

Optimization of Household Equipment and Instrumentation in an Effort to Save Electrical Energy in a Restaurant

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Abstract.

The escalating consumption of electrical energy in the residential and micro, small, and medium enterprise (MSME) sectors—particularly within culinary businesses—has emerged as a critical issue requiring immediate attention. Energy generation in Indonesia remains heavily reliant on fossil fuels, such as coal and petroleum, which significantly accelerates carbon emissions and environmental degradation. Restaurants, as prominent entities in the culinary sector, typically exhibit high electricity consumption due to the continuous operation of electronic appliances without structured energy management. This community service initiative aimed to deliver educational intervention and implement simple instrumentation to conserve electrical energy at Raja Bakso Restaurant. The execution methodology encompassed preliminary site surveys, high-load appliance identification, installation of rudimentary monitoring and control devices, energy management workshops, and post-implementation evaluation. The technical interventions included automatic digital timers, temperature sensors, and portable power monitoring meters.

Keywords: Energy efficiency, electricity conservation, instrumentation and community service.

I. INTRODUCTION

Electrical energy represents a vital utility supporting modern societal operations in both residential and commercial sectors. Driven by technological advancements and the ubiquitous deployment of electronic devices, national demand for electricity experiences continuous annual growth [1]. In Indonesia, the primary energy mix remains dominated by fossil fuels: coal-fired power plants account for approximately 60%, petroleum and natural gas contribute 30%, while renewable sources comprise merely 10% of total national demand. Heavy reliance on fossil fuels induces adverse environmental impacts, including greenhouse gas emissions, atmospheric pollution, and accelerated global warming [2].

Beyond residential sectors, micro, small, and medium enterprises (MSMEs) specifically culinary establishments—are substantial contributors to electricity demand. The prolonged, often uninterrupted operation of heavy-load electrical appliances such as refrigerators, deep freezers, commercial rice cookers, exhaust fans, lighting, and air conditioning units escalates daily energy consumption significantly. However, a vast majority of culinary operators lack systematically integrated energy management practices, leading to uncontrolled energy waste.

Raja Bakso Restaurant, selected as the focal subject of this intervention, exemplifies a culinary MSME with high potential for electrical energy optimization. Initial field observations revealed that major electrical equipment operated without scheduled operating timers or periodic energy tracking mechanisms, directly inflating monthly operational costs [3].

Through this community service program, a academic team from the Faculty of Earth Technology and Energy, Universitas Trisakti, conducted educational outreach and implemented low-cost instrumentation to streamline electrical energy management [4]. This initiative aimed to deliver practical, low-barrier operational solutions while cultivating energy conservation awareness. Lowering power consumption yields

dual benefits: reducing operational expenditure and diminishing environmental impact. The potential for energy efficiency improvements remains exceptionally vast in developing economies, though successful execution depends heavily on market readiness and public policy support.

II. METHODOLOGY

This community service program was executed on April 3, 2026, at Raja Bakso Restaurant, located in Ciledug, Tangerang, approximately 16.5 km from Campus A, Universitas Trisakti, Grogol. The implementation utilized a combined approach of technical workshops, hands-on mentoring, and the deployment of accessible energy-saving technology. The location map of the field implementation is presented in Figure 1.

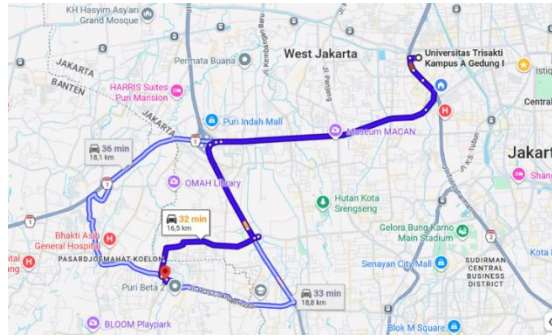


Fig. 1. Location map of the community service program implementation

The community service team from FTKE Universitas Trisakti comprised five faculty members, one administrative staff member, and three undergraduate students, as shown in **Figure 2** and **Figure 3**.



Fig. 2. FTKE Universitas Trisakti Community Service Team



Fig. 3. FTKE Team with Mrs. Nurina, owner of Raja Bakso Restaurant

The program was systematically conducted in five distinct phases:

- The program was systematically conducted in five distinct phases:
- Preliminary Survey:** Execution of baseline electrical load measurements and audit analysis to map energy usage patterns across the facility.
- Appliance Load Profiling:** Identification and categorisation of high-energy-consuming equipment.

- d. **Instrumentation Design and Deployment:** Installation of targeted instrumentation [5], comprising:
 - a. Automatic programmable timers to control operational duty cycles.
 - b. Thermostatic sensors for dynamic cooling regulation.
 - c. Portable plug-in kWh meters for real-time power monitoring.
- e. **Socialization and Training:** Educational sessions delivered to the business owner and operational staff regarding energy management best practices and instrument handling.
- f. **Evaluation and Performance Assessment:** Comparative analysis of energy consumption metrics and power utility expenditures before and post-implementation.

Program Significance

initiative yields multifaceted benefits across stakeholder groups:

- **For Commercial Partners:** Provides practical tools to optimize energy distribution, leading to measurable cost reductions, reduced monthly overhead, and enhanced financial sustainability [6], [7]
- **For Participating Students:** Serves as an experiential learning platform, enabling students to apply theoretical engineering knowledge to real-world community challenges [8].
- **For the General Public:** Promotes public awareness regarding energy stewardship, demonstrating that behavioral and low-cost technological adaptations yield both direct financial benefits and broader ecological conservation [9], [10]

III. RESULT AND DISCUSSION

The implemented program yielded significant quantitative and qualitative improvements in electrical efficiency through accessible instrumentation and structured behavioral modification. **Table 1** details the comparative electrical appliance consumption pre- and post-intervention.

No	Equipment / Appliance	Unit Qty	Baseline Consumption (kWh/month)	Post-Optimization Consumption (kWh/month)
1	Air Conditioners	2 units	600 (10 hrs/day)	350 (6 hrs/day)
2	Lighting Fixtures	6 units	150 (Conventional)	50 (LED)
3	Standby Equipment	4 units	100	50
Total			850	450

As shown in **Table 1**, total monthly electricity consumption decreased substantially. Restructuring the duty cycle of air conditioning units from 10 hours to 6 hours daily, augmented by automated controls, yielded an energy reduction of 400 kWh/month. Overall, this intervention achieved an approximate **47% reduction in energy usage**, translating to operational savings of approximately IDR 600,000 per month.

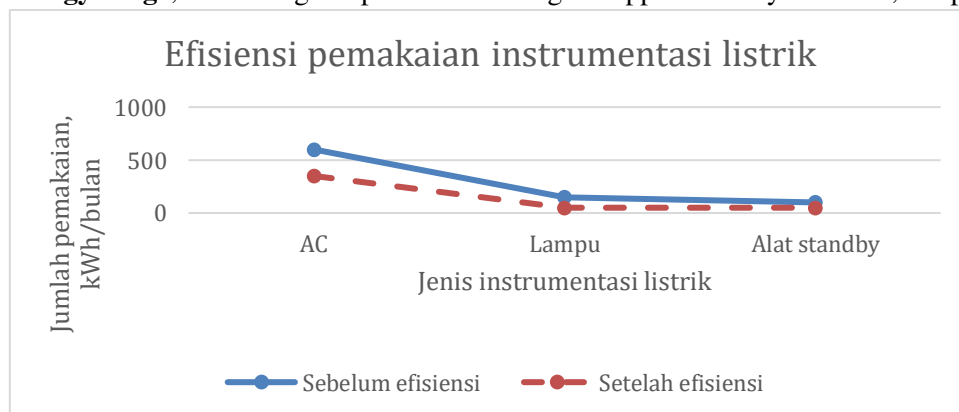


Fig. 4. Comparative electricity consumption efficiency pre- and post-optimization

Transitioning to energy-efficient LED luminaires demonstrated a marked reduction in lighting load while providing optimal illumination (Mas Ahmad Baihaqi et al., 2024). Furthermore, active operational adjustments by site personnel confirmed that user behavior plays a pivotal role in achieving sustainable energy savings [11].

IV. CONCLUSION

Optimizing household-grade appliances and integrating low-cost monitoring instrumentation demonstrated a substantial overall energy consumption reduction of 47%, translating to financial savings of IDR 600,000 monthly for the partner enterprise. Program success relied on both technological intervention and behavioral adaptations among end-users [12]. Overall, this program delivered tangible economic relief through reduced operational overhead while promoting environmental sustainability.

The findings confirm that combining accessible control devices with educational training offers a highly effective, scalable framework for enhancing energy efficiency in small businesses. Broader replication of this framework across adjacent service and commercial sectors is highly recommended to advance regional energy conservation targets.

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