

Research Article

Monitoring the Evolution of Electricity Consumption Parameters in Mamou, Guinea, from 2020 to 2021

Jean Ouere Toupouvogui^{1,*} , Ansoumane Sakouvogui² ,
Mohamed Ansoumane Camara³ , Roger Marcelin Faye⁴ 

¹Instrumentation and Physicals Measurements Department, Higher Institute of Technology, Mamou, Guinea

²Energy Department, Higher Institute of Technology, Mamou, Guinea

³Electrical Engineering Department of the Polytechnic Institute, Gamal Abdel Nasser University, Conakry, Guinea

⁴Higher School of Engineering Sciences and Techniques, Amadou Mahtar Mbow University, Dakar, Senegal

Abstract

Accurate monitoring of electricity consumption is essential for the efficient operation and planning of power distribution systems, particularly in rapidly growing urban areas of developing countries. This article analyzes the evolution of electricity consumption parameters in the city of Mamou (Guinea) over the period 2020-2021, based on annual peak load statistics and energy consumption data for the main lines of the Guinean Electricity Company (EDG) for the years 2020 and 2021. The study aims to characterize consumption trends, load profiles, and factors influencing electricity demand. It analyzes the electricity consumption of the urban municipality of Mamou in order to understand and evaluate the demand for electrical energy in Mamou in order to highlight the capacity of the station in relation to the demand of the municipality in the future. The methodology relies on the statistical analysis of monthly consumption, active and reactive power demand, power factors, and current demand for the various feeders, supplemented by an interannual comparison. The results reveal a noticeable increase in electricity demand, reflecting population growth, urban expansion, and increased socio-economic activities. Seasonal variations in consumption are clearly observed, with higher demand during the dry season due to intensified commercial activities and residential energy use. The results highlight a significant variation in consumption between 2020 and 2021, marked by the impact of the COVID-19 pandemic in 2020 and a gradual resumption of activity in 2021. The analysis of peak demand indicates increasing stress on the existing distribution infrastructure, while power factor trends highlight the persistent presence of reactive power consumption in the network. Furthermore, the load factor values suggest suboptimal utilization of installed capacity, pointing to opportunities for improved demand-side management and reactive power compensation. The findings emphasize the importance of continuous monitoring of consumption parameters to support network optimization, loss reduction, and investment planning. This work provides useful insights for utilities and decision-makers seeking to enhance the reliability and efficiency of electricity supply in Mamou and other medium-sized cities in Guinea with similar characteristics.

Keywords

Monitoring of Evolution, Electrical Energy, Production, Consumption, Mamou

*Correspondence: Jean Ouere Toupouvogui (toupou1976@gmail.com)

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1. Introduction

Analyzing electricity consumption is a fundamental tool for planning, operating, and optimizing electricity systems, particularly in developing countries where generation and distribution infrastructure remains limited [1, 2]. Managing energy demand not only improves grid reliability but also guides investment and energy efficiency policies [11, 12]. Energy efficiency is the primary driver of electricity consumption, partially offsetting the effects of economic growth, population growth, market share gains, and new uses [16, 17].

In Guinea, population growth, progressive urbanization, and the development of economic activities have led to a sustained increase in electricity demand, exacerbating the strain on urban and peri-urban grids [3, 4]. Guinea has seen a gradual increase in national electricity consumption in recent years. Total electricity consumption rose from less than 2.1 billion kWh in 2020 to approximately 3.62 billion kWh in 2023, representing continued growth in energy consumption across all sectors (residential, industrial, and commercial) in the country. Secondary cities, such as Mamou, exhibit specific consumption patterns that require in-depth local studies to better understand demand dynamics and the performance of the distribution network [5, 8].

Furthermore, the period from 2020 to 2021 was marked by the COVID-19 pandemic, which had a significant impact on electricity consumption patterns worldwide [4]. Health measures and economic disruptions altered load profiles, particularly in the residential and commercial sectors, making a comparative analysis of this period relevant [6, 7].

In this context, monitoring and analyzing the evolution of electricity consumption parameters in Mamou appears essential to better understand demand dynamics, identify factors influencing consumption, and assess the performance of the distribution network. This article proposes a quantitative analysis of the evolution of the main electricity consumption parameters in the city of Mamou between 2020 and 2021 [9]. The study relies on distribution data and annual peak load statistics, as well as energy consumption data from the main lines of Electricité de Guinée (EDG), to characterize consumption trends, assess the performance of the local electricity network, and provide decision-making support for demand management and energy planning [9].

2. Materials and Method

2.1. Study Framework

The town Mamou, capital of the administrative region of Mamou, is located between 9°54' and 11°10' north latitude and 11°25' and 12°26' west longitude, with an average altitude of

700 m. According to the latest population and housing censuses, it covers an area of 8,000 km² with a population of 318,981 inhabitants, or an average density of 30 inhabitants per km² [14]. It is bounded to the north by the Prefectures of Dalaba and Tougue; to the south by the Republic of Sierra Leone; to the East by the Prefectures of Dabola and Faranah; to the West by the Prefecture of Kindia. Its climate is characterized by two (2) seasons of equal duration: a dry season from November to April and a rainy season from May to October. The rainy season is dominated by short, infrequent showers and violent winds which cause power outages. The population is essentially rural; 79% of the population of Mamou lives in rural areas. Its population density is 30 inhabitants/km² and its climate is tropical [9, 10].

Mamou is located 266 km from Conakry. It is bordered to the north by Boulliwel and Tolo, to the northeast by Dounet, to the southeast by Soyah, and to the west by Konkoure. Mamou, a town located in the heart of Guinea on the Conakry-Kindia-Kankan-Faranah-Labe road, is known as a crossroads town, reflecting the ethnic diversity of Guinea [8, 9]. The highest temperatures are observed in March-April (37 and 38 °C), while the lowest are recorded in December (11 °C) [9, 10].

2.2. Tools Used

As part of this work we used Spyder software, a database of peak load statistics for the Mamou substation for the years 2020 and 2021, and the electrical power production of the Electricity of Guinea power plants for the years 2020 and 2021.

2.3. Methodology

The methodology is based on the statistical analysis of monthly consumption, active and reactive power demand, power factors, and current demand from the various feeders of the Mamou electrical substation (110kV/30kV, 15MVA) [13, 14]. For data collection (energy consumption), electrical parameters are recorded hourly on measuring devices [18]. We obtained the peak load statistics for the Mamou substation, from the annual peak load statistics of Electricity of Guinea (EDG). From this data obtained, we determined the total energy consumption for the urban commune of Mamou.

3. Results and Discussion

This study shows that in 2020 and 2021 the electricity consumption of Mamou evolved in accordance with the graph in Figures 1, 2, 3 and 4.

3.1. Evolution of Electricity Consumption in Mamou in 2020 and 2021

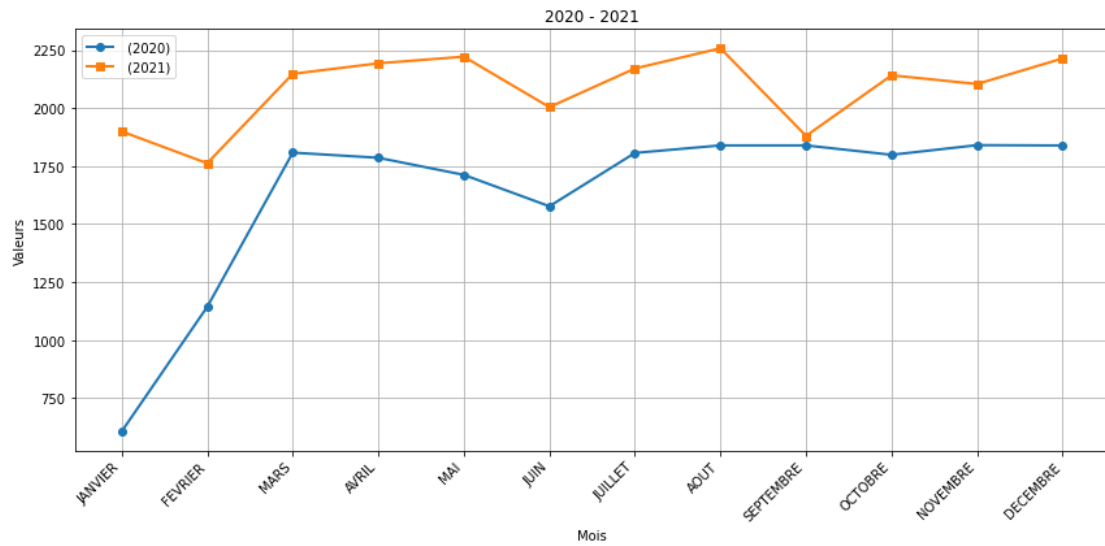


Figure 1. Electricity consumption of Mamou in 2020 and 2021.

This trend over these different years shows a fluctuation in electricity consumption in the urban commune of Mamou. A decrease in electricity consumption is observed from March until the end of May; this is due to a decrease in electricity production by hydroelectric power plants caused by the drop in water levels in these hydroelectric dams.

3.2. Evolution of Mamou's Energy Parameters

3.2.1. Active Power

The active power of the different feeders supplying the municipality of Mamou is shown in [Figure 2](#).

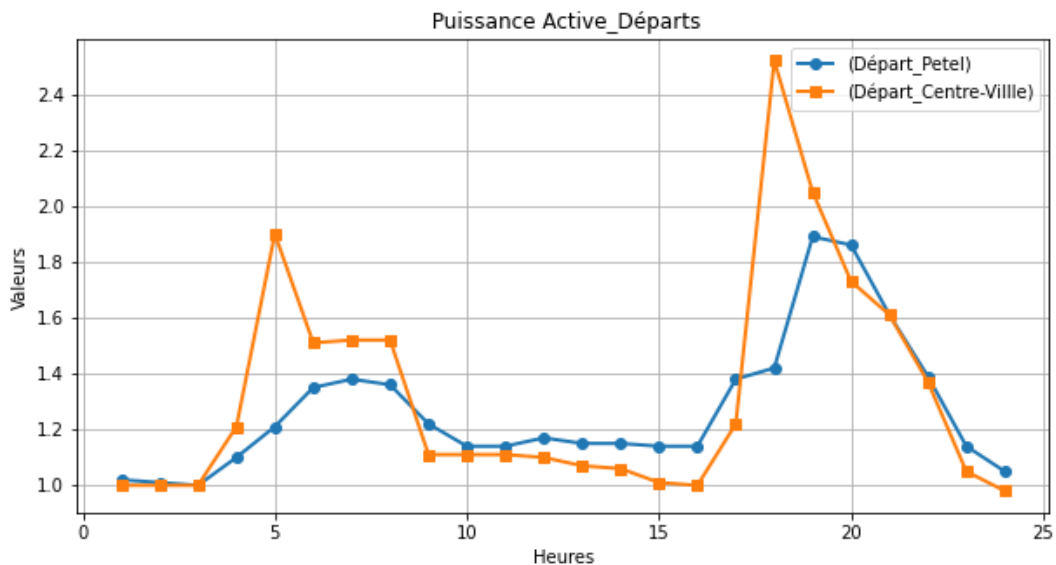


Figure 2. Active power of the different circuits in the municipality of Mamou.

[Figure 2](#) illustrates a power peak around 6-7pm due to the massive use of high-power appliances for cooking, goods and services production activities.

3.2.2. Reactive Power

The reactive power of the different feeders supplying the

municipality of Mamou is shown in Figure 3.

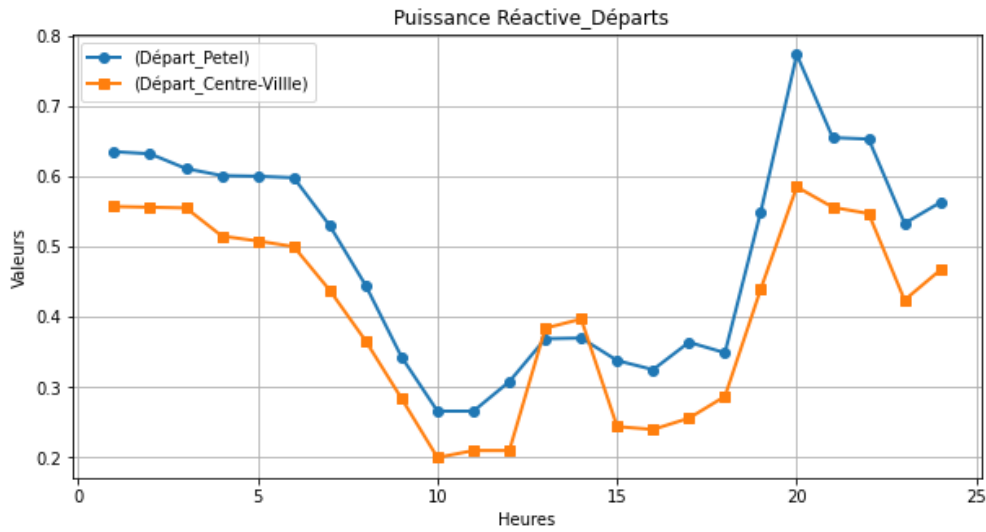


Figure 3. Reactive power of the different circuits in the municipality of Mamou.

Figures 2 and 3 show that a peak load in the commune of Mamou, around 7 p.m.-8 p.m. due to the massive use of electrical energy in households.

There is a significant variation in reactive power demand across the different circuits of the substation. This leads us to recommend the use of compensated fluorescent lamps and appliances with a good power factor.

3.2.3. Power Factor

To get an overview of the voltage profile of the Mamou power supply network, the power factor of the different feeders is shown in Figure 4.

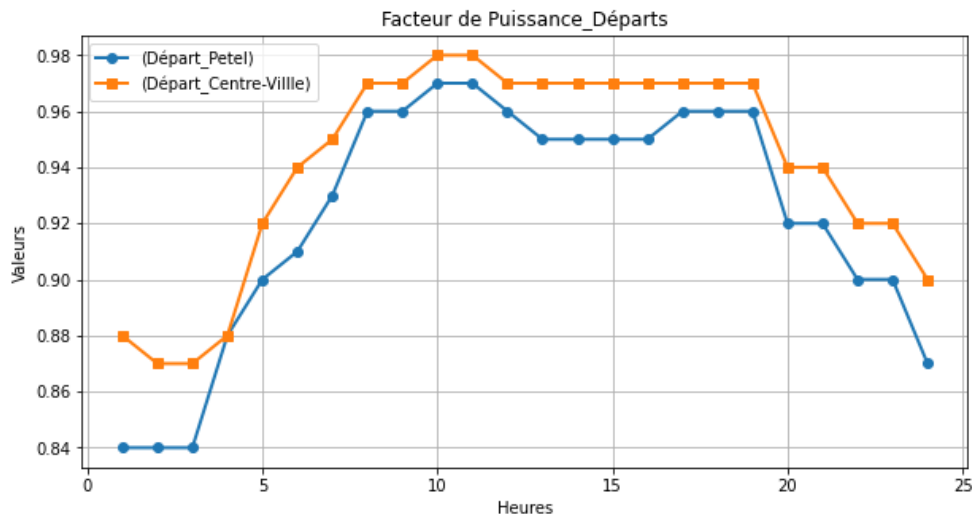


Figure 4. Variation in the power factor of the different feeders in the municipality of Mamou.

Figure show a poor power factor during nighttime hours, this is due to the use for lighting of fluorescent lamps which have a poor power factor (0.48), uncompensated discharge lamps (0.4 to 0.6); the use of induction furnaces with integrated compensation (0.85), resistance welding machines (0.3

to 0.8), single-phase static arc welding stations (0.5).

3.2.4. Currents from the Different Departures of Mamou

The load curve of the different outlets is shown in Figure 5.

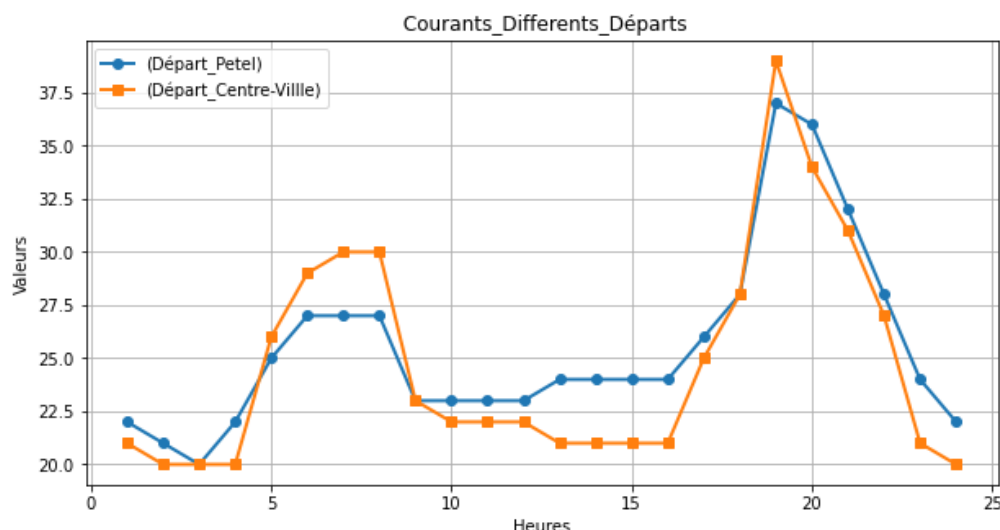


Figure 5. Currents from the different outlets of Mamou.

This figure shows a peak load on the various circuits starting at 5 p.m. The maximum load is observed around 7-8 p.m., due to the massive use of household appliances for cooking, lighting, air conditioning, and other activities [15]. We observe an increase in consumption of approximately 98% during these peak hours.

4. Conclusion

This study analyzed the evolution of key electricity consumption parameters in the city of Mamou between 2020 and 2021, using available production and distribution data. The results highlight significant variations in electricity consumption between the two years, heavily influenced by socio-economic disruptions. The residential sector remains predominant, with load profiles characterized by nighttime peaks, reflecting primarily domestic use.

This study has provided an overview of the evolution of energy consumption in Mamou, both present and future, and has proposed solutions applicable to real-life situations such as: planning the maintenance of electrical systems with minimal impact on consumers; and determining the size of electrical equipment that can support this consumption without risk of overloading the electrical network in Mamou.

Peak-hour electricity demand is approximately 95% of off-peak demand. Analyzing per capita electricity consumption, we observed a positive correlation between income level and electricity consumption.

Energy efficiency should be the primary determinant of long-term electricity consumption, partially offsetting the effects of economic growth, demographics, as well as market share gains and new uses.

Looking ahead, future work could incorporate longer data series, more detailed sectoral analysis and the evaluation of

optimization solutions such as improved metering, strengthening of distribution infrastructure and integration of decentralized renewable energy sources, in order to contribute to more efficient and sustainable energy planning for the city of Mamou.

Abbreviations

EDG Electricity of Guinea

Conflicts of Interest

The authors declare no conflicts of interest.

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