# An Electricity Indicator and Early Economic Impacts of the Covid-19 Pandemic

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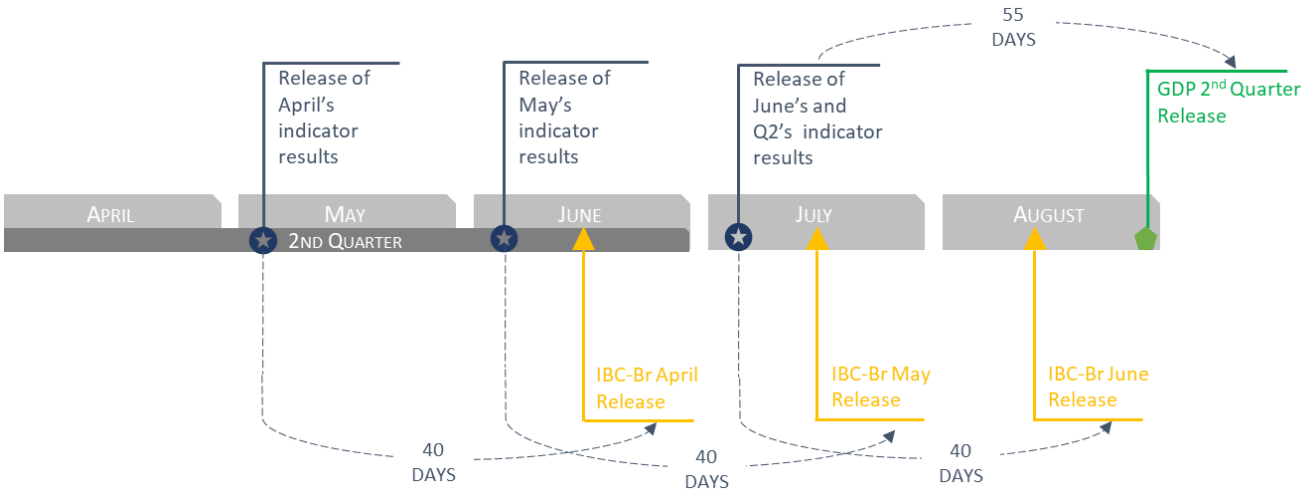
## 1. Introduction

The Sars-Cov-2 (Covid-19) pandemic imposes a new reality on society and governments with extremely short time frames for decision making. Policies and measures are adopted under a significant level of uncertainty and will have a huge impact. The only conviction is that the economic and social costs of social isolation and distance policies will be enormous. To a large extent, this depends not only on the response of government officials, but also on unmanageable factors. Huge packages have been designed and implemented in several countries, from Australia to the United States. Similar policies are also being implemented in Brazil.

In addition to the lack of more accurate information regarding the behavior of the virus (infection rates and short and long-term health impacts), government officials face uncertainties regarding the economic impacts of the pandemic and confinement. One of the limitations of traditional economic indicators for estimating the impact of events on variables such as GDP and unemployment is that they are released with a considerable lag. When available to decision-makers, they provide a picture of what has already happened, not what is happening in real time.

Figure 1 – Indicator's release timeline




Source: FGV CERI.

Given the lag for producing traditional economic indicator of not less than 40 days, we follow Cicala (2020)[1] and estimate an indicator based on electricity consumption that have a shorter than a week lag to help policy makers in challenging times. It is not a replacement or a concurrent measure, but a more instantaneous picture of the economy in times of rapid economic changes when policymakers must also act fast. We argue it also contribute to understand the impact of specific events on the load, which is needed for sectoral policy implementation.

## 2. Understanding the impact of the COVID on electricity consumption

The electricity sector faces great challenges worldwide. A drastic drop in consumption results from isolation and social distance measures as the economy is severely hit. Inaccuracy regarding the spread and effects of the virus exacerbates uncertainty about the pace of economic recovery.

The development of economic indicators takes time. In developing countries, the high relative size of the informal sector and the greater limitation of resources and technical capacity exacerbate the problem. Researchers are working to understand how available and reliable data, such as high-frequency information on electricity consumption, contribute to improving these estimations or work as a proxy that anticipate a reliable information.

For example, the use of satellite data makes it possible to check the use of lights at night. This variable, in turn, has been used as a proxy for electricity consumption since seminal work of Henderson et al (2012). Because it is standardized information across countries, (doesn't rely on countries institutions), it is a good variable for cross-country analysis. There is some evidence of a positive correlation with economic activity[2]. This turns them into a good candidate for estimating economic variables in countries whose data are not fully reliable.[3]

Economist Steve Cicala, from the Tufts University is working on an article[4] based on aggregate consumption data from electric grids in the United States. This article shows how electricity consumption and economic activity were strongly correlated during the 2008 recession, as anticipated in some media

[1] https://home.uchicago.edu/~scicala/papers/real_time_EU/real_time_EU.pdf

[2] Yingyao and Yao (2019) for a review of the use of this measure as an economic indicator. They also show how this can vary according to the region's level of economic development.

[3] Henderson, J Vernon, Adam Storeygard, and David N Weil, 2012, "Measuring Economic Growth from Outer Space," American Economic Review, Vol. 102, No. 2, pp. 994–1028; and Henderson, J Vernon, Tim Squires, Adam Storeygard, and David Weil, 2018, "The Global Distribution of Economic Activity: Nature, History, and the Role of Trade," The Quarterly Journal of Economics, Vol. 133, No. 1, pp. 357–406.

[4] Not yet available, but anticipated by Cicala (2020).

outlets.[5] For this exercise, Cicala[6] uses an electricity consumption indicator/measure. The indicator is a measure of electricity demand adjusted for temperature, week of the year, day of the week and time of day, in addition to holidays. He builds it for some European countries, US regions, India and China[7], countries strongly affected by the pandemic, and shows the reduction of adjusted electricity consumption has reached about 25% in Italy and about 15% in Spain, France and the United Kingdomin, from the social isolation measures date.

The idea of using electricity-based measures is that in the short term it has the potential to be a powerful indicator of the level of economic activity. In the longer term, however, the relationship between electricity demand and GDP is affected for a range of factors, such as demand response to changing tariffs, energy efficiency, improvements in production processes and changes in regulations.[8] In addition, technological innovations at an increasingly fast pace, coupled with an increasing understanding of consumer behavior, enable more efficient tariff designs. This dynamic has the power to alter the responsiveness of consumers to prices. In Brazil, the interplay of the economic activity and theft may also play a role in this medium to longer term relation.

Still, as Cicala argues in the *New York Time* article,[9] in the very short-term, electricity is more difficult to replace. Following this lead, we build a similar indicator for the four zones operated by the Brazilian Independent System Operator (ONS) – The Southeast/Midwest, North, Northeast and South. We aim at contributing to a better understanding of the COVID impact on the electricity system and on providing some information on the economic activity within a very short lag. Our indicator shows a very strong correlation with economic indexes. Even more remarkable, it has a stronger relation with the economic activity (downturn and recovery) when the country faces a recession with a well-defined start date, as was the 2008 crises (Lehman Brothers filed for Bankruptcy on September 15th, 2008). We report preliminary results from Figer et al (2020).[10]

[5] https://www.businessinsider.com/electricity-usage-data-economists-predict-recession-is-2020-4 and https://www.nytimes.com/interactive/2020/04/08/upshot/electricity-usage-predict-coronavirus-recession.html

[6] https://home.uchicago.edu/~scicala/papers/real_time_EU/real_time_EU.pdf

[7] Available on th website https://epic.uchicago.edu/area-of-focus/covid-19/

[8] Vipin Arora and Jozef Lieskovsky's 2014 article argue that this relationship is still strong if well controlled.

[9] https://www.nytimes.com/interactive/2020/04/08/upshot/electricity-usage-predict-coronavirus-recession.html

[10] Figer, Vivian, Jardim, Fernanda, Martins de Souza, Rafael and Medeiros, Pedro, "Electricity Consumption and Economic activity in Brazil".

## 3. Impact of the COVID in Brazil

A reliable indicator of electricity consumption is the first step in understanding the effect of disruptive events in the COVID-19 crisis and, in a second step, with some additional work it is possible to make some inferences of the impact on the daily load curve.[11] This understanding is extremely relevant for electric system operators.

In Brazil, the distribution companies – DISCOS - have already been facing enormous challenges imposed by the current electricity contracting model. It does not encourage or allow an efficient allocation of risks and returns.

The National Electric Energy Agency (ANEEL) released an analysis by the Electrical Situation Monitoring Office (GMSE), which notes a reduction in the billing of the distributors of R$ 3.3 billion until May 17th, a value that represents a nominal drop of 10.2% in relation to the same period of the previous year. Additionally, the default rate for April more than tripled compared to April 2019[12], worsen by the measures adopted by the regulator to ensure that essential services and residential consumers are still provided for default until July 31st.

Provisions for deferred payment of electricity bills by residential consumers and essential services have been debated. Although some countries have already established rules for deferral, the mechanisms to recover this loss of revenue by utilities are still being developed. In Brazil, Provisional Measure (PM) 950/2020 exempts consumers who benefit from the social tariff from paying the bill for consumption of up to 220 kWh/month, as long as the emergency aid is granted. On the other hand, the PM foresees an investment of R$ 900 million in the Energy Development Account (CDE) to cover the mismatch of revenues with the Treasury resources and a loan with a tariff pass, along the lines of the Regulated Contracting Environment ACR account and, in this case, called Covid-Account. The Covid-Account was regulated by Normative Resolution 885/2020 at the end of June and consists of a loan of R$16.1 billion for distribution companies to honor their financial commitments in the face of reduced revenues. On the consumer side, the goal is to smooth out in five years the tariff increase that would occur over the next 12 months.

Such measures impose a cost on consumers and DISCOs who already has a high amount of over procured electricity[13] and expectation of low imbalance settlement price (PLD) for a long

[11] The load is the average electrical power requested by an equipment, bus, substation, agents of the operation, zones or electrical system, during a certain time interval, calculated by ONS. It represents the demand added to technical losses.

[12] Technical Report nº 77/2020 - SGT/SFF/SRM/SRD/GMSE/ANEEL and Technical Report nº 0018/2020 - SRD/SGT/ANEEL

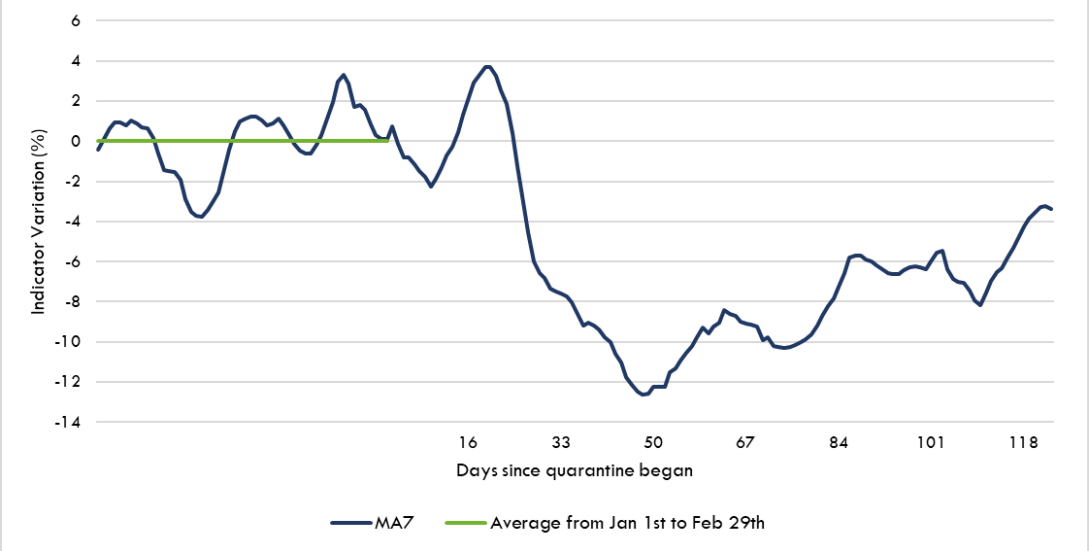
[13] This is exacerbated for the low flexibility for adjusting their portfolio and weak incentives for optimal procuring strategy.

period. In order to assess the adequacy of the policies adopted, an effort is needed to identify which portion of the reduction in consumption and, consequently, the loss of revenue perceived by companies in the sector can be attributed exclusively to Covid-19 and its response.

A first and necessary step is to identify how much of the electricity consumption (daily load, in the sector's jargon) is not explained by variables commonly related to the demand for electricity, such as time of day, day of the week, temperature,[14] rain, week of year and business days.

This is the measure we built from the method used by Cicala (2020) and from existing data in Brazil.[15] The World Health Organization (WHO) declared the Covid-19 pandemic on March 11. As a result, five days later, the Brazilian government instituted the Crisis Committee for Supervision and Monitoring of the Impacts of Covid-19 through Decree 10.277/2020. Thus, to capture anticipation effects March 1 is defined as the beginning of the effects of the pandemic on the consumption of electricity. The analysis was developed for each of the four zones of the National Integrated System (SIN) using hourly load data.

Figure 2 - Variation of Normalized Energy Consumption for Brazil (%)

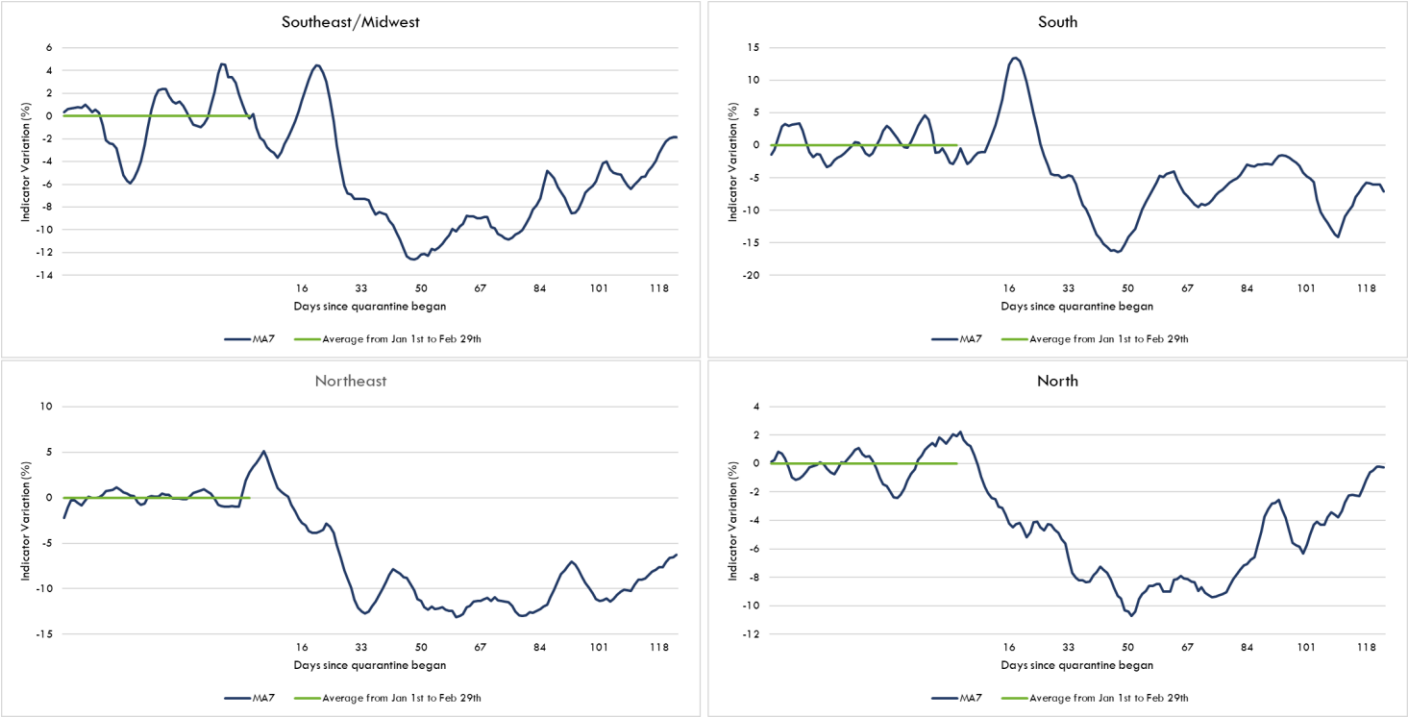



Source: FGV CERI.

Figure 3 - Variation of Normalized Energy Consumption for SIN Zones (%)

[14] More specifically, we control for thermal sensing using the Heat Index developed by Rothfusz described in a 1990 National Weather Service (NWS) Technical Attachment (SR 90-23): https://www.weather.gov/media/ffc/ta_htindx.PDF

[15] Data Source: National System Operator (ONS), Electric Energy Trading Chamber (CCEE), National Meteorological Institute (INMET), Wudergound and Brazilian Association of Financial and Capital Market Entities (ANBIMA).




Source: FGV CERI.

Table 1 - Variation of Average Normalized Energy Consumption for SIN Zones (%)

| Zone | Period | | | |
|---|---|---|---|---|
| | 01/03 to 31/03 | 01/04 to 30/04 | 01/05 to 31/05 | 01/06 to 30/06 |
| **Brazil** | **-1,64** | **-10,53** | **-8,05** | **-5,66** |
| **SE/MW** | -1,87 | -10,61 | -8,37 | -4,42 |
| **South** | 2,21 | -10,48 | -5,36 | -7,87 |
| **Northeast** | -3,99 | -11,11 | -10,61 | -8,99 |
| **North** | -3,77 | -8,92 | -6,63 | -3,04 |

Source: FGV CERI.

From March 16th, the official beginning of the quarantine, through June 30th, our controlled-indicator shows that the electricity consumption was down 7.3% relative to the previous period in 2020, with a sharper decrease in April, which decreased 10.5%. The indicator's lowest point is recorded in the week beginning on April 12th and ending on April 18th. We report week moving averages for our countrywide results and for each of the four systems in the country (Figure 1 and Figure 2).[16]

[16] As in Cicala 2020, we employed a rolling window of analysis pooling data 3 years. Pooling them for 4 years resulted in similar estimates. We chose the 3 years specification to have the indicator for a longer series we report in the next section.

## 4. Economic Activity

A second step is to understand how the indicator relates to economic activity

Following the common sense that residential consumption is more affected by temperature, we also built an indicator where the variable of interest in the consumption on a specific day – when economic activity is at its highest – between 11am and 4pm, when it should be more severely affected by the COVID. We report results in Table 2.

Table 2 - Variation of Average Normalized Energy Consumption for SIN Zones during work hours (%)

| Zone | Period | | | |
|---|---|---|---|---|
| | 01/03 to 31/03 | 01/04 to 30/04 | 01/05 to 31/05 | 01/06 to 30/06 |
| SE/MW | -2,83 | -11,70 | -9,07 | -5,83 |
| South | 0,39 | -10,48 | -4,90 | -4,78 |
| Northeast | -4,82 | -12,99 | -12,31 | -9,52 |
| North | -3,38 | -9,85 | -7,31 | -3,02 |

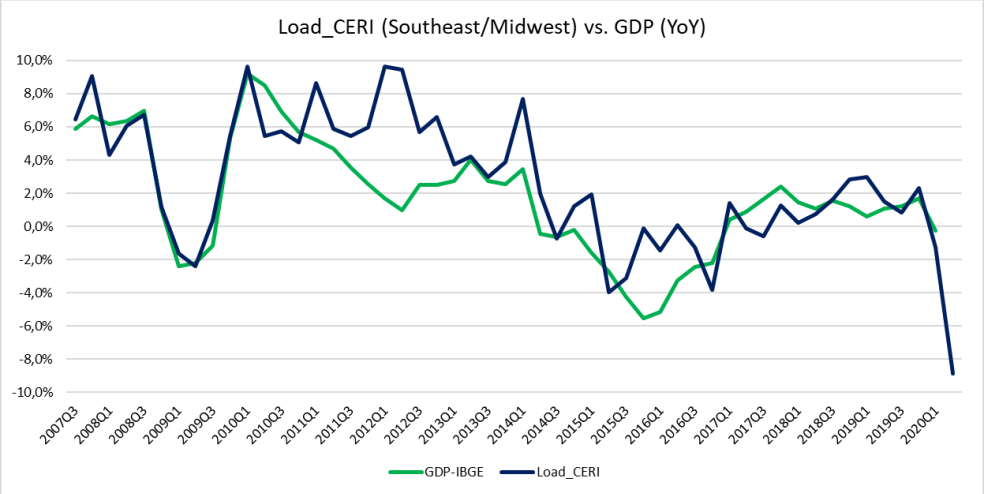
Source: FGV CERI.

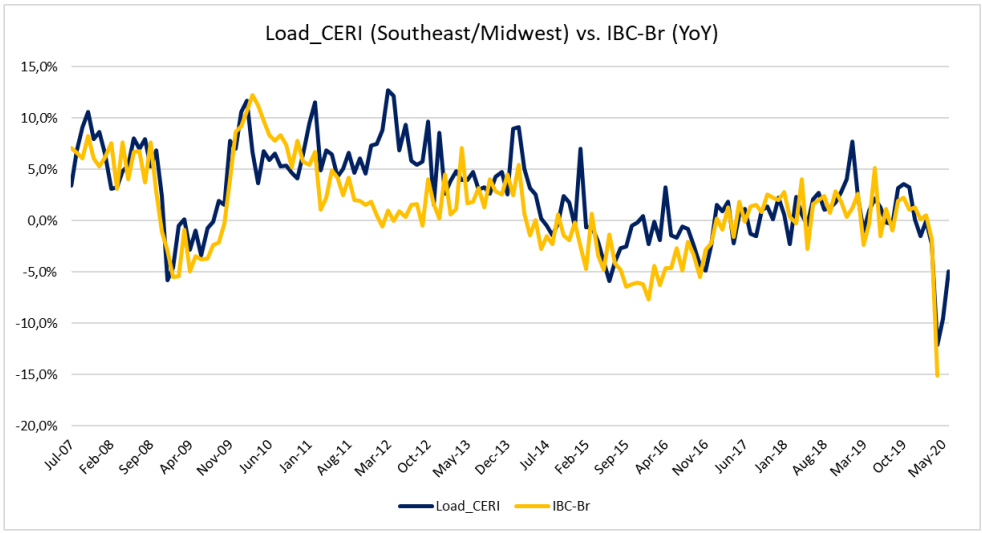
The next step was to test a longer series of the indicator against widely used economic indicator: the monthly GDP monitor, the quarterly GDP and the Central Bank monthly indicator IBC-br. It is important to stress they are produced with a lag of about one and a half to two months, against our indicator which can be produced with a lag shorter than a week, as soon as the load is available (usually within two to five days).

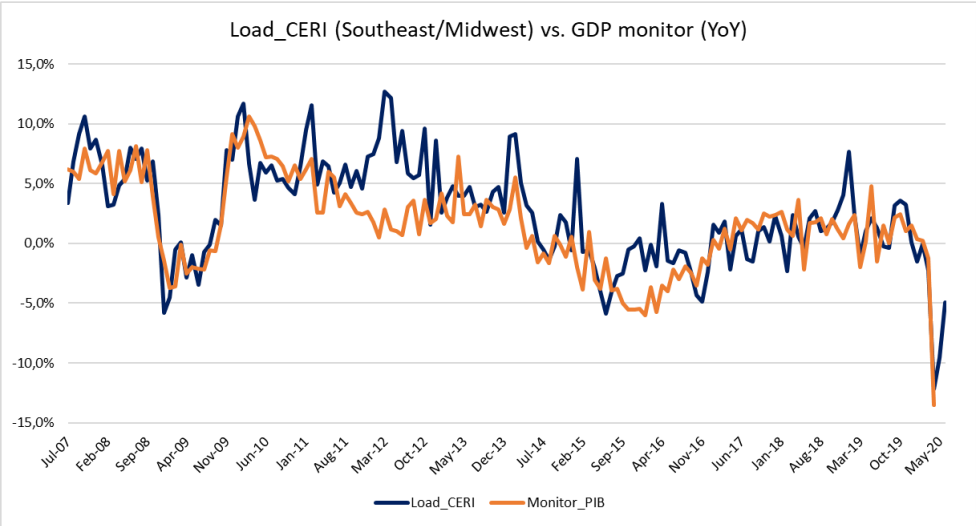
Our preliminary results indicate that the electricity consumption indicator shows a stark relation with the economic ones, especially for the 2008 and current events, presenting a correlation of 0.74 and 0.77, respectively. It also shows a similar pattern for the 2008 and current crises' recovery: the monthly electricity indicator starts recovering at least a month before the economic one (IBC-br). We present the figures for the SE/CO that represents more than half the electricity load and where the economic activity is highly concentrated.[17] The appendix contains additional pictures for Brazil.

[17] Further analysis is need for the better way to aggregate the data to estimate the country-level indicator without loosing the local effects of the controls.

Figure 5 – Electricity consumption indicator and economic activity (%)




Source: FGV CERI.

## 5. Conclusion

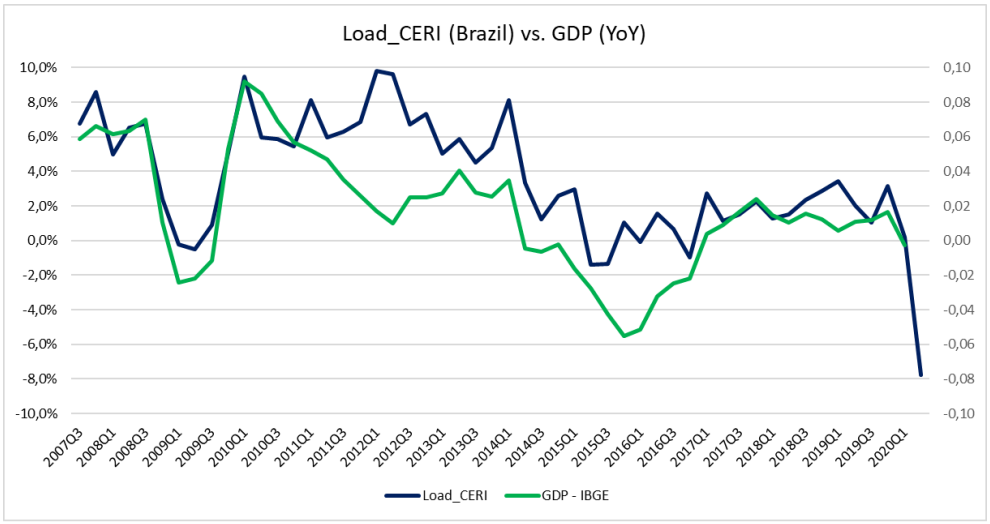
With this indicator, it is possible to understand more robustly what is happening with electricity consumption. The impacts observed through the indicator take into account the effects of temperature (thermal sensation) and seasonal effects, which are typically responsible for large parts of the load variation. This is important because the difference in load on similar days (for example, the first Monday in October) of two consecutive years may reflect, in part, the fact that one year was excessively hot.

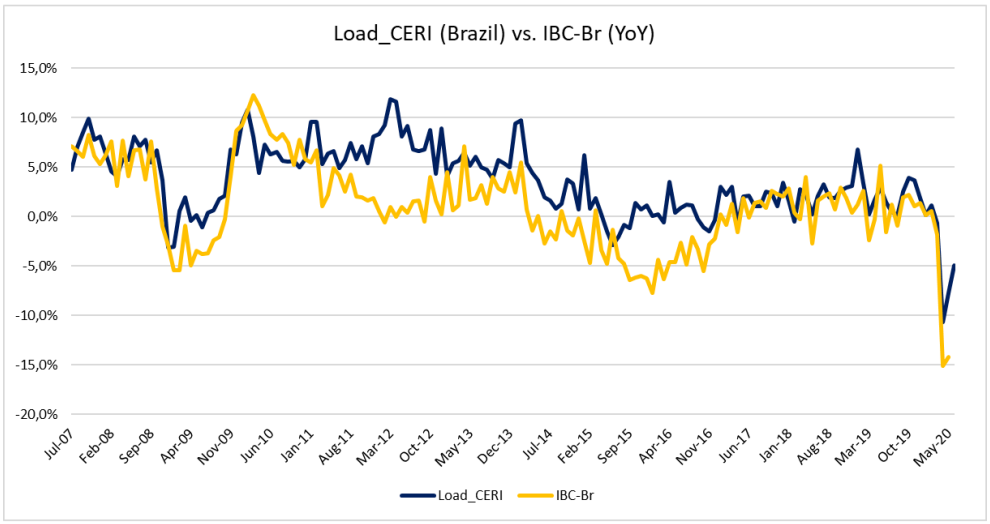
Especially in economies and sectors that simultaneously faced challenges prior to the Covid-19 crisis, it is essential to understand what impacts can be associated with the pandemic and the measures adopted to contain it.

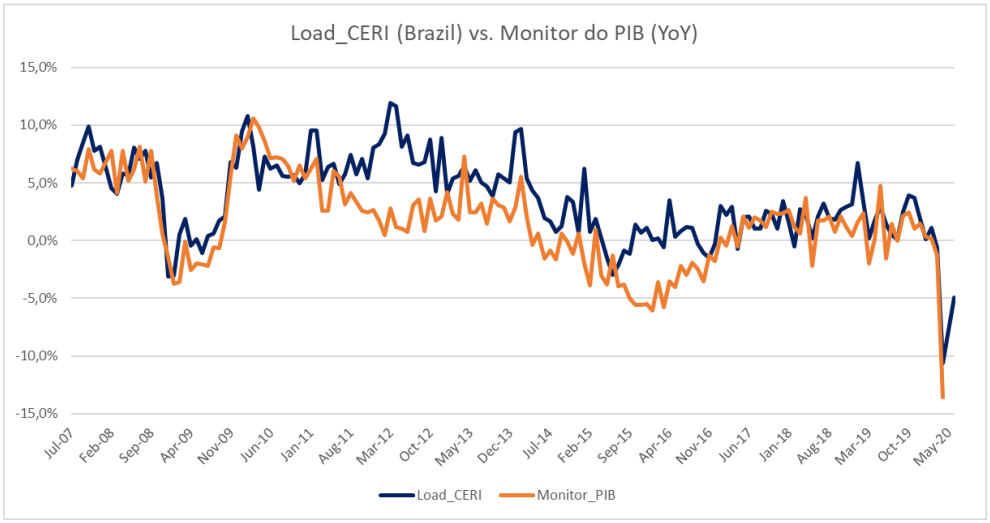
In addition, the results of the larger indicator series corroborate the idea that electricity consumption is stronger related to the economic activity, especially in the short-term. We stress it is not a replacement for traditional economic indicator, but a more instantaneous picture of the economy in times of rapid economic changes when policymakers must also act fast. This is the subject of ongoing research.

# Appendix

Figure A1 – Electricity consumption indicator and economic activity (%)




Source: FGV CERI.

ERRATA: The plots with quarterly data in Figures 5 and A1 were both corrected due to misleading information in the previous version.