Contribution of the Federal University of Mato Grosso do Sul to Energy Efficiency Through Case Studies in Governmental and Private Institutions

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Abstract—This article analyzes the contribution of the Federal University of Mato Grosso do Sul to the application of energy efficiency in governmental and private institutions through the development of case studies. The adopted methodology is based on measurement campaigns using power quality analyzers, allowing the evaluation of relevant electrical quantities, such as voltage, current, power, and harmonic distortions. The studies cover different types of systems, enabling the identification of operational inefficiencies and opportunities for improvement. The obtained results may indicate the presence of conditions that directly impact energy consumption and power quality, highlighting the potential for loss reduction and optimization of the performance of the analyzed systems. It is concluded that the role of the university, through applied research and technological extension activities, constitutes a relevant agent in the dissemination of energy efficiency practices, with the potential to generate technical, economic, and social benefits.

Index Terms: Case studies; electrical systems; energy efficiency; measurement campaigns.

INTRODUCTION

The concern with energy efficiency in Brazil has grown over the last decades, driven by the need to optimize energy consumption and reduce operational costs in governmental and private institutions. In this context, higher education institutions assume a strategic role in the generation of knowledge and its practical application through research and technological extension activities.

The Federal University of Mato Grosso do Sul has been actively involved in initiatives aimed at energy efficiency, contributing to the analysis and diagnosis of electrical systems in different types of installations. These actions enable the identification of operational inefficiencies and support decision-making processes related to energy management and the optimization of the analyzed systems (Mamede Filho, 2017).

Despite advances in the field, many institutions still operate under conditions that may compromise energy performance and power quality, often due to the lack of detailed technical analyses. In this context, the implementation of measurement campaigns using power quality analyzers becomes essential, as it allows the evaluation of relevant electrical quantities and the identification of problems that are not evident by conventional methods (ANEEL, n.d.).

This article aims to analyze the contribution of the Federal University of Mato Grosso do Sul to the application of energy efficiency in governmental and private institutions through the development of case studies (Yin, 2018). The adopted approach seeks to demonstrate the relevance of the integration between university and society in identifying opportunities for improvement and promoting applied solutions, with the potential to generate technical, economic, and social benefits.

METHODOLOGY

The methodology adopted in this article is based on the execution of measurement campaigns in electrical installations of governmental and private institutions, with the objective of evaluating energy performance and power quality. The measurements are conducted using power quality analyzers, allowing the acquisition of representative data of the real operating conditions of the analyzed systems (UFMS, 2025).

The measurement campaigns are carried out over continuous operating periods, enabling the observation of electrical quantities under different load conditions, as shown in Fig. 1.



Fig. 1. Power quality analyzer installed in the electrical panel during measurement campaign.

The measurement campaigns are carried out over continuous operating periods, enabling the observation of electrical quantities under different load conditions. Among the analyzed quantities, voltage, current, active and reactive power, power factor, and harmonic distortions stand out, as they are fundamental for the characterization of system performance (Mamede Filho, 2017).
The obtained data are treated in a consolidated manner, without exposing sensitive or specific information from the evaluated installations, prioritizing the qualitative and quantitative analysis of the observed phenomena. From this approach, it becomes possible to identify operational patterns, inefficiencies, and conditions that may negatively impact energy consumption and the quality of electrical supply (ANEEL, n.d.).

Based on the measurement results, technical analyses are carried out to identify opportunities for improvement related to energy efficiency and power quality. This stage enables the proposition of general guidelines for optimizing system performance, without requiring detailed descriptions of interventions, maintaining the focus on the applicability of the results, as evidenced in applied studies developed by the university's energy efficiency laboratory (UFMS, 2025).

RESULTS AND DISCUSSION

The results obtained from the measurement campaigns show that the analyzed systems may operate under conditions that directly impact energy performance and power quality. In general, behaviors associated with load variation, the presence of harmonic distortions, and power factor conditions are observed, which may not comply with the limits established by ANEEL through PRODIST, potentially resulting in regulatory penalties (ANEEL, n.d.), as shown in Figs. 2 and 3. However, a detailed harmonic spectrum analysis was not included in this study. Fig. 2 presents the variation of three-phase power over time, while Fig. 3 shows the corresponding power factor behavior during the monitoring period. It can be observed that variations in load demand directly influence the power factor behavior, indicating possible periods of low efficiency associated with reactive power consumption.

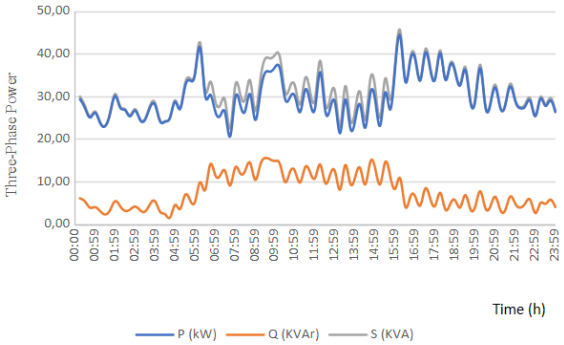


Fig. 2. Three-Phase Power Curves Measured During The Monitoring Period

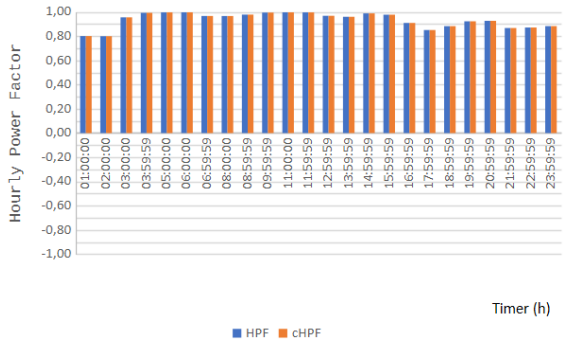


Fig. 3. Power Factor Variation During The Monitoring Period

The consolidated analysis of the data allows the identification of recurring operational patterns, which may be related to specific processes or characteristics of the installed loads. In some cases, indications of operation close to system limits are observed, which may result in increased electrical losses and reduced overall efficiency (Mamede Filho, 2017).
From the perspective of power quality, the presence of harmonic distortions and possible phase imbalances may contribute to increased heating in conductors and equipment, as well as impact the performance of sensitive loads. These phenomena, when not properly monitored, may compromise the reliability and service life of the equipment.

From the obtained results, it is observed that the application of analysis techniques based on real measurements constitutes an effective tool to identify opportunities for improvement, as observed in applied studies (UFMS, 2025). The role of the university, through applied studies, allows not only the diagnosis of operating conditions but also the guidance of actions aimed at optimizing energy consumption and improving power quality.

The results reinforce the importance of the integration between academic knowledge and practical application, showing that measurement campaigns and technical analyses can significantly contribute to energy efficiency in different types of institutions (Yin, 2018). In this context, the relevance of technical-scientific cooperation between universities and public and private organizations stands out, enabling knowledge transfer and the application of solutions in real scenarios.

CONCLUSION

It becomes evident that the application of measurement campaigns associated with the analysis of electrical quantities constitutes an effective tool to evaluate energy performance and power quality in different types of installations. The adopted approach allows the identification of operational conditions that may negatively impact energy consumption and system efficiency, reinforcing the importance of continuous monitoring and specialized technical analysis (Mamede Filho, 2017).

The role of the Federal University of Mato Grosso do Sul demonstrates the strategic importance of higher education institutions in applying technical knowledge to real scenarios, contributing to the identification of opportunities for improvement and the development of energy efficiency solutions (Yin, 2018).

Additionally, it is highlighted that the execution of measurement campaigns using power quality analyzers, although involving operational costs, constitutes a technically grounded approach to identify inefficiencies and reduce energy losses. In this sense, such activities can be understood as part of a system performance optimization process, with potential return associated with efficiency improvement and mitigation of regulatory penalties (ANEEL, n.d.). The integration between universities and organizations, through technical-scientific cooperation, contributes to expanding access to these analyses, favoring the development of more efficient solutions and the dissemination of practices based on real measurements (UFMS, 2025).

It is also emphasized that technical-scientific cooperation enables knowledge transfer and the application of solutions in different contexts, contributing to the development of more efficient systems and the reduction of energy losses.

Finally, it is concluded that the approach based on case studies and real measurements presents potential to be applied in different types of installations, serving as a basis for future analyses and initiatives aimed at improving energy performance and power quality.

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