Energy consumptions in Portugal in the last three decades, Impact of COVID-19 in the Portuguese energy consumption and a pos-pandemic forecast

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I - Introduction

The worsening of the pandemic caused by the new SARS-COV 2 coronavirus, has forced government authorities to apply restrictive measures to combat the spread of the virus and thus prevent a breakdown of national health services. In addition, the implementation of measures such as teleworking, for example, were crucial in containing the spread of the disease and preventing potential sources of infection in the respective workplaces.

Our main goal in this small project is to evaluate the energy expenditures in the last 27 years, in Portugal, in order to determine how remote work has changed the energy consumptions of families, industries and governmental sectors.
For this analysis, we will apply statistical models for analyzing and forecasting time series data, in order to obtain concise and coherent results that allow us to draw relevant conclusions.
That being so, we will do a forecast for the next 5 years so that we can assess future trends about potential upcoming scenarios regarding energy consumptions. It is relevant to mention that this prediction will consider the end of the lockdown previously implemented and, consequently, the gradual opening of the country, as we cannot predict the emergence of new variants that would require a new lockdown.

II - Analysis

For a better understanding of the graphs obtained (Fig. 1), it is important to begin this analysis by mentioning that the unit of energy used is the KWh per capita associated with the respective year it represents.
The general framework of these graphs allows us to verify a growing and upward trend in energy consumption since the beginning of the 1990s. This is due to the rapid development of the country through the evolution of industries and cities.
Although by the year 2020 we can see a decrease of about 200 kWh per capita in consumption, it remains at a similar level to that of this decade, meaning that energy consumption levels have remained similar to the average of recent years.

Moving on to the individual analysis of each sector, we can see that Domestic, Non-domestic, Industry and the Agricultural sectors follow the expected overall growth pattern. It is also relevant to mention that, regarding the 2008 crisis, we were not able to detect any abrupt decrease in the energy consumption registry, but only a certain discrepancy in the industrial sector of around 100 kWh per capita.
Regarding the streetlights and government buildings sectors, we can see a downward trend in energy consumption since 2010. In the first case, this can be explained by the gradual adoption of more efficient and less polluting lamps, as evidenced in some articles of this time. In the second case, this decrease can be explained by the adoption of more environmentally friendly policies and the creation of several online portals associated with different governmental organizations, which allowed a better use of these spaces.

Putting 2020 in perspective, we can clearly observe that there was a general reduction of energy consumption in all sectors, when compared to the previous 4-5 years, with exception of the Domestic energy consumption.
This is due to the application of restrictive measures aimed at containing the advance of the Covid-19 pandemic in the country, such as, the implementation of remote work and the closure of schools.

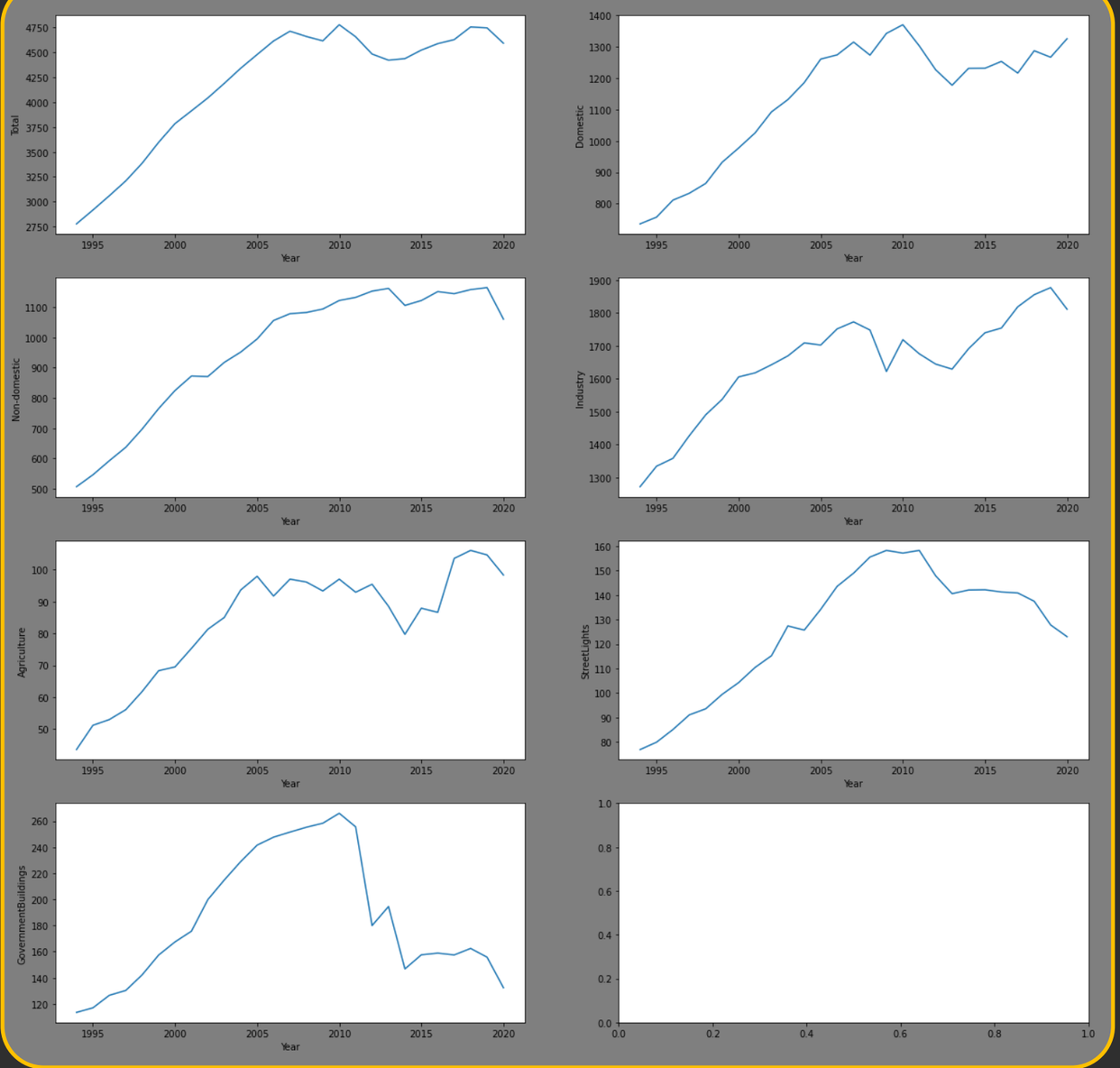

Fig. 1 (Analysis)

III - Methodology for Forecasting

As far as the methodology used, we decided to apply the ARIMA model. This model is considered to be a generalization of the more common ARMA model, thus leading to a greater variety of potential utilities. Our choice was also based on the fact that we are facing only 1 time series and, therefore, it is not necessary to use vector-based forecasting models such as VAR, used in the analysis of multiple time series.

Thus, the ARIMA model can be applied not only to forecast results, but also as a way to understand the behavior of past data and to understand how possible changes could have altered the results obtained. In this project, and taking into account that our goal is the future forecast of energy consumption, we decided to use a non-seasonal ARIMA, thus requiring a differentiation of the data that, by consensus, we decided to be logarithmic. This transformation was applied for a number of reasons: we are not dealing with monetary values, it helps us linearize exponential trends, and it does not contribute to the disregard of the identified trends.

As we mentioned earlier, we wanted to emphasize the fact that this forecast assumes a return to pre-pandemic normality at the national level. For this reason, if some unaccounted event occurs in the ensuing period, such as a worsening of the pandemic in the country, our forecast will become invalid.

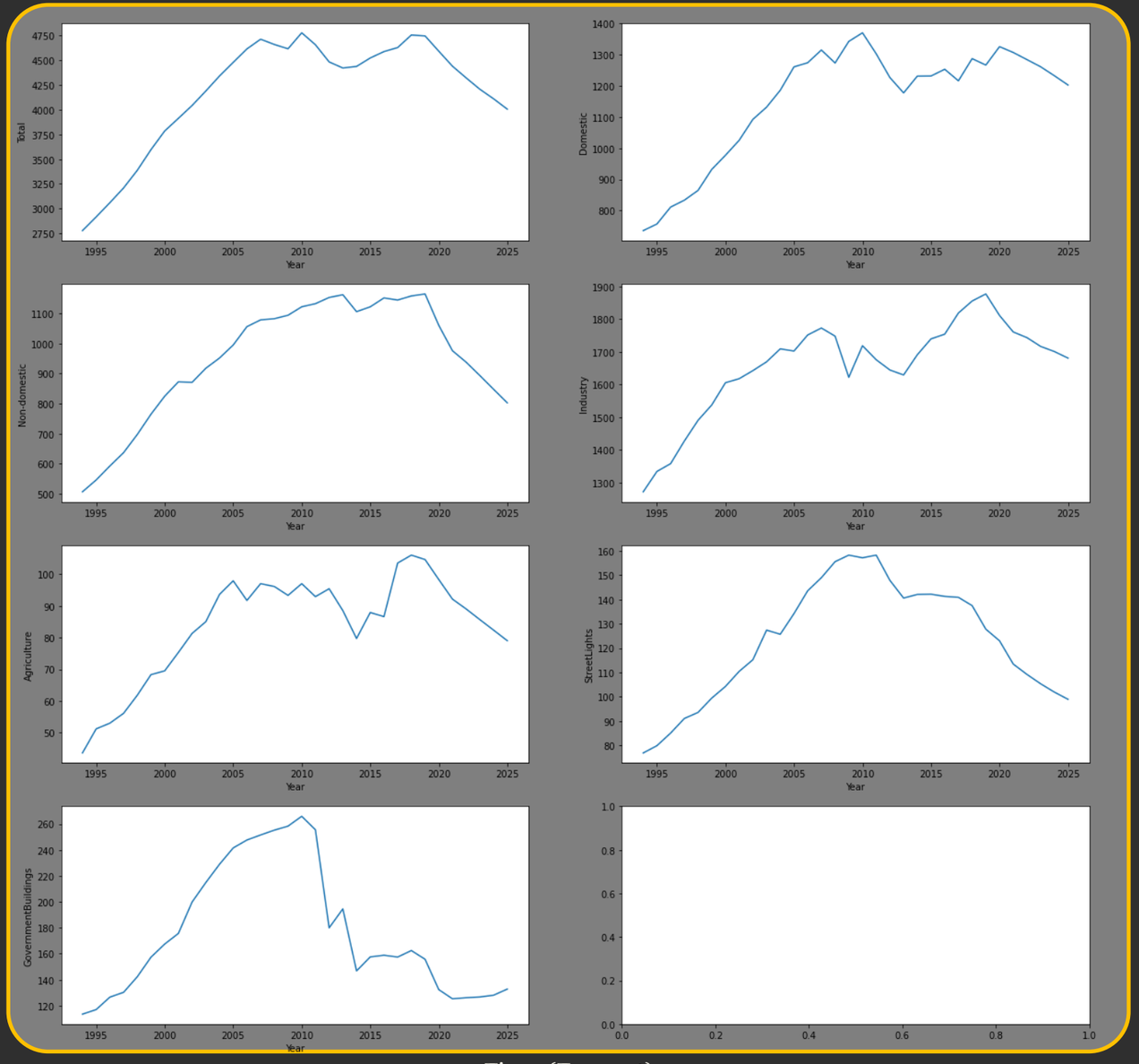

Fig. 2 (Forecast)

IV - Interpretation of forecast results and conclusion

Taking into account all the information obtained and analyzed, we can now proceed to the realization of a sustained forecast, of the levels of energy consumption at the national level for the next 5 years (until 2025) (Fig. 2).

In the graphs obtained, we can clearly see a generalized reduction in energy consumption at a national level in all the studied areas, probably due to the bankruptcy of many agricultural and industrial companies, due to the pandemic. In addition, the gradual transition to less polluting technologies that has occurred during the last decade may also be responsible for this decrease for the next 5 years (until 2025).

These results are in line with the return of people to their workplaces, which will consequently also lead to reductions in energy costs in their homes, as we can see in the domestic plot.

Finally, in contrast to the generality of sectors, the energy consumed by government buildings tends to stabilize at pre-pandemic values, which can be explained by the return to operation of these entities.

Sources

Dataset:
https://www.pordata.pt/en/Portugal/Electricity+consumption+per+capita+total+and+by+type+of+consumption-1230

News articles for investigation and integration
https://info.portaldasfinancas.gov.pt/pt/at/10_anos_AT/Paginas/10_anos_AT.aspx
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