Data Article

Electricity consumption data of a student residence in Southern Africa

S.O. Masebinu\textsuperscript{a,b,}\textsuperscript{*}, J.B. Holm-Nielsen\textsuperscript{b}, C. Mbohwa\textsuperscript{c}, S. Padmanaban\textsuperscript{b}, N. Nwulu\textsuperscript{d}

\textsuperscript{a} Process, Energy and Environmental Technology Station, University of Johannesburg, South Africa
\textsuperscript{b} Center for Bioenergy and Green Engineering, Department of Energy Technology, Aalborg University, Esbjerg, Denmark
\textsuperscript{c} Department of Quality and Operations Management, University of Johannesburg, South Africa
\textsuperscript{d} Electrical and Electronic Engineering Department, University of Johannesburg, South Africa

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\section*{A B S T R A C T}

The time-series dataset presented in this article was captured using a real-time energy monitoring device from a distribution panel of a student residence in Johannesburg, South Africa. The data was captured from April 2016 to January 2018. The data from the three conductors supplying the student residence with electricity was automatically aggregated and presented as a single data point. The granularity was at resolution levels of watt-minute and kilowatt-hour. A total of 13,966 hrs of data points was captured. The data has not been processed further. Hence, data consists of 1,209-hour of missing data points. In addition to the energy consumption data, 16 months of hourly data for wind speed, temperature and humidity of the closest weather station has been provided. The data will be useful in the formulation of mathematical models of electricity consumption that is most suitable for a student residence. Furthermore, the data provided in this article will encourage the development of a data-driven electricity consumption management strategy and policy formulation for student residences.

\textsuperscript{*} Corresponding author. S.O. Masebinu.
E-mail address: smasebinu@uj.ac.za (S.O. Masebinu).

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Value of the Data

- The real-time data provided in this article will aid the development of mathematical models suitable for a student residence electricity consumption profile [1].
- The real-time data provided in this article is useful in the development of energy management strategies and for the design, sizing, modelling, and simulation of alternative energy systems for a student residence [2,3].
- The real-time data provided in this article can be useful in studying response behaviour of alternative sources of energy in response to a case of load-shedding or an abrupt disruption in the supply of grid electricity [3].
- The real-time data provided in this article is useful to researchers and teachers on data science related to electricity consumption data [4].
- The environmental data provided can be used as an independent variable in modelling the electricity consumption of a typical student residence.

1. Data description

The real-time electricity consumption data for a student residence in Auckland Park, Johannesburg, South Africa is presented [5]. The student residence is occupied by students of the University of Johannesburg. The student residence consists of 17 rooms (inclusive of a kitchen and a washing bay) and 4 toilets and bathrooms. An asset assessment of the student residence is summarised in Table 1. The electrical energy consumption data presented, was gathered using a real-time energy monitor. An Efergy Engage app was used to visualise the data and download the data directly from a cloud server as a .csv file. The data consists of watt-minute and watt-hour energy consumption from April 2016 to January 2018. A total of 13,966 hrs of data points...
The table provides the list and counts of electrical appliances at the student residence. The power rating of each appliance differs, hence, a power range for similar appliances has been provided based on an energy audit conducted at the residence. Approximated energy consumption of the electrical appliances has been provided. The aggregated energy consumption of the residence was captured using the energy monitor.

**Table 1**

| Individual room Appliances | Counts | Power range (W) | Avg. kWh/day |
|----------------------------|--------|-----------------|--------------|
| Refrigerator               | 10     | 90–120 W        | 9.90 – 13.20 |
| Microwave                  | 13     | 1200 – 1300 W   | 1.82 – 1.97  |
| Flat iron                  | 15     | 2200 - 2400     | 3.30 – 3.60  |
| Laptop                     | 15     | 45 – 90 W       | 2.70 – 5.40  |
| Bread Toaster              | 5      | 750 W           | 0.31         |
| Sound system               | 8      | 150 – 280       | 0.60 – 1.12  |
| CFL Lightings              | 17     | 10 – 30 W       | 1.36 – 4.08  |
| TV                         | 5      | 220 W           | 2.20         |
| Fan                        | 4      | 50 W            | 0.20         |
| Phone charger              | 15     | 5 – 10 W        | 0.04 – 0.08  |
| Kettle                     | 13     | 1850 - 2000 W   | 4.01 – 4.33  |
| 2-plate electric cooker    | 2      | 1850 W          | 1.85         |
| Electric heater            | 15     | 400 – 1200 W    | 18.00 – 54.00|
| 4-plate electric stove     | 2      | 2200 W          | 22.00        |
| Washing machine            | 1      | 600 W           | 1.20         |
| Refrigerator               | 1      | 120 W           | 1.32         |
| Double Florescent lightings| 7      | N/A             | 3.36         |
| CFL Lightings              | 8      | 10–25 W         | 0.56 – 1.40  |
| Geyser                     | 2      | 3000 W          | 18.00        |

The data also contains 1,209-hour points of missing data. Two factors contributed to the missing data, namely scheduled load shedding from the utility company providing electricity to the area [6,7] and the exhaustion of internet data for router connectivity. The data has not been statistically analysed for any inference. However, average energy consumption per day of the appliances has been provided considering the variation of usage. In **Table 1**, the electric heaters are mostly used only during the austral winter season (June, July and August). Aside, the austral winter season, the heaters are only used on a few occasion of cold fronts typically experienced in South Africa.

The file naming convention for the energy data is monthyear_time, as shown in **Fig. 1**. For example, April16_m represents data collected for April 2016 with energy consumption presented in watt-minute, as shown in **Table 2A**. April16_h represents data collected for April 2016 with the energy consumption presented in kilowatt-hour, as shown in **Table 2B**. April16_d represents...
data collected in April 2016 with the aggregated energy consumption for each day of the month in kilowatt-hour, as shown in Table 2C. Therefore, April16_d will contain daily energy consumption data for each day of the month. Environmental data for ambient temperature, wind speed and humidity has also been provided. A sample for a ten-day data points over a 12-hour period is shown in Table 3.

2. Experimental design, materials and methods

The energy monitor consists of three equipment, as shown in Fig. 3, namely a current transformer (CT) scanner (12–19 mm conductor diameter, nominal current of 90–120 A for the 12 mm CT and 120–200 A for the 19 mm CT), a transmitter with 70 m radius operating range, and a receiver (wireless frequency 433.5 MHz, a measurement range of 50 mA to 120 A per phase and a voltage range of 110–300 VAC) [8]. Table 4 summaries the technical specification of the energy monitor system. The layout of the energy monitoring system is presented in Fig. 2. Three current transformers were attached to the conductor wires supplying the student residence with electricity, as shown in Fig. 4. The current transformers were connected to a single data transmitting hub. The student residence uses a single load point distribution board; therefore, all electricity consumption of the residence was distributed across the three conductors with a CT scanner. The receiver unit collects the data automatically from the transmitting hub and uploads to the cloud through a router, as shown in Fig. 5. From the cloud system, the data can be remotely accessed
**Fig. 2.** Schematic diagram for the layout of the energy monitoring system
The figure descriptively explains how the energy monitoring system was connected and how data was exchanged.

**Fig. 3.** Energy monitoring kits
The figure shows the data capturing device which include three current transformers, a transmitting hub, and a receiving hub. The device was manufactured by Efergy.
Table 4
Technical specification of the energy monitoring system.

| Components                        | Current Transformer | Transmitter | Receiver |
|-----------------------------------|---------------------|-------------|----------|
| Conductor diameter                | 12 – 19 mm          |             |          |
| Nominal Current                   | 90–120 A (12 mm)    | 120–200 A (19 mm) |          |
| Voltage                           | 110–300 VAC         |             | 5 VDC    |
| Frequency                         | 60 Hz               |             |          |
| Transmitter Operating Range       | 40 - 70 m           |             |          |
| Transmission/receiver time        | 12 s                | 12 s        |          |
| Wireless Frequency                | 433.5 MHz           |             |          |
| Measurement range per phase       | 50 mA – 120 A       |             |          |
| Measurement accuracy              | >90%                 |             |          |

The table provides the specification and operating range of the energy monitor.

Fig. 4. CT scanners and transmitter
The figure shows the experimental set-up at the student residence.

Fig. 5. Energy consumption data receiver and uploading to cloud system
The figure shows the data receiver and the internet route. The internet route enables the transfer of captured energy consumption data to the cloud.
through a web browser, as shown in Fig. 6 or via an app on a smartphone or tablet. At the end of installation and synchronisation, an accuracy test was conducted. The test involves switching off known loads in Table 1 and the reduction in the captured real-time data was concurrent to the power demand of the respective appliances. The online monitoring interface as presented in Fig. 6, shows the real-time power demand of the entire residence, it provides historical power demand profile as well as historical electrical energy consumption. The electricity consumption data can be aggregated as per minute, hour, day, and month. The electricity consumption data was downloaded as a .csv file.

The environmental data was obtained from the closest weather station, Johannesburg Botanical Garden, operated by the South African Weather Service. The weather station is referenced with a climate number of 04758790 at a coordinate of −26.1560, 27.9990 (latitude, longitude) and at a height of 1,624 m above sea level. The botanical garden is approximately 4 km away from the student residence. Details of the environmental data capturing system were not provided.

**Declaration of Competing Interest**

The authors declare that they have no known competing financial interest or personal relationship which have, or could be perceived to have, influenced the data reported in this work.

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**Supplementary materials**

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.dib.2020.106150.

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