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Review paper

THE ROLE OF ENMS IN THE APPLICATION OF ISO 50001 IN THE CONSTRUCTION INDUSTRY

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Abstract

The construction industry, as a significant and expansive sector of the global economy, is distinguished by a high level of market risk and competitiveness. In such a demanding environment, construction firms must effectively identify and address emerging needs and challenges in order to enhance their visibility in both domestic and international markets, optimize revenue generation, and minimize operational costs. To manage risk effectively and improve key performance areas such as operational efficiency, inter-organizational collaboration, supply chain management, and the adoption of innovative solutions, one of the relevant strategic instruments is the implementation of the international standard ISO 50001. This standard provides a comprehensive framework for the development and application of systematic energy management practices. Through the adoption of ISO 50001, construction companies are better equipped to comply with environmental regulations, particularly those concerning carbon emissions, thereby enhancing their energy efficiency and overall organizational performance.

Key words: construction industry, ISO standards, energy norms, management.

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1. INTRODUCTION

Energy, as a fundamental input in all forms of business activity, holds a critical position in determining both the operational efficiency and financial viability of modern enterprises. Regardless of the sector, whether manufacturing, services, logistics, or technology, energy represents not only a necessary resource but also a potential bottleneck due to its variable costs, availability, and associated environmental impacts. Therefore, sustainable energy management has become a central strategic concern for organizations aiming to maintain competitiveness and resilience in increasingly dynamic and uncertain global markets.

Sustainable development has led organizations to rethink how they procure, use, and manage energy resources. As energy prices fluctuate and the availability of fossil fuels becomes more constrained, ensuring predictable and optimized energy expenditure is no longer a matter of cost-saving alone, but a determinant of long-term operational continuity. Moreover, the growing societal and regulatory demands for environmental stewardship have added layers of complexity to corporate energy strategies. Energy use is not isolated from its broader ecological and social context; it is intimately linked to carbon emissions, pollution, and broader climate change concerns. Consequently, the pressure on organizations to adopt more transparent, responsible, and future-oriented energy practices is mounting.

In contemporary discourse on sustainability and industrial development, the challenges associated with energy use extend beyond issues of scarcity and cost. A critical concern is the significant role that irrational and excessive consumption of energy, particularly from non-renewable sources, plays in accelerating climate change and exacerbating environmental degradation. Fossil fuel dependence continues to dominate global energy systems, resulting in diminishing resource reserves and escalating energy prices. These trends highlight the urgent need for a paradigm shift in energy governance, emphasizing responsible resource utilization and systemic efficiency across economic sectors.

The interplay between rising energy costs, the imperative for sustainable resource management, and the expanding demands of global trade calls for innovative, structured approaches to energy usage. Urbanization, fueled by demographic growth that has seen the global population double since 1950, with more than half now living in urban areas, has significantly increased the demand for new infrastructure and housing. This growth exerts substantial pressure on the construction industry, a sector central to national economies due to its direct contributions to employment, GDP, and international trade. However, the environmental footprint of accelerated construction activity is substantial, with significant implications for resource depletion, pollution, and overall ecological balance.

Given its dual role as both an economic engine and an environmental stressor, the construction sector is increasingly subject to regulatory and normative pressures to improve sustainability performance. International standards, particularly those developed by the International Organization for Standardization (ISO), have emerged as essential instruments in guiding the construction industry toward more environmentally responsible practices. ISO standards address environmental and energy-related challenges at all stages of the construction lifecycle, promoting efficiency while ensuring compliance with sustainability goals. They provide frameworks for integrating best practices, reducing energy-related externalities, and enhancing overall environmental performance.

One of the prominent standards is ISO 50001, a globally recognized standard that defines the requirements for establishing, implementing, maintaining, and improving an energy management system (EnMS). The primary objective of ISO 50001 is to support organizations

in achieving continuous improvements in energy performance, including energy efficiency, energy use, and energy consumption. The adoption of this standard is not merely a technical measure but a strategic endeavor with both economic and environmental implications.

Economically, the implementation of ISO 50001 allows organizations to systematically monitor and reduce their energy consumption, thereby lowering operational costs and enhancing market competitiveness. These savings, in turn, support reinvestment, innovation, and resilience in the face of fluctuating energy markets. Environmentally, adherence to the standard contributes to a reduction in greenhouse gas emissions and other pollutants, while also mitigating the exploitation of finite natural resources. This aligns organizational practices with broader climate action frameworks and environmental protection mandates.

However, the degree to which energy performance can be enhanced through EnMS implementation is contingent upon the level of institutional commitment, particularly from top management. The establishment of an effective EnMS necessitates an organizational culture that prioritizes sustainability, fosters cross-functional collaboration, and encourages behavioral change at all hierarchical levels. This transformation is not solely procedural but deeply cultural, requiring a shift in how energy is perceived, valued, and managed within the organization.

Ultimately, through their emphasis on process standardization, continuous improvement, and stakeholder accountability, ISO standards contribute to strengthening a company's reputation as a disciplined, transparent, and socially responsible entity. In the construction sector and beyond, the integration of such standards into core operational strategies is a critical step toward aligning industrial growth with sustainable development goals.

2. ENERGY MANAGEMENT SYSTEM – ENMS

The EnMS defines the requirements for establishing, implementing, maintaining, and improving an EnMS, which enables a company to follow a systematic approach to achieving energy performance improvements. As such, an EnMS

- is applicable to any company, regardless of its type, size, complexity, geographical location, organizational culture, or the products and services it provides;
- is applicable to activities that affect energy performance that the company manages and controls;
- is applicable regardless of the amount, use, or type of energy consumed;
- requires continuous improvement of energy performance, but does not define the levels to which energy performance should improve;
- is used independently, or in harmony with, or integrated with other management systems [1].

Accordingly, the company identifies external and internal issues that are relevant to it and that impact its ability to achieve the intended outcomes of its EnMS and improve its energy performance.

The company must identify:

- the stakeholders that are relevant to its energy performance and EnMS;
- the relevant stakeholder requirements;

- which of the identified needs and expectations the company will address through its EnMS.

The company must:

- provide access to applicable legal requirements, as well as other requirements related to its energy efficiency and energy use and consumption;
- determine how these requirements apply to its energy efficiency and energy use and consumption [2].

The company's management must demonstrate leadership and commitment to the continuous improvement of energy performance and the effectiveness of the EnMS by:

- defining the objects and scope of the EnMS;
- ensuring that the energy policy and objectives are compatible with the company's strategic direction;
- ensuring that the EnMS requirements are integrated into the organization's business processes;
- ensuring that action plans are approved and implemented;
- ensuring that the resources needed for the EnMS are available;
- communicating the importance of effective energy management and compliance with the EnMS requirements;
- ensuring that the EnMS achieves the intended outcomes;
- promoting continuous improvement of energy performance and the EnMS;
- ensuring that the energy management team is established [3].

3. ENMS – ISO FRAMEWORK

Companies cannot influence energy prices or government policy, but they can improve the way they manage energy. Such improvements in energy performance can quickly lead to reduced costs and energy consumption in companies, thereby mitigating the harmful effects of global energy use and consumption, global warming, and overconsumption of natural resources.

ISO has identified energy management as one of the five most important areas for the development of international standards, and in 2008 a project committee, ISO/PC 242, was established. The project committee was led by national standardization bodies, ISO members from the United States (American National Standards Institute – ANSI) and Brazil (Associació Brasileira de Normas Técnicas – ABNT). ISO developed the new standard based on guidelines, regulations, and other legislation, as well as standards related to energy management, at the national level of the USA, the European Union, Denmark, Germany, the Netherlands, China, and Japan.

The standard *EN ISO 50001 Energy Management System – Requirements with instructions for use*, was published in 2011 and included in the normative system as DIN EN ISO 50001 [4].

The following international and European standards have been adopted in this field:

- ISO 50002:2015 Energy audits – Requirements with user guide [5];
- ISO 50003:2015 Energy management systems – Requirements for bodies providing verification and certification of energy management systems [6];

- ISO 50004:2015 Energy management systems – Guidelines for the implementation, maintenance and improvement of energy management systems [7];
- ISO 50006:2015 Energy management systems – Measuring energy performance using energy benchmarks and energy performance indicators – General principles and guidance [8];
- ISO 50006:2015 Energy management systems – Measurement and verification of an organization's energy performance – Basic principles and guidance [9].

The Institute for Standardization of the Republic of Serbia (Energy Management Commission, KS A424) has adopted a series of Serbian standards in the field of energy management since 2010.

3.1. SRPS EN ISO 50001:2012 Standard

The SRPS EN ISO 50001:2012 enables companies to establish and maintain systems and processes for continuous improvement in terms of reducing energy consumption, increasing energy efficiency, and improving the way energy is used. The aim of implementing the standard is to establish and maintain an EnMS in companies that will reduce energy consumption and harmful environmental impacts while controlling energy costs [10].

There are various reasons for introducing standards, conditioned by external and internal factors arising from the needs of energy management. External factors include the following: requirements from applicable legislation, application of existing rules, fulfillment of company obligations, certification obligations set by energy suppliers, and financial institutions for loans. The most common internal factors include security of constant supply of energy and energy products, transparent insight into energy consumption in all company subsystems, reduced overall production costs, and increased energy efficiency.

The standard is based on the PDCA cycle methodology, as shown in Figure 1.

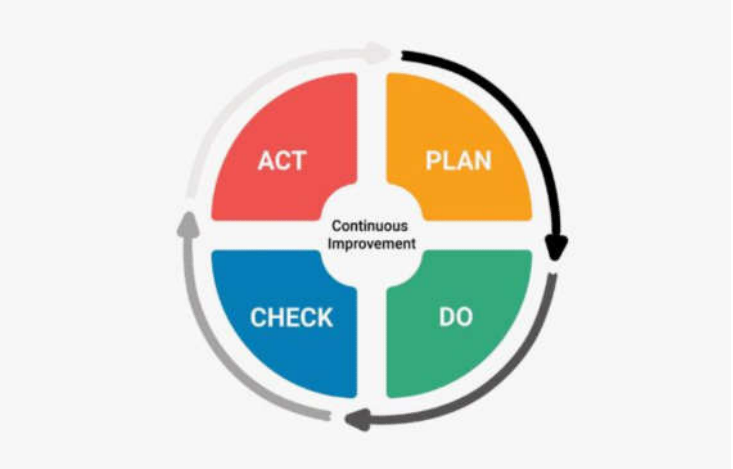

Figure 1. PDCA cycle methodology [11]

The following phases are to be completed in a cyclic, continuous way:

- Planning: Implementing energy flows within the defined boundaries of a company's system, defining the baseline of energy consumption and energy efficiency, and establishing goals and action plans to increase energy efficiency.
- Implementation: Realizing the defined action plans.
- Verification: Monitoring and measuring parameters and comparing them against the defined strategic and action plans.
- Action: Defining corrective and preventive measures and their implementation.

The standard covers all factors that may have an impact on energy consumption, with the possibility of adapting the application to the specific requirements of the company.

3.2. Comparison of ISO 50001 with other management system standards

The EN ISO 50001 standard was developed based on common principles and elements found in other ISO management system standards. [12] Table 1 provides an overview of the main provisions of the SRPS EN ISO 50001, SRPS ISO 9001, and SRPS ISO 14001.

Table 1. Comparison of ISO 50001 with other management system standards [13]

Content	ISO 9001	ISO 140001	ISO 50001
Basic concept of the standard	Based on:		
Policy	Client's request regarding quality management	Relevant aspects of environmental protection	Energy consumption of a company or a specific production process
	Meet the client's requirements regarding quality management	The environmental policy illustrates the way the company manages environmental protection, its commitment to environmental protection, and the corresponding guidelines and goals in this field.	The energy policy illustrates the company's strategy regarding energy management.
Strategic approach	Establishing guidelines, goals and plans for quality management	Compliance with relevant regulatory requirements regarding environmental protection	Conducting energy reviews in order to identify activities that lead to significant energy consumption as well as energy consumption indicators
Characteristic profile	There are no such requirements.	There are no such requirements.	Determining the characteristic energy consumption profile is essential in terms of establishing an EnMS.

Management systems based on the PDCA cycle methodology are much easier to implement in companies where one of the management system standards is already applied. The application of the ISO 50001 standard in buildings enables the integration of energy management into existing business practices.

4. CONCLUSION

Introducing an EnMS, particularly one that adheres to internationally recognized standards such as ISO 50001, presents both opportunities and challenges. On the positive side, such systems enable a structured and data-driven approach to energy consumption. They promote a culture of continuous improvement, facilitate benchmarking, and offer verifiable evidence of energy performance to stakeholders. The implementation of a certified EnMS often leads to significant cost reductions through enhanced energy efficiency, as well as reduced greenhouse gas emissions. These benefits extend beyond financial savings and contribute to the organization's reputation, regulatory compliance, and alignment with global sustainability goals.

However, the adoption of an EnMS is not without its limitations. Initial implementation costs, including infrastructure upgrades, staff training, and audit procedures, can be substantial, particularly for small and medium-sized enterprises. Moreover, the success of such systems often depends on the organizational culture and the degree of top management commitment. Without a genuine organizational shift toward sustainability and operational integration, energy management initiatives risk becoming superficial or symbolic, yielding minimal long-term impact. Furthermore, the dynamic nature of energy markets, evolving technologies, and emerging regulations requires that these systems remain adaptive and continuously updated – posing ongoing strategic and financial challenges.

Looking ahead, future directions in energy management are likely to be shaped by technological innovations, digital transformation, and regulatory evolution. Smart grids, real-time data analytics, artificial intelligence, and Internet of Things (IoT)-based monitoring systems are redefining how energy is managed and optimized in real time. These technologies enable predictive maintenance, load balancing, and demand-response mechanisms, enhancing both efficiency and reliability. Additionally, the integration of renewable energy sources, such as solar and wind, into corporate energy strategies is no longer optional but an expected progression toward decarbonization.

In the longer term, energy management is expected to evolve from a standalone operational concern into a core element of corporate strategic planning and sustainability reporting. This evolution will likely rely on interdisciplinary collaboration between engineers, data scientists, economists, and sustainability professionals. Furthermore, organizations will be increasingly required to align their energy management practices with broader ESG (Environmental, Social, and Governance) frameworks to satisfy investor expectations and policy obligations.

In conclusion, while energy is an indispensable asset in business operations, its management is becoming increasingly complex, influenced by economic, environmental, and social considerations. A certified EnMS offers a pathway toward efficiency, accountability, and sustainability, but it demands sustained effort, investment, and adaptability. The trajectory of future energy management will likely be determined by the

ability of organizations to integrate emerging technologies, align with global sustainability agendas, and foster a culture of innovation and responsibility.

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