Articles

Energy management system in compliance with ISO 50001:2018, energy efficiency assessment in a textile industry

Sistema de gestión energética en conformidad con la norma ISO 50001:2018, evaluación de eficiencia energética en una industria textil

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REVISTA TECNOLÓGICA
ciencia y educación
Edwards Deming

ISSN: 2600-5867

Edited by: Tecnológico Superior Corporativo Edwards Deming
January - March Vol. 6 - 1 - 2023
https://revista-edwardsdeming.com/index.php/es
e-ISSN: 2576-0971
Received: May 22, 2022
Approved: December 23, 2022
Page 44-55

ABSTRACT

It is essential for the productivity of companies to take care of their resources and optimize both environmental and economic aspects for their long-term profitability; in the industrial sector of Ecuador, the textile industry has a great productive impact, which is why this research has investigated its energy efficiency. The recent update of the ISO 5001:2018 standard, allows to set the focus on an energy management system based on continuous improvement, which allows changing not only business realities, but also environmental. This work addresses the analysis of the energy baseline of a textile company, which indicates that there is no adequate correlation between energy consumption and production. This study demonstrates the benefit of implementing an energy management system based on ISO 50001: 2018.

Keywords: energy efficiency, energy management systems, energy in the industrial sector, ISO 5001:2018 standard.

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RESUMEN

Es primordial para la productividad de las empresas cuidar sus recursos y optimizar aspectos tanto ambientales como económicos para su rentabilidad a largo plazo; en el sector industrial de Ecuador, la industria textil tiene un gran impacto productivo, es por eso que en esta investigación se ha indagado en la eficiencia energética de la misma. La reciente actualización de la norma ISO 5001:2018, permite fijar la atención en un sistema de gestión energética basado en la mejora continua, que permita cambiar realidades no solo empresariales, sino también ambientales. Este trabajo aborda el análisis de la línea de base energética de una empresa textil, el cual indica que no existe una adecuada correlación entre el consumo energético y la producción. Este estudio demuestra el beneficio de la implementación de un sistema de gestión energético basa en la norma ISO 50001: 2018.

Palabras clave: eficiencia energética, sistemas de gestión energética, energía en el sector industrial, norma ISO 5001:2018

INTRODUCTION

The energy crisis constitutes one of the most relevant current problems worldwide, which is why several researches have been developed around this issue.(Díaz Méndez & Varón Buenaventura, 2019). The United Nations Organization (UN), in 2015 proposed the Sustainable Development Goals, whose objective focused on the energy sector and its sustainability, encouraging the massive consumption of clean energy, in addition to promoting the social responsibility of people in energy consumption in cities and communities. (Mendoza et al., 2015). In the productive and economic field within the industrial field, it has been shown that the implementation of an energy management system reduces energy billing costs by up to 25%, in a period of time of approximately 1 to 3 years. (Sevilleja Aceituno & Soto Martos, 2011).

This work focuses on the use of an energy management system in accordance with the ISO 50001 standard, which is based on the continuous improvement of energy performance. (Buritica Macias et al., 2021). Several companies worldwide have established its implementation, as is the example of the United States with the Superior Energy Performance (SEP) program, this program in relation to ISO 50001, use relevant data such as energy measurements to perform the calculation of energy performance.(Carretero Peña & García Sanchez, 2015)..

Another example is Chile, which in recent years has transformed its energy consumption with the introduction of renewable energy sources, becoming the third in South America in investing in this type of energy in the last 10 years, with an approximate investment of $14,000. (Pastén, 2012) It is for this reason that it is of great importance to guarantee the

reliability and stability of these systems, considering the energy supply and demand that depends on renewable natural resources. (Gómez Rodriguez & Chou Rodriguez, 2019)..
In national spheres, the National Energy Balance (BEN), carried out in Ecuador in 2019, states that the consumption of electric energy per person has increased by 39.4% since 2009, and despite that, one of the main energy sources was also oil.(Ministry of Energy and Non-Renewable Natural Resources, 2019). The year 2019 statistical data was obtained that showed that electricity and diesel were the most consumed sources in the public and commercial sector. (Ludeña & Wilk, 2013)..
The ISO 50001 standard, since its entry into force, has been rapidly implemented in the production processes of the business sector, however, sometimes this implementation has been conditioned by difficulties in the energy baseline and its proper delimitation.(Bravo Hidalgo & Martinez Perez, 2017) This standard has had several modifications, the last one was made in 2018 and aims to improve energy efficiency, and energy use and consumption. (International Organization for Standardization, 2018)
Therefore, the ISO 50001:2018 standard focuses on performance improvement, in order to obtain improvements in its long-term indicators, such as the energy baseline. (International Organization for Standardization, 2018) In the industrial sector there are a large number of organizations with high energy consumption, so ISO 50001:2018 is an ideal option for the implementation of an energy management system, because this promotes environmental responsibility and improvement of the working environment, where all levels of the organization are involved, led by senior management because its implementation involves the acquisition of optimal and adequate equipment and protocols that use energy for its operation. (Andrade Zambano & Lucia, 2021)(Gamaso López, 2018)
The energy baseline (EBC) is a measurable representation of the ideal consumption. This energy baseline is calculated using mathematical methods that result in an approximation of the energy values that should be used to produce certain elements, these calculations can be performed before and after improvements have been implemented.(Lara Izaguirre et al., 2019). It can be calculated with the use of both linear and nonlinear regressions, after the analysis of the straight line, the Pearson correlation coefficient is obtained in an easier way, which indicates the variation of the two variables that means the energy that is consumed during production. (Jiménez Jiménez, Diego David; Potes Valencia, 2022)
With this background, this article is based on the implementation of an energy management system in a textile industry, in compliance with the ISO 50001 standard as modified in 2018, and analyzes the adequacy of its energy baseline.

MATERIALS AND METHODS

The present study was conducted through literature analysis of research related to energy management systems based on the ISO 50001 standard of the year 2018 and its energy efficiency, in addition to the analysis of data from a textile company.
Several types of research were used, including documentary research, which was necessary to obtain information related to energy efficiency, obtained from various databases such as Google Scholar, and using keywords for searching, such as: energy

Articles
Revista tecnológica ciencia y educación Edwards Deming
ISSN: 2600-5867

efficiency, energy management systems, energy in the industrial sector, ISO 5001:2018; the selected articles were examined in their summary to be subsequently selected for further study. Articles were collected without language distinction and in a publication period ranging from 10 years old, in addition, implementation guides, and national and international regulations were obtained.

The field research methodology was used to obtain the invoices of energy consumption and expenses used in the textile company under investigation; through the analysis of the invoices and a Fluke 43 type network analyzer, the results regarding electric energy were identified.

The descriptive research was necessary for the determination of the existing problems in the electrical condition of the company, which affect the energy efficiency of the company.

The inductive-deductive method was used to identify the equipment, processes and tools used by the textile company to determine the respective energy efficiency indicators, and in turn highlight the aspects that require improvement to reduce energy consumption at the same level of production.

Based on the synthetic analytical method, the information collected in the initial phase was integrated with the measurement of the corresponding electrical parameters, in order to determine the current energy status of the company.

Using the statistical method, the results of the initial analysis of the company's energy management system and its energy baseline were tabulated, and the non-representative energies were discriminated with the Pareto diagram.

In order to obtain the company's electrical parameters, the company's facilities were observed, checking its electrical system, equipment, electrical protections and lighting.

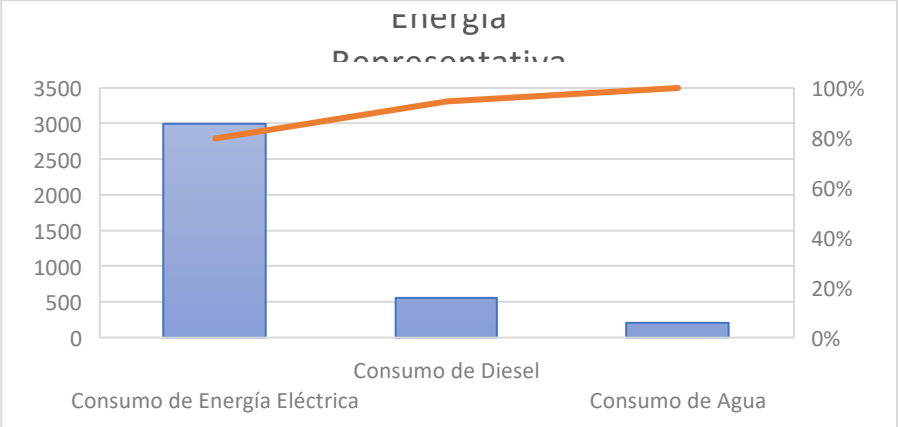
The measurement was another important step to obtain the electrical parameters and was performed with the Fluke 345 equipment, by means of which important current unbalances were determined, which require attention and improvement.

The calculation of the low power factor penalty was also performed, as well as the energy baseline calculated with the energy consumption in relation to production.

RESULTS

In a recount of all the company's consumption over a period of 1 year (July 2021 - July 2022), it was obtained that water consumption is $201.15, equivalent to 5%; electricity consumption is $2998.91, equivalent to 80% and diesel consumption is 558.33, which corresponds to 15%. Electric energy is the most representative according to its consumption, which covers 80% of the total energy consumed and paid in the company. For this reason, this article focuses on electric energy. It is explained in the following Pareto diagram.

Illustration 1 Pareto diagram of the types of energy used.



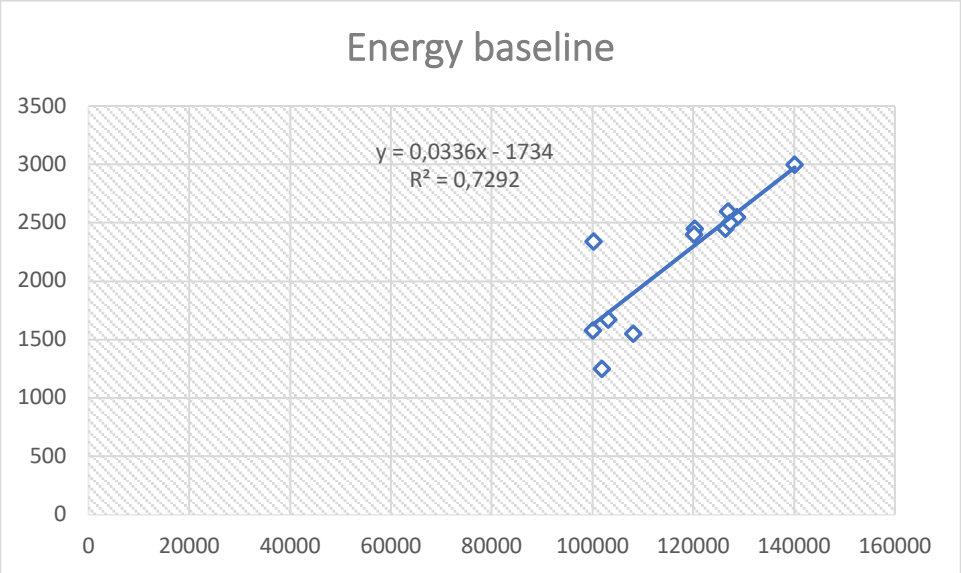
Source: Authors, 2022

Energy management system focused on consumption

ISO 5001:2018, seeks in its strategy, that companies improve their energy management by taking advantage of opportunities based on their characteristics and production processes. During the design of the energy management system, the different energy sources that are used and the impact that each of them has on the organization are analyzed. In this company, electricity has been identified as the main source, so the management system based on this standard is based on its economic and environmental impact and benefit.

To obtain this data, a study was made of electricity consumption in relation to production for the last year, which runs from July 2021 to July 2022. These data were obtained from monthly invoices and production of historical records. Where it was determined that in this energy baseline the R2 is 0.72, which explains that there is not an adequate correlation with the minimum value which is 0.9. The objective of implementing an energy management system based on ISO 50001:2018 is to improve energy efficiency and this would be reflected in the energy baseline.

Illustration 2: Energy base diagram



Source: Authors, 2022

DISCUSSION

The analysis and calculations showed that the most significant consumption in the company is electrical energy, leading to a future study and implementation of a management system that implements improvements in energy efficiency. The quantification of energy consumption in the company allowed determining the energy baseline that indicates an R^2 of 0.792, which explains that there is a low correlation when taking into account the minimum value of $R^{2,}$ which is 0.9 to be considered within the normal range; the reliability of the data is 95%.

It can finally be stated that the improvements in energy consumption are attributable to the modification of organizational awareness, which integrates and implements an energy management system aimed at consumption with greater responsibility and control, such as one based on the ISO 50001:2018 standard, because that is its primary objective.

REFERENCES

Andrade Zambano, E. E., & Lucía, R. P. G. (2021). SMEs and energy efficiency with ISO 50001. *Polo Del Conocimiento*, *6*(6), 674-694. https://doi.org/10.23857/pc.v6i6.2777. https://doi.org/10.23857/pc.v6i6.2777

Bravo Hidalgo, D., & Martinez Perez, Y. (2017). Energy efficiency, business competitiveness and green economy. *Publishing*, *3*(9), 447-466. https://revistapublicando.org/revista/index.php/crv/article/view/343

Buritica Macias, A. M., López Quintero, J. G., & Buriticá Noreña, C. A. (2021). ISO 50001

Energy management system 2018. Implementation guide. *Scientia et Technica*, *26*(2), 178-181. https://doi.org/https://doi.org/10.22517/23447214.22761.

Carretero Peña, A., & García Sanchez, J. M. (2015). Energy efficiency management: indicators and improvement. In AENOR (Ed.), *Spanish Association for Standardization and Certification.* https://www.aenor.com/normas-y-libros/buscar-libros/detalle?c=9451

Díaz Méndez, E. G., & Varón Buenaventura, E. S. (2019). Literature review of the implementation of ISO 50001, energy efficiency in entities and organizations. *Universidad Santo Tomás*, *4*(1), 88-100.

Gamaso López, A. (2018). *Energy Efficiency Measures in the Chemical Industry* [University of Seville]. https://ingemecanica.com/tutorialsemanal/objetos/tutorial24.pdf

Gómez Rodriguez, V. G., & Chou Rodriguez, R. (2019). Ecuador De Cara a La Sustentabilidad En El Siglo Xxi: Ley De Eficiencia Energética. *Identidad Bolivariana*, *3*(1), 1-8. https://doi.org/10.37611/ib3o111-8

Jiménez Jiménez, Diego David; Potes Valencia, P. W. (2022). *Evaluation of energy efficiency to improve IDEn performance indicators in the farm "La Cordillera" belonging to Mejia Canton, Province of Pichincha*.

Lara Izaguirre, B. I., Acosta Pintor, D. C., Ramírez Aguilar, C., & Vidal Becerra, E. (2019). Energy baseline: study in public hospital. *Tectzapic*, *5*(2).

Ludeña, C., & Wilk, D. (2013). ECUADOR : Mitigation and Adaptation to Climate Change. Framework for the preparation of the IDB Strategy 2012 - 2017 in Ecuador. In *Inter-American Development Bank* (pp. 1-29). https://publications.iadb.org/publications/spanish/document/Ecuador-Mitigación-y-adaptación-al-cambio-climático.pdf

Mendoza, C., Rosaura, P., Yanes, M., José, P., Nordelo, B., Oqueña, Q., & Ciro, E. (2015). Energy Baseline in the implementation of ISO 50001. Case studies. *El Hombre y La Máquina*, *46*, 54-44.

Ministry of Energy and Non-Renewable Natural Resources (2019). *Balance Energetico Nacional 2019*. 1-174. https://www.recursosyenergia.gob.ec/wp-content/uploads/2020/12/Balance-Energetico-Nacional-2019-1.pdf

International Organization for Standardization (2018). Energy management systems implementation guide: ISO 50001:2018 standard. *Nqa*, 55. https://www.nqa.com/medialibraries/NQA/NQA-Media-Library/PDFs/Spanish QRFs and PDFs/NQA-ISO-50001-Guia-de-implantacion.pdf.

Pastén, C. (2012). Chile, energy and development. *Obras y Proyectos*, *11*, 28-39.

Sevilleja Aceituno, D., & Soto Martos, F. (2011). *Eficiencia Energética En El Sector Industrial* [Universidad Carlos III de Madrid]. http://e-archivo.uc3m.es/bitstream/handle/10016/13678/PFC_Diego_Sevilleja.pdf;jsessionid=F1B8AF45E8F848D9911663825555597C4?sequence=1