Data Article

Data supporting the improvement of forecasting and control of electricity consumption in hotels

José Cabello Eras a,*, Vladimir Sousa Santos a, Alexis Sagastume Gutierrez a, Carlo Vandecasteele b

a Universidad de la Costa, Calle 50 No 55-66, PBX 336 22 00, Calle 58 # 55 e 66, Atlántico, Barranquilla, Colombia
b Department of Chemical Engineering, University of Leuven, de Croylaan 46, B-3001 Heverlee, Belgium

ARTICLE INFO

Article history:
Received 4 April 2019
Received in revised form 8 May 2019
Accepted 4 June 2019
Available online 12 June 2019

Keywords:
Energy management
Buildings energy efficiency
Electricity consumption

ABSTRACT

Improving and managing the electricity efficiency in hotel facilities is essential to reduce the hotel operation costs and its environmental impacts. The data presented shows the evolution of the electricity consumption and management between 2013 and 2015 in two hotel facilities in Cuba (one beach hotel and one city hotel). The data additionally includes the daily measures used to develop control tools for an energy management system. The data presented in the article relates to the research study: Tools to improve forecasting and control of the electricity consumption in hotels Cabello et al., 2016, and it corresponds to the energy audits developed in one beach hotel (Hotel A) and one city hotel (Hotel B) in Cuba.

© 2019 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

1. Data

The data includes the occupied rooms per day (ORD), the outdoor temperature and the electricity consumption on daily and on monthly basis. It additionally includes the parameters calculated and

* Corresponding author.
E-mail address: jcabello2@cuc.edu.co (J.C. Eras).

https://doi.org/10.1016/j.dib.2019.104147
2352-3409/© 2019 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).
used to develop the electricity management of the hotel facilities (i.e. room degree-day (RDD), energy performance indicators (EnPI), energy baselines (EnB) and control graphics), to forecast and control the electricity consumption in hotels A and B, by highlighting their main sources of inefficiencies. Originally, the dataset [1] considered data from 2011 to 2012 to develop the EnBs and EnPIs used. This data was updated up to 2015 to show the evolution of the electricity management system and the control tools over time.

Fig. 1 and Fig. 2 show the average electricity consumption of the different areas for hotels A (Fig. 1) and B (Fig. 2). Moreover, Fig. 3 and Fig. 4 show the electricity consumption between 2011 and 2014 for both hotels, and additionally show the Energy Performance Indicators (EnPI) developed for hotels A and B. Furthermore, the daily control graphs, developed for each month based on the daily electricity consumption measured in each hotel are shown in Fig. 5 and Fig. 6. Finally, Fig. 7 shows a scatter analysis between the measured and the forecasted electricity consumption in hotels A and B. In addition, Table 1 shows the monthly electricity consumption measured between January 2011 and December 2014 and the reference parameters calculated based on the measurements. Moreover, Table 2 shows the monthly electricity consumption measured during 2015 and the reference parameters calculated based on the measurements. The data used to develop Figs. 1–6 is available in the article.

2. Experimental design, materials, and methods

The monthly electricity consumption was taken from the electric bills of each hotel, while the daily consumption was taken from the mandatorily measures take every day at 7 a.m. in the electric meter of every hotel by the maintenance staff, as requested by the Cuban Ministry of Tourism to keep track of the electricity consumption of the tourist sector. Other data (e.g. occupied rooms per days, occupied rooms per month, etc.), was taken from each hotel records.

The electricity consumption per areas used to identify the main electricity uses (as depicted in Figs. 1 and 2), was measured with two IP power meter of four channels to measure 4 areas simultaneously.
Fig. 1. Pareto of the electricity consumption by areas (Hotel A). * Kitchen and restaurant, ** Outdoor lighting, † Shops and dance club, ‡ Beach snack bar.

Fig. 2. Pareto of the electricity consumption by areas (Hotel B). * Kitchen and restaurant, ** Outdoor lighting, † Shops and dance club.

Fig. 3. Monthly EnPl and control graphics (Hotel A).
Fig. 4. Monthly EnPI and control graphics (Hotel B).

Fig. 5. Daily control graphs (Hotel A).
Fig. 6. Daily control graphs. Hotel B.

Fig. 7. Scatter analysis of the measured and forecasted electricity consumption on monthly basis (2015).
with each one. Additionally, a power quality and energy analyzer Fluke 435 series 6 was used. Moreover, the electricity consumption of the hotel was directly taken from the hotel electric meter. The areas on each hotel were measured during one month, Figs. 1 and 2 shows the average values.

Similar to Ganguly [4], the climatic year (i.e. a continuous 12-month period with a complete annual cycle), developed using 30 years of daily temperature data [5], available in the Weather Underground Database [6], was used to forecast the daily outdoor temperature.

### Table 1
Monthly data and reference parameters calculated (January 2011–December 2014).

| Month | Hotel A | | | | Hotel B | | | |
|-------|---------|---|---|---|---------|---|---|---|
| Electricity | 5,798 | 5,678,256 | 55,990 | 1,294 | 176,015 |
| Month | 5,247 | 640,055 | 49,887 | 1,292 | 157,605 |
| | 5,544 | 831,600 | 61,064 | 1,404 | 210,600 |
| | 3,970 | 877,370 | 68,912 | 1,357 | 299,897 |
| | 2,860 | 742,170 | 63,896 | 940 | 243,930 |
| | 3,088 | 883,168 | 60,154 | 644 | 184,184 |
| | 2,773 | 837,466 | 68,000 | 963 | 290,826 |
| | 3,267 | 1,007,870 | 67,996 | 948 | 292,458 |
| Sep-2011 | 1,970 | 556,525 | 59,959 | 530 | 149,725 |
| Oct-2011 | 2,220 | 580,530 | 64,738 | 1,002 | 262,023 |
| Nov-2011 | 3,262 | 606,732 | 63,982 | 1,363 | 253,518 |
| Dec-2011 | 2,987 | 492,855 | 61,124 | 1,158 | 191,070 |
| Jan-2012 | 5,788 | 784,274 | 59,868 | 1,385 | 187,532 |
| Feb-2012 | 6,190 | 755,087 | 57,778 | 1,344 | 163,948 |
| Mar-2012 | 6,358 | 953,700 | 60,949 | 1,397 | 209,550 |
| Apr-2012 | 5,129 | 1,133,509 | 63,225 | 1,311 | 289,731 |
| May-2012 | 3,860 | 1,001,670 | 64,899 | 1,210 | 313,995 |
| Jun-2012 | 3,910 | 1,118,260 | 72,670 | 891 | 254,826 |
| Jul-2012 | 3,524 | 1,087,154 | 73,937 | 1,043 | 321,766 |
| Aug-2012 | 2,866 | 815,205 | 58,759 | 672 | 189,640 |
| Sep-2012 | 3,196 | 835,754 | 60,804 | 1,023 | 267,515 |
| Oct-2012 | 5,584 | 1,038,628 | 56,876 | 1,200 | 223,200 |
| Nov-2012 | 3,759 | 620,235 | 54,006 | 1,118 | 184,470 |
| Dec-2012 | 5,323 | 637,760 | 60,786 | 1,304 | 209,944 |
| Jan-2013 | 5,461 | 660,781 | 55,705 | 1,224 | 149,310 |
| Feb-2013 | 5,430 | 814,500 | 60,141 | 1,387 | 147,203 |
| Mar-2013 | 5,401 | 1,003,018 | 65,085 | 1,260 | 278,460 |
| Apr-2013 | 5,430 | 602,300 | 64,705 | 1,046 | 275,098 |
| May-2013 | 5,401 | 1,118,260 | 72,670 | 891 | 254,826 |
| Jun-2013 | 5,461 | 660,781 | 55,705 | 1,224 | 149,310 |
| Jul-2013 | 5,430 | 814,500 | 60,141 | 1,387 | 147,203 |
| Aug-2013 | 5,401 | 1,003,018 | 65,085 | 1,260 | 278,460 |
| Sep-2013 | 5,401 | 602,300 | 64,705 | 1,046 | 275,098 |
| Oct-2013 | 5,430 | 814,500 | 60,141 | 1,387 | 147,203 |
| Nov-2013 | 5,401 | 1,003,018 | 65,085 | 1,260 | 278,460 |
| Dec-2013 | 5,430 | 814,500 | 60,141 | 1,387 | 147,203 |
| Jan-2014 | 5,401 | 1,003,018 | 65,085 | 1,260 | 278,460 |
| Feb-2014 | 5,430 | 814,500 | 60,141 | 1,387 | 147,203 |
| Mar-2014 | 5,401 | 1,003,018 | 65,085 | 1,260 | 278,460 |
| Apr-2014 | 5,430 | 814,500 | 60,141 | 1,387 | 147,203 |
| May-2014 | 5,401 | 1,003,018 | 65,085 | 1,260 | 278,460 |
| Jun-2014 | 5,430 | 814,500 | 60,141 | 1,387 | 147,203 |
| Jul-2014 | 5,401 | 1,003,018 | 65,085 | 1,260 | 278,460 |
| Aug-2014 | 5,430 | 814,500 | 60,141 | 1,387 | 147,203 |
| Sep-2014 | 5,401 | 1,003,018 | 65,085 | 1,260 | 278,460 |
| Oct-2014 | 5,430 | 814,500 | 60,141 | 1,387 | 147,203 |
| Nov-2014 | 5,401 | 1,003,018 | 65,085 | 1,260 | 278,460 |
| Dec-2014 | 5,430 | 814,500 | 60,141 | 1,387 | 147,203 |
The Room Degree Day (RDD) is calculated as:

$$ \text{RDD} = \text{ORD} - \text{CDD} $$

where CDD stands for Cooling Degree Day, which is calculated as [7]:

$$ \text{CDD} = \sum (\text{\(\varphi_0\)} - \text{\(\varphi_b\)}) $$

where \(\varphi_0\) is the outdoor temperature, and \(\varphi_b\) is the reference temperature (maximum outdoor temperature at which no cooling is required to maintain the thermal comfort in a building). The reference temperature must be individually determined for each building [7].

The monthly electricity consumption was forecasted during 2013 and 2014 using the correlation between the electricity consumption and the RDD for hotels A (equation (3)) and B (equation (4)), originally with data from 2011 to 2012:

$$ E = 6.47 \cdot 10^{-5} \cdot \text{RDD} + 40.262 $$

$$ E = 8.69 \cdot 10^{-5} \cdot \text{RDD} + 41.856 $$

Figs. 3 and 4 show the monthly EnBs used during 2013 and 2014, based on data from 2011 to 2012, which was updated in 2015 using data from 2013 to 2014. Additionally, Figs. 3 and 4 show the EnPl control graphs for hotels A and B on monthly basis. Moreover, Figs. 5 and 6 show the daily control graphs used for each month in hotels A and B. Finally, Fig. 7 shows a scatter analysis between the measured and forecasted electricity consumption in hotels A and B.

Equations (3) and (4) were updated including data from 2013 to 2014 to forecast and manage the consumption during 2015:

$$ E = 6 \cdot 10^{-5} \cdot \text{RDD} + 40.756 $$

$$ E = 6 \cdot 10^{-5} \cdot \text{RDD} + 48.302 $$

Table 2

| Month | Hotel A | | Hotel B | |
|-------|---------|---|---------|---|
| | ORD | CDD | RDD | ECM* | ECF** | | ORD | CDD | RDD | ECM* | ECF** |
| Jan | 5,323 | 120 | 638,760 | 83.802 | 79.082 | 1,304 | 161 | 209,944 | 56.625 | 60.899 |
| Feb | 5,461 | 121 | 660,781 | 76.383 | 80.403 | 1,224 | 122 | 149,310 | 56.221 | 57.262 |
| Mar | 5,430 | 150 | 814,500 | 85.512 | 89.626 | 1,387 | 147 | 203,889 | 61.528 | 60.535 |
| Apr | 4,601 | 218 | 1,003,018 | 99.338 | 100.937 | 1,260 | 221 | 278,460 | 62.950 | 65.010 |
| May | 2,321 | 260 | 602,300 | 69.875 | 76.964 | 1,046 | 263 | 275,098 | 68.790 | 64.808 |
| Jun | 2,733 | 282 | 770,706 | 84.897 | 86.998 | 716 | 286 | 204,776 | 61.598 | 60.589 |
| Jul | 1,901 | 302 | 574,102 | 73.197 | 75.202 | 1,087 | 301 | 327,187 | 71.760 | 67.933 |
| Aug | 1,727 | 306 | 528,462 | 67.432 | 72.464 | 986 | 309 | 304,181 | 68.512 | 66.582 |
| Sep | 1,843 | 283 | 520,648 | 69.408 | 72.050 | 479 | 280 | 134,120 | 54.262 | 56.349 |
| Oct | 2,137 | 264 | 564,168 | 69.565 | 74.606 | 863 | 262 | 225,675 | 62.866 | 61.868 |
| Nov | 4,616 | 186 | 858,576 | 83.424 | 92.271 | 1,256 | 189 | 237,384 | 60.559 | 62.545 |
| Dec | 3,512 | 162 | 568,944 | 77.189 | 74.893 | 1,096 | 165 | 180,840 | 61.152 | 59.152 |

*ECM – electricity consumption measured; **ECF – electricity consumption forecasted
Table 1 shows the monthly electricity consumption and the reference parameters between January 2011 and December 2014, while Table 2 shows the same data measured and calculated during 2015, when the updated control tools, depicted in figures Figs. 3—6 were implemented. Additionally, Table 2 includes the electricity consumption forecasted with the updated EnPI and the monthly reference parameters during 2015.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.104147.

References

[1] J. Cabello, V. Sousa, A. Sagastume, M. Alvarez-Guerra, D. Haeseldonckx, C. Vandecasteele, Tools to improve forecasting and control of the electricity consumption in hotels, J. Clean. Prod. 137 (2016) 803–812.
[4] W. Underground, Weather Underground, Available online, 2019 (03.04.2019), http://www.wunderground.com.
[5] G. Krese, M. Prek, V. Butala, Analysis of building electric energy consumption data using an improved cooling degree-day method, J. Mech. Eng. 58 (2012) 107–114, 2012.
[6] A. Sagastume, J.J. Cabello, D. Huisingh, C. Vandecasteele, L. Hens, The current potential of low-carbon economy and biomass-based electricity in Cuba. The case of sugarcane, energy cane and marabu (Dichrostachys cinerea) as biomass sources, J. Clean. Prod. 172 (2018) 2108–2122.
[7] J. Cabello, D. Garcia, A. Sagastume, R. Priego, L. Hens, C. Vandecasteele, An approach to sustainable development: the case of Cuba. Environment, Dev. Sustain. 14 (2012) 573–591.