrected for European weather differentials in post-lockdown periods do not have a significant impact on observed drops in demand, as European temperatures did not vary greatly during this time (Ember 2020). In a recent [report](#), the French transmission system operator stipulates that consistent climatic corrections would only change the observed variations by a few percentage points at most (RTE 2020). Furthermore, it argues that the climatic profiles of some countries, e.g., Italy and Spain, do not suggest any further adjustments to their raw data are needed.

In summary, the spread of COVID-19 and the subsequent government actions have caused significant reductions in electricity demand globally. However, despite this expected trend, electricity demand increased in some regions (e.g., Texas and Florida in the U.S.). Determining the factors behind these trends requires further country-specific research.

Figure 1. Electricity demand variation in selected European Union (EU) countries.



Sources: ENTSOE; KAPSARC analysis.

Note: DE = Germany; ES = Spain; FR = France; IT = Italy; UK = United Kingdom.

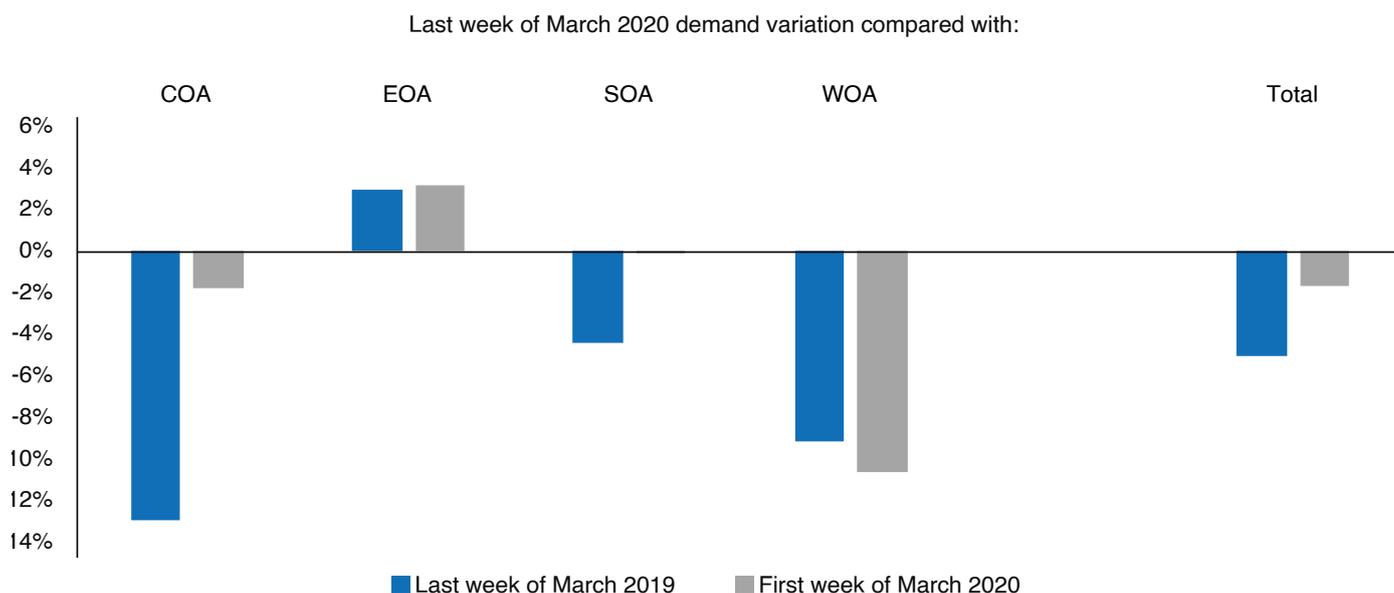
The COVID-19 lockdown and the impact on Saudi electricity demand

The first COVID-19 cases in Saudi Arabia were reported in early March. By mid-March, the government began implementing lockdown measures, including confining specific areas, such as Qatif province, and suspending international flights. By the third week of March, the authorities ordered a nationwide lockdown. In this section, we assess the immediate short-term effects of the lockdown policy on domestic electricity consumption.

We look at electricity demand at two reference points before and after the lockdown policy was implemented, and compare them with the last week of March 2019. We adjust the calendar to account for working days in the Kingdom. Therefore, our pre-lockdown reference week is March 1-5, and the lockdown reference week is March 22-26. We compare this with the last week of March 2019. Finally, we use the four operating areas of the Saudi Electricity Company for the comparative analysis: central (COA), eastern (EOA), southern (SOA) and western (WOA).

Figure 2 shows that the country’s total electricity demand during the fourth week of March was 5.1% lower year-on-year, and only 1.7% lower than in the pre-lockdown period. The observations show variations across the four regions. The COA and WOA recorded the highest drops in weekly demand year-on-year during the lockdown, at -13% and -9%, respectively. However, only the WOA’s electricity consumption dropped dramatically (almost -11%) compared with the pre-lockdown period. The WOA is therefore the primary contributor to the observed slight drop in national demand. The WOA is home to the holy cities of Makkah and Madinah, where worshiping activities have decreased significantly since the lockdown measures began. Demand in the COA decreased slightly, the SOA remained relatively stable, and demand in the EOA increased by around 3% compared with the two reference periods.

Figure 2. Variation of power demand in the Saudi regions.



Source: KAPSARC analysis.

These observations provide preliminary insights about how Saudi electricity demand has evolved in the lockdown period compared with the selected reference dates. Based on these raw observations using both metrics (comparing demand during lockdown with the same period in 2019 and demand two weeks before the lockdown started), one can conclude that Saudi demand was less impacted than the sample of European countries analyzed earlier. Indeed, while Saudi weekly power demand has fallen 5.1% year-on-year, electricity demand in the European sample has fallen by an average of

11.6%. Likewise, compared with its pre-lockdown levels, power demand in the Kingdom only fell by 1.7%, whereas power demand in the European sample declined by an average of 17.1%.

There are several reasons behind the relatively small drop in Saudi electricity demand despite the country's lockdown policy. However, the sensitivity of the country's electricity demand to weather conditions remains the most notable factor. Almost 80% of Saudi electricity demand is used in buildings, and around 70% of residential and commercial use is for air conditioning (AC). Therefore, warmer weather increases electricity demand. In addition, residential demand accounts for 44% of Saudi Arabia's total power demand, compared with an average of 30% for the sample of European countries. More residential electricity demand during the lockdown period thus helps mitigate the loss in the country's total demand. Finally, another factor worth mentioning is that the average household size (in persons per dwelling) in Saudi Arabia is 4.6, compared with an average of 2.3 for the sample of European countries. This is reflected in the average annual electricity consumption per Saudi household of 17.6 megawatt-hours (MWh), almost five times that of the household average of the European sample countries (3.7 MWh). Households with more people and higher electricity use contribute to increased electricity demand.

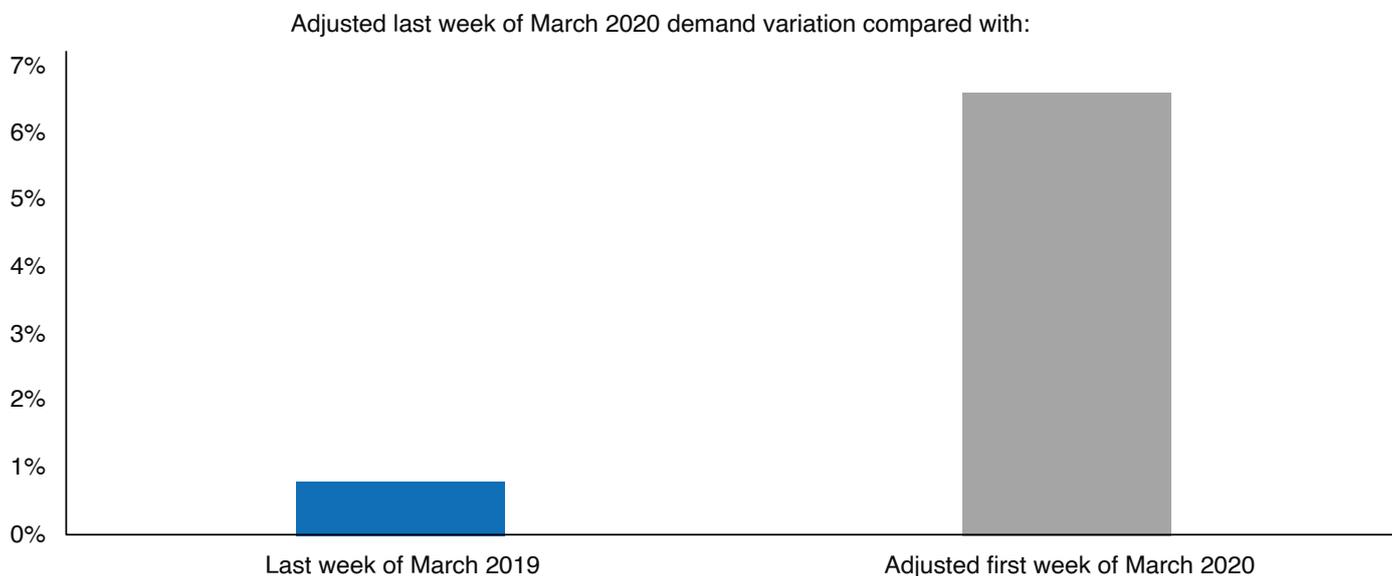
Although the variations presented in Figure 2, based on raw data, provide insights into the *magnitude* of the impact of the lockdown measures on electricity demand, the picture that it portrays is incomplete. To derive a more consistent illustration of Saudi power demand variation, we adjust the demand data with temperature corrections across the reference periods. This climatic correction aims to estimate the *fundamental* demand, i.e., the demand that would have prevailed if the weather conditions were similar on the selected dates. To do this, we use an econometric model to estimate the demand in the pre-lockdown and lockdown periods based on temperature data from the first and fourth weeks of March 2019.

Figure 3 shows the estimated electricity demand after accounting for temperature differentials. To validate the consistency of our estimates, we use the reference periods in 2019 and their corresponding temperatures to check whether, based on the model's parameters, we can replicate the observed demands. The returned demand deviates by only 0.5% and 1.1% from the observed demand during the first and fourth weeks of March 2019, respectively. The estimations reveal that the year-on-year drop in weekly electricity demand in the lockdown period, of -5.1%, results primarily from the yearly difference in temperature. Indeed, during the fourth week of March 2020, the average weekly temperature across the Kingdom was 1.7 degrees Celsius (°C) lower year-on-year (22.4°C vs. 24.1°C). After correcting for this temperature variation, the weekly demand in the lockdown period rises by +0.8% year-on-year. Comparing demand pre-lockdown and during the lockdown shows similar results. Adjusting for the annual rise in temperature for the first week of March 2020 (+1.8°C) corrects demand downward. Therefore, comparing the adjusted electricity demand pre-lockdown with that during the lockdown shows demand increased by 6.6% as a consequence of the lockdown measures.

Finally, we compare the total monthly electricity demand for March 2020 with March 2019. During March 2020, observed demand increased by 3.3% compared with March 2019. This was due to the combination of the lockdown and higher temperatures in March 2020, which averaged +1.5°C over the month.

After correcting electricity demand to account for temperature variations, monthly demand increased by 1.9%, in line with the overall increasing trend.

Figure 3. Demand variations using climatic correction.



Source: KAPSARC analysis.

In summary, the impact of COVID-19 on electricity demand varies by location and the structural characteristics of the respective electricity markets. In the European countries we analyzed, demand reduction is widespread and has reached historically low levels. In Saudi Arabia, observed short-term electricity demand decreased less than in other countries. After accounting for the impact of temperature on Saudi Arabia’s electricity demand, monthly demand increased by 1.9% year-on-year during the lockdown period. A major reason for this is the significant contribution of residential demand in the country’s total demand driven by high individual use. In our next analysis, we will develop scenarios for how Saudi Arabia’s electricity demand might evolve throughout the rest of 2020, based on variables including further lockdown measures and the pace of the country’s economic recovery.

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