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Analysis of the implementation of the Lean Kaizen methodology in energy management: a systematic review

Análisis de la implementación de la metodología Lean Kaizen en la gestión de energía: una revisión sistemática

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Abstract

The present study aimed to analyze the application of the Lean Kaizen methodology in energy management through a comprehensive review of recent cases. To do so, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology was used, which allowed for the identification, selection, and synthesis of relevant information from renowned academic databases such as Scopus, ERIC, Dialnet, Google Scholar, and Springer. The review focused primarily on research conducted in the industrial and agri-food sectors of Latin America, as well as in other regions where energy efficiency is a significant challenge. The results showed that Lean Kaizen is an effective tool for the continuous improvement of energy-related processes, achieving significant reductions in resource consumption and operating costs. A close relationship was also identified between its application and the strengthening of an organisational culture oriented towards sustainability, as well as the promotion of active staff participation. The conclusions highlight that, despite the difficulties encountered during implementation—such as resistance to change and lack of training—Lean Kaizen is an adaptable and replicable methodology in different contexts, promoting more efficient, conscious, and sustainable energy management. This research provides valuable evidence to promote practices that integrate continuous improvement and environmental responsibility in the industry.

Keywords: Lean Kaizen, energy management, continuous improvement, energy efficiency, organizational sustainability.

Resumen

El presente estudio tuvo como objetivo analizar la aplicación de la metodología Lean Kaizen en la gestión energética mediante una revisión exhaustiva de casos recientes. Para ello, se empleó la metodología PRISMA (Elementos Preferidos para Reportes de Revisiones Sistemáticas y Metaanálisis), que permitió identificar, seleccionar y sintetizar información relevante proveniente de bases académicas reconocidas como Scopus, ERIC, Dialnet, Google Scholar y Springer. La revisión se centró principalmente en investigaciones desarrolladas en los sectores industrial y agroalimentario de América Latina, así como en otras regiones donde la eficiencia energética constituye un reto significativo. Los resultados evidenciaron que Lean Kaizen constituye una herramienta eficaz para la mejora continua de procesos relacionados con la energía, logrando reducciones significativas en el consumo de recursos y los costos operativos. Asimismo, se identificó una relación estrecha entre su aplicación y el fortalecimiento de la cultura organizacional orientada hacia la sostenibilidad, así como la promoción de la participación activa del personal. Las conclusiones destacan que, a pesar de las dificultades encontradas durante la implementación —como la resistencia al cambio y la falta de capacitación—, Lean Kaizen es una metodología adaptable y replicable en distintos contextos, favoreciendo una gestión energética más eficiente, consciente y sostenible. Esta investigación aporta evidencia valiosa para fomentar prácticas que integren mejora continua y responsabilidad ambiental en la industria.

Palabras clave: Lean Kaizen, gestión de energía, mejora continua, eficiencia energética, sostenibilidad organizacional.

Introduction

How does the implementation of Lean Kaizen methodology in energy management contribute to the reduction of commercial energy losses, according to evidence derived from systematic case studies? Currently, amid the increasing demand for energy and the pressure industries face to optimize their resources, a significant challenge emerges: inefficiency in energy management, which is particularly reflected in commercial losses and affects both profitability and the long-term sustainability of organizations (Alvarez & Concha, 2024).

Despite technological advancements, many companies still struggle to minimize energy waste, generating negative economic and environmental impacts. In this context, investigating the application of Lean Kaizen methodology, which focuses on continuous improvement and waste elimination with a specific emphasis on energy management, becomes pertinent (Laoyan, 2025).

This study is relevant as it offers an innovative and structured approach to addressing energy challenges from the perspective of operational efficiency. The primary motivation lies in rigorously examining, supported by concrete data, how Lean Kaizen can enhance energy management and reduce commercial losses while fostering an organizational culture oriented toward continuous improvement (Vargas & Camero, 2021). Globally, while multiple studies exist on Lean and Kaizen across various sectors, there remains a lack of systematic analyses evaluating their specific impact on energy management.

For instance, at the GE Gas Power plant in Schenectady, New York, which manufactures steam turbines for power plants and spans 1.1 million square feet, the operational team faced the challenge of detecting compressed air leaks in such an extensive area. By implementing Lean Kaizen principles, which emphasize continuous improvement through direct observation in the workplace, they identified a significant leak caused by a defective air dryer. This failure not only resulted in compressed air waste but also led to high energy consumption. Thanks to detailed analysis, on-site observation, and collaboration among multidisciplinary teams, the issue was resolved, resulting in an estimated annual savings of approximately 230 MWh and nearly $15,000 in energy costs (Morey, 2022).

In Latin America, Lean Kaizen methodology has begun to establish itself as an effective approach to optimizing both operational and energy efficiency across various industrial sectors. However, it has not yet reached the level of systematization observed in developed countries. Manufacturing, agribusiness, and energy companies have started adopting continuous improvement principles to reduce waste, maximize resources, and promote environmental sustainability (Cavero, 2025).

Countries such as Mexico, Colombia, and Brazil stand out, where successful initiatives have demonstrated that applying Kaizen events contributes to reducing energy consumption in production lines. Additionally, the utilization of equipment has improved through Total Productive Maintenance (TPM) and tools such as Value Stream Mapping (VSM). Although regional statistical data are limited, reported cases show energy consumption reductions ranging from 15% to 30%, along with significant progress in the organizational culture toward sustainability. These results indicate that Lean Kaizen is not only applicable in the Latin American context but also a key tool for addressing competitiveness and energy efficiency challenges in the region (Piñero et al., 2019).

From a theoretical framework, this study is grounded in the concept of continuous improvement (Kaizen) and Lean philosophy, whose principles aim to optimize processes through the identification and elimination of waste (muda), standardization of activities, and active participation of personnel. These theoretical foundations are complemented by energy management models inspired by standards such as ISO 50001, which provide guidelines for establishing efficient energy systems (Cousins, 2023).

Ultimately, the primary objective of this research is to conduct a thorough analysis through a systematic review of cases to evaluate the effectiveness of Lean Kaizen application in energy management and its impact on reducing commercial energy losses. This analysis will identify trends, best practices, limitations, and key factors for success in various organizations that have implemented this methodology.

Methodology

This research adopted a qualitative approach, based on a detailed analysis of case studies with both descriptive and inferential characteristics. The primary goal was to explore, examine, and compile existing information regarding the use of Lean Kaizen methodology in energy management, identifying operational challenges and successful strategies implemented in various industrial settings. To ensure transparency,

traceability, and comprehensiveness of the process, the PRISMA protocol was applied, facilitating the development of a clear and replicable methodological structure.

1. Identification stage

In this phase, a systematic search of the scientific literature was conducted in recognized academic databases, such as Scopus, Springer, Dialnet, ERIC, and Google Scholar. Searches were executed using combinations of keywords such as “Lean Kaizen,” “energy management,” “energy efficiency,” “industrial energy waste,” “continuous improvement,” and “Lean tools in energy,” combined using boolean operators AND and OR to optimize the relevance of the results. This procedure allowed for the collection and filtering of relevant information aimed at identifying the most effective management practices, as well as internal and external factors influencing energy efficiency in industrial contexts applying Lean Kaizen.

Table 1

Search strategy for the study

Database	Keywords with Boolean operators	Identified studies
ERIC	("Lean Kaizen" AND "energy management") OR ("continuous improvement" AND "industrial energy efficiency")	14
Scopus	("Lean" AND "Kaizen" AND "energy efficiency") OR ("Lean tools" AND "energy waste" AND "industry")	22
Dialnet	("Mejora continua" AND "gestión energética") OR ("Lean Kaizen" AND "eficiencia energética industrial")	11
Google Scholar	("Lean Kaizen" AND "energy management") OR ("Lean Manufacturing" AND "energy optimization")	34
Springer	("Lean Kaizen" AND "energy efficiency") OR ("continuous improvement" AND "energy use" AND "case study")	17

As a result, a total of 98 records were identified; after removing 12 duplicates, 86 studies remained for the next stage.

2. Selection stage

In this stage, to preserve the quality and relevance of the studies, inclusion and exclusion criteria were applied based on the PRISMA model:

Inclusion criteria:

- Articles published between January 2020 and March 2025.
- Publications in Spanish and English.
- Research focused on agricultural supply chains.
- Studies developed in the context of higher education or relevant related fields.

Exclusion criteria:

- Duplicate articles or those in languages other than Spanish or English.
- Research focused exclusively on agricultural supply chains, agro-food logistics, distribution, marketing, or transportation of agricultural products.
- Works lacking full-text access or that lacked methodological rigor.
- Opinion articles, editorials, or essays without scientific grounding.

3. Eligibility stage

The titles and abstracts of the 98 identified studies were reviewed, excluding 12 for duplication and 45 for not meeting the established criteria. From the remaining 41 studies, access to full texts was sought, but 16 could not be retrieved due to access restrictions. Subsequently, after a thorough review, an additional 14 articles were

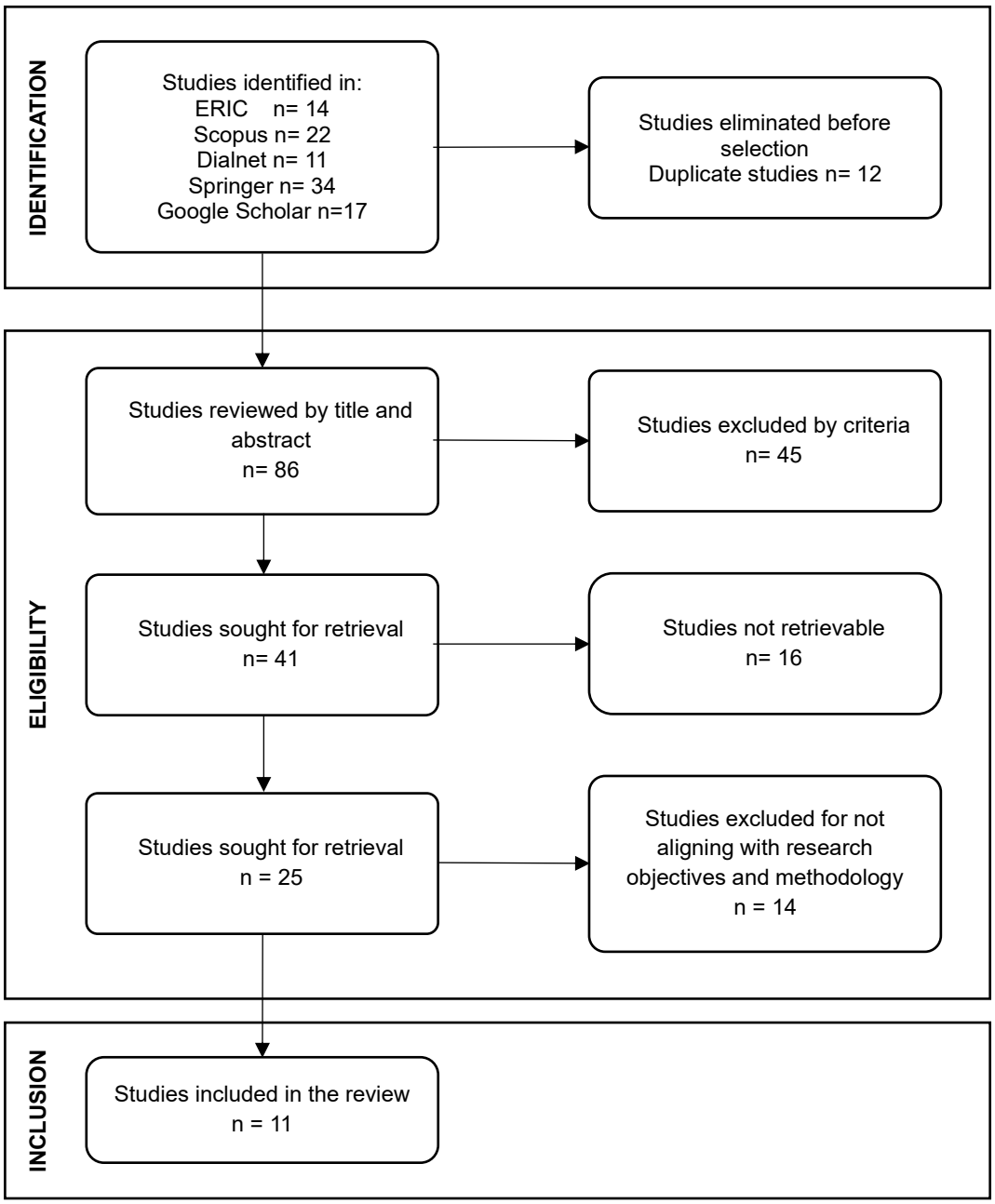
discarded due to issues related to methodological relevance and the pertinence of the educational context of the applied simulations.

4. Inclusion and synthesis stage

Finally, 11 studies that fully met the defined criteria were included. These documents underwent in-depth analysis to extract relevant and significant findings. Below, the corresponding flowchart for the PRISMA analysis is presented.

Figure 1

PRISMA flow diagram



Results and discussion

Based on the systematic review conducted on the 11 selected articles, the findings are presented in the following tabular format.

The strategy of this research was grounded in a qualitative approach, supported by a thorough review of cases. The objective was to identify, analyze, and synthesize existing evidence related to the application of Lean Kaizen methodology in energy management. Through an organized process, information was gathered from recent studies addressing similar topics in productive areas such as agro-food logistics, distribution, marketing, and transportation, where continuous improvement tools were also employed to achieve satisfactory results in operational and energy efficiency.

Table 2

Results of the systematic review

No.	Authors (Year)	Title	Study Type	Results	Relationship to Lean Kaizen in Management
1	(Contreras et al., 2024)	Startup Lean-Kaizen in the Production Processes of Panela: The Case of a Sugar Mill	The application of Lean-Kaizen philosophy has proven effective for organizations to achieve continuous improvement in quality and productivity.	The types of waste present throughout the panela production process were identified, along with the current state of order and cleanliness, and the manner in which operations are executed to obtain the final product. With the implementation of the cleaning program (5S) and the standardization of operational procedures, the main sources of waste and dirt were eliminated, in addition to reducing the time required for manufacturing.	The application of Lean Kaizen in the agro-industrial sector demonstrates that by adopting the 5S principles and formalizing administrative processes, even the smallest companies can achieve continuous improvements in quality, efficiency, and production. From a management perspective, it shows how leading processes with Lean methodologies fosters an organizational culture focused on the systematic elimination of losses and strengthening operational discipline.
2	(Androniceanu et al., 2023)	Increasing Energy Efficiency Based on the Kaizen Approach	Through the Kaizen approach, organizational processes were analyzed to identify key vulnerabilities and implement necessary changes that enhance energy consumption efficiency.	Various technical improvements aimed at increasing energy efficiency were applied. The results showed an increase in this efficiency, with reductions in consumption of 7.5% in the production line, 3.5% in the extrusion stage, and up to 20% in the injection stage of the manufacturing process.	The standardization of procedures proved fundamental for the development of Kaizen projects, which can be applied with certain limitations. The implications of these results are analyzed to better understand the reduction of energy consumption.

3	(Kazim et al., 2024)	Lean Energy Efficiency: Application Scenario Analysis in a Refrigeration Plant	Energy-flexible processes and the valorization of energy waste are well-established strategies, as they can be easily implemented in any manufacturing plant.	Processes that present energy consumption above the industrial average are considered bottlenecks. The use of value stream maps specific to energy consumption is recognized as a practice of “Efficient Energy Efficiency.” The parameters obtained from these maps are complemented and enriched through the analysis of established interdependencies between the various related elements.	The combination of the Lean Energy Efficiency Method with the Bayesian Belief Network Method will enable decision-makers to develop more informed strategies based on knowledge. The case study is conducted in a refrigerator factory that manages energy consumption across different departments.
4	(Momenitabar et al., 2021)	Proposal for an Efficient Distribution System for Solar Power Plants Using Mathematical Modeling and Simulation Techniques	Initially, mathematical models were proposed to reduce production costs, followed by the application of simulation techniques to electrical transmission and distribution systems.	The main focus was to use both models—mathematical and simulation—to compare results. The analysis conducted with the CPLEX tool of MATLAB Software 2019 allowed for a significant reduction in energy demand costs within the electrical distribution system.	Mathematical models aimed at reducing production costs were proposed, and subsequently, the simulation technique was applied to electrical transmission and distribution systems. Additionally, two criteria were considered for comparison: the different costs of the system and the rate of energy waste during transmission.
5	(Ioshchikhes et al., 2024)	A Systematic Review of Expert Systems for Improving Energy Efficiency in the Manufacturing Industry	Expert systems (ES) provide the opportunity to overcome this challenge by automatically identifying potential improvements in energy efficiency, playing a fundamental role in reducing electricity consumption.	The most advanced approaches to expert systems for improving energy efficiency in the manufacturing industry are systematically identified. The bibliographic search yielded 1,692 results, of which 54 articles published between 1987 and 2023 were analyzed in depth.	The research reveals how Lean tools can be complemented with automated expert systems for energy management. Lean management includes methods that structure information and automate diagnostics, facilitating well-founded decisions and allowing for a more proactive approach to electricity consumption in the industry.

6	(Zhipeng et al., 2024)	Business Models for Digitalization Enabling Energy Efficiency and Flexibility in Industry: A Survey with Nine Case Studies	Expert systems (ES) represent a key tool for tackling the challenge of improving energy efficiency by automatically detecting potential improvements and contributing to the reduction of electricity consumption.	Publications were classified according to system scope, type of manufacturing, perspective and application purpose, type of expert system, and industrial sector. Additionally, the structure, implementation, use, and development of these systems in this context were examined. This analysis revealed gaps in research and highlighted promising topics for future studies.	Digitalized business models integrating Lean Kaizen are transforming energy management in industries by combining a culture of continuous improvement with intelligent technologies. From a managerial perspective, this promotes more flexible decision-making structures, robust control of key performance indicators, and energy savings that can be expanded through digitalization and Lean practices.
7	(Sánchez et al., 2020)	Analysis of the Scope of Kaizen and Ecological Practices: State of the Art and Future Directions	Given the growing importance of environmental management, this work aims to analyze the current state of Kaizen and ecological practices.	The relationship between Kaizen and ecological practices is an evolving topic, predominantly featuring case studies. Therefore, further research is required, as improving environmental management becomes an increasing necessity in a competitive environment.	The research emphasizes that Kaizen is evolving into an essential component of environmental management in companies. The integration of Lean with ecological practices is beginning to align with sustainable strategic management, uniting operational objectives with environmental goals, a key aspect for contemporary energy management.
8	(Mohamed et al., 2023)	An Empirical Study of the Implementation of an Integrated Ergo-Green-Lean Framework: A Case Study	An integrated conceptual model called Ergo-Green-Lean was developed based on a review of existing literature.	In implementing the integrated framework in an auto parts industry, key performance indicators (KPIs) were identified, such as ergonomic risk scores, job satisfaction, carbon footprint derived from both direct energy consumption and material waste, cycle time, delivery time, mold setup, and rejection rates.	By combining Lean with ergonomic and sustainable practices, this study demonstrates how management in industrial environments can comprehensively address efficiency, health, and sustainability objectives. Lean management allows for measuring and improving indicators such as cycle time, rejection rates, carbon footprint, and employee satisfaction within a coordinated framework.
9	(Nyimbili et al., 2023)	Kaizen Practices and Performance Improvement in Manufacturing Companies in Zambia	A cross-sectional descriptive research design was employed, with a population composed of manufacturing companies from two highly	The adoption of Kaizen practices has generated significant improvements in the operational performance of manufacturing companies, evidenced in productivity, quality, and overall equipment	It highlights how the adoption of Kaizen positively impacts operational management in the manufacturing sector: productivity, quality, and efficiency show notable improvements thanks to the systematic implementation of

			industrialized regions in Zambia; thirty-three questionnaires were distributed, obtaining 31 responses.	efficiency. This research provides a preliminary understanding of the successes of Kaizen in manufacturing companies in Zambia.	Lean practices. From the administrative angle, this implies better planning capabilities, more effective control, continuous feedback, and greater team participation in the ongoing improvement of the system.
10	(Herrmann et al., 2020)	Continuous Implementation of Kaizen to Improve Efficiency: A Case Study of an Automotive Assembly Line in India	A continuous Kaizen program was implemented on an assembly line using the case study methodology, demonstrating how this implementation allows for achieving the objectives set by upper management.	Quality control techniques such as Gemba walks, 3M analysis (muda, mura, muri), and ECRS study (eliminate, combine, reduce, or simplify) were applied to conduct a micro-analysis of activities. It was confirmed that continuous Kaizen can be effectively implemented on assembly lines to improve productivity, balance, and efficiency.	Management uses tools such as Gemba walks, 3M analysis (muda, mura, muri), and ECRS (eliminate, combine, reduce, or simplify) to implement small improvements in processes. It demonstrates that a well-executed Lean management strategy can reduce cycle times, optimize balance on the production line, and increase overall efficiency, while simultaneously strengthening the responsiveness and planning capability of the management team.
11	(Silva et al., 2024)	Implementation of Lean Kaizen: A Case Study in the Food Retail Industry	To achieve the required sustainable objectives, many companies are choosing to invest in new methodologies, including the Kaizen-Lean methodology.	The study was conducted through an action research intervention, where the most critical areas were identified to guide the interventions. Additionally, various actions supported by Kaizen and Lean methodologies were implemented and monitored.	The study based on participatory action demonstrates how management can identify key areas requiring improvement, apply specific Kaizen interventions, and monitor results in real time. From the administrative perspective, the Lean approach consolidates as a methodological governance tool, grounded in PDCA cycles, continuous feedback, and strategic alignment with sustainable objectives.

Analysis and interpretation

The evaluation of the studied cases reveals a clear consensus regarding the effectiveness of Lean Kaizen as an approach to energy management. From the agro-industrial sector, as noted by Contreras et al. (2024), to factories and intelligent energy systems, according to Zhipeng et al. (2024), the implementation of this methodology has been shown to help identify and eliminate inefficiencies, enhance operational effectiveness, and optimize energy resource usage.

Additionally, research conducted by Androniceanu et al. (2023) and Kazim et al. (2024) records significant reductions in energy consumption resulting from the standardization of processes and the application of Lean tools, such as value stream mapping. These findings underscore that efficient energy management does not solely depend on technological investments, but also on a shift in methodology and, above all, on an organizational culture driven by Lean Kaizen.

In the same vein, studies like those of Ioshchikhes et al. (2024) highlight the combination of Lean with digital or expert systems, facilitating agile management and informed decision-making in real time. This reflects an evolution of the Kaizen approach, which has transitioned from its traditional format to a hybrid model supported by advanced technologies, reinforcing management capabilities in complex energy contexts.

On the other hand, works by Sánchez et al. (2020) and Mohamed et al. (2023) expand the analysis to environmental and social aspects, evidencing that Lean Kaizen not only improves energy efficiency but also impacts metrics such as carbon footprint, occupational health, and corporate sustainability. This expansion solidifies Kaizen as a key tool within strategic environmental management frameworks and corporate social responsibility (CSR).

Moreover, research by Herrmann et al. (2020) and Nyimbili et al. (2023) supports the idea that Lean Kaizen strengthens organizational culture by fostering active team participation, continuous feedback, and ongoing improvement—essential aspects for efficient operational management. As a result, it enhances planning, monitoring, and timely reaction capabilities, which are critical competencies for managing limited energy resources.

It is important to highlight that the application of Lean Kaizen in energy management goes beyond being a set of tools; it represents a comprehensive vision that transforms processes, organizational structures, and individual behaviors. The review demonstrates that this model is adaptable to multiple sectors, from agro-industrial production to high-tech manufacturing, and aligns perfectly with current sustainability and energy efficiency challenges.

Among the most relevant benefits, it is noted that Lean Kaizen facilitates methodological management based on PDCA cycles (Plan-Do-Check-Act), promoting continuous and dynamic administration of energy usage, enabling rapid adjustments in response to operational or regulatory changes. This adaptability is particularly valuable in Latin American contexts, where energy infrastructure faces significant challenges in efficiency and costs.

Finally, the research suggests that the integration of digital technology and automation with the Kaizen culture enhances expected outcomes. Rather than replacing the Lean methodology, digitalization strengthens it by providing precise information, predictive models, and real-time monitoring systems.

Conclusions

The reviewed studies allow us to conclude that Lean Kaizen is a methodology that is not only viable but also scalable and effective for improving energy management. Its implementation contributes not only to reducing energy consumption and optimizing operational efficiency but also to fostering a cultural transformation within organizations oriented toward sustainability, responsibility, and operational excellence. For Latin American countries, this represents a strategic opportunity to modernize their productive sectors using accessible and high-impact tools, adapting to various levels of technological and organizational maturity.

The application of Lean Kaizen in energy management has proven to be an extremely effective mechanism for optimizing processes and reducing energy consumption across various productive sectors. Through a thorough analysis of case studies, it has been evidenced that its focus on continuous improvement and the systematic elimination of waste enables greater operational efficiency without requiring substantial investments, making it a viable option even for organizations with limited resources. This methodological model easily adapts to industrial and agro-food environments, generating both technical and environmental benefits.

Furthermore, the analyzed studies emphasize that the success of Lean Kaizen largely depends on organizational commitment and active personnel participation. Promoting a culture of continuous improvement not only enhances energy performance but also strengthens corporate sustainability by incorporating responsible practices. The flexibility of this methodology, along with its compatibility with digital technologies, demonstrates that it can be replicated in diverse contexts, contributing to more efficient, conscious, and strategic energy management in the long term.

References

Alvarez, V. J., & Concha, R. J. (2024). Incidencia de la crisis energética en los costos de producción en empresas manufactureras. *Revista Científica Zambos*, *4*(1), 226–248. https://doi.org/10.69484/rcz/v4/n1/88

Androniceanu, A., Enache, L. C., Narcisa, V. E., & Felix, R. F. (2023). Aumentar la eficiencia energética con base en el enfoque Kaizen. *Revista Energías*, *16*(4), 1930–1960. https://doi.org/10.3390/en16041930

Cavero, J. (2025, 23 de octubre). El método Kaizen para emprendedores. Aproximaciones sucesivas. https://mentorday.es/wikitips/metodo-kaizen-emprendedores/?gad_source=1&gad_campaignid=22563976967&gbraid=0AAAADRjVLd40S-BQPBnR6yJdmDq_FMyc&gclid=Cj0KCQjwyvfDBhDYARIsAItzbZEkJbE6bFqIWwtx4WWIJuf60dr6skCycmjI7NWF2gJ3wXeHgR7oDPkaAoaIEALw_wcB

Contreras, C. E., Gordillo, G. J., & Olaya, R. K. (2024). Startup Lean-Kaizen en procesos productivos de panela: el caso de un trapiche. *Ingeniería Cogent*, *11*(1), 1–14. https://doi.org/10.1080/23311916.2024.2322834

Cousins, M. (2023, 30 de enero). ¿Metodología de mejora empresarial Six Sigma, Lean o Kaizen? https://blog.triaster.co.uk/blog/lean-six-sigma-continuous-improvement

Herrmann, C., Braunschweig, G., Kara, S., & Sydney, A. (2020). Implementación continua de Kaizen para mejorar la eficiencia: un estudio de caso de una línea de ensamblaje automotriz en India. *Series Editors*, *11*(6), 51–69. http://www.springer.com/series/10615

Ioshchikhes, B., Frank, M., & Weigold, M. (2024). Una revisión sistemática sobre sistemas expertos para mejorar la eficiencia energética en la industria manufacturera. *Revista*, *11*(3), 123–145. https://doi.org/10.48550/arXiv.2407.04377

Kazim, A., Duzdar, A. İ., Kayakutlu, G., & Kayalıca, Ö. (2024). Eficiencia energética lean: análisis de escenarios de aplicación en una planta frigorífica. *Revista Konya de Ciencias de la Ingeniería*, *12*(1), 53–68. https://doi.org/10.36306/konjes.1251805

Laoyan, S. (2025, 13 de enero). Método Kaizen: la guía para la mejora continua en las empresas. https://asana.com/es/resources/continuous-improvement

Mohamed, K., Ansa, R. D., Amjad, H., Muhammad, S. H., & Zaher, A. (2023). Un estudio empírico de la implementación de un marco integrado Ergo-Green-Lean: un estudio de caso. *Revista Ingeniería y Ciencia Sostenible*, *15*(13), e-10138. https://doi.org/10.3390/su151310138

Momenitabar, M., Dehdari, E. Z., Hassan, H. S., & Arani, M. (2021). Propuesta de un sistema de distribución eficiente para plantas de energía solar mediante técnicas de modelado y simulación matemática. *Revista Matemáticas*, *12*(1), 123–134. https://doi.org/10.48550/arXiv.2101.06193

Morey, D. (2022, 4 de mayo). La presión está en aumento: cómo el enfoque Kaizen ayuda a GE Gas Power a reducir las emisiones de carbono y los costos energéticos. https://www.gevernova.com/news/reports/the-heat-is-on-how-the-kaizen-approach-is-helping-ge-gas-power-with-carbon-emissions-and?utm_source=chatgpt.com

Nyimbili, H., Sichinsambwe, C., Lubosi, S. P., & Nyimbili, H. (2023). Prácticas Kaizen y mejora del rendimiento en empresas manufactureras de Zambia. *Ingeniería Cogent*, *10*(1), 123–145. https://doi.org/10.1080/23311916.2023.2183590

Piñero, E. A., Vivas, V. F., & Flores, d. V. (2019). Programa 5S´s para el mejoramiento continuo de la calidad y la productividad en los puestos de trabajo. *Actualidad y Nuevas Tendencias*, *6*(20), 99–110. https://www.redalyc.org/journal/2150/215057003009/html/

Sánchez, R. L., Blanco, B., Marín, G. J., & Diez, B. E. (2020). Análisis del alcance de las prácticas Kaizen y ecológicas: estado del arte y direcciones futuras. *Environ, Int. J.*, *17*(21), e-8258. https://doi.org/10.3390/ijerph17218258

Silva, P., Mota, S., & Soares, M. (2024). Implementación de Lean Kaizen: un estudio de caso en la industria minorista de alimentos. *Reactivación de Empresas con Nuevas Estrategias de Gestión del Cambio Organizacional*, *4*(2), 1–14. https://doi.org/10.4018/978-1-7998-7452-2.ch010

Vargas, C. E., & Camero, J. J. (2021). Aplicación del Lean Manufacturing (5S y Kaizen) para el incremento de la productividad en el área de producción de adhesivos acuosos de una empresa manufacturera. *Industrial Data*, *24*(1), 1–18. https://doi.org/10.15381/idata.v24i2.19485

Zhipeng, M., Nørregaard, J. B., Levesque, M., Amazouz, M., & Grace, M. Z. (2024). Modelos de negocio para la digitalización que posibilitaron la eficiencia energética y la flexibilidad en la industria: una encuesta con nueve estudios de caso. *Revista Computadoras y Sociedad*, *23*(7), 123–145. https://doi.org/10.1007/978-3-031-48649-4_15