Organisational Context Analysis Integration with Stakeholder Requirements and Risk-based Planning for Improvement of Energy Management System Effectiveness

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Please cite this paper as:
Rădulescu, C.V., Gâf-Deac, I, Moncea M.I. and Purcărea, L., 2025. Evaluation of the Start-Up Nation Romania Program based on the Perception of Entrepreneurs. In: C. Vasiliu, D.C. Dabija, A. Tziner, D. Pleșea, V. Dinu eds. 2025. *11th BASIQ International Conference on New Trends in Sustainable Business and Consumption*. Oradea, Romania, 26-28 June 2025. Bucharest: Editura ASE, pp. 310-317
DOI: 10.24818/BASIQ/2025/11/039

Abstract

This study investigates the effectiveness of strategic analytical components within corporate energy management, based on a case study analysis of 19 organisations operating in energy-intensive sectors. The central hypothesis posits that the systematic and context-specific integration of context analysis, stakeholder requirements, and risk-based planning significantly enhances the performance of energy management systems (EnMS) in accordance with ISO 50001:2018.

The empirical findings demonstrate that organisations that embed these analytical elements methodically and coherently into their decision-making and control structures achieve demonstrably enhanced system performance than those with predominantly formal or isolated implementations. Particularly critical are the integration of strategic assessment components, the rigorous prioritisation of measures, and the consistent derivation of energy performance improvements. The study underscores the pivotal role of strategic system integration as a key determinant for effective and sustainable corporate energy management and concludes with practice-oriented recommendations to support implementation.

Keywords

Energy management system (EnMS), ISO 50001:2018, Organisational Context Analysis, Stakeholder Requirements, Risk-based Planning.

DOI: 10.24818/BASIQ/2025/11/039

Introduction

In recent years, corporate energy management has evolved into an integral component of organisational sustainability strategies (Bensouda et al., 2024). It no longer serves merely to fulfil regulatory requirements or achieve short-term optimisation of energy consumption. Rather, it increasingly supports the systematic integration of energy-related considerations into corporate governance structures (Zatonatska et al., 2024; Ali et al., 2023). A fundamental prerequisite for this integration is a structured understanding of the organisational context, relevant stakeholders, and the internal and external factors influencing energy performance (Karltorp & Vico, 2024).

The legal obligation to implement an energy management system (EnMS) arises primarily from the European Energy Efficiency Directive and its transposition into national law through the German Energy Efficiency Act (Kurth et al., 2018; European Parliament and Council of the European Union, 2023). These regulatory frameworks require companies above a certain size threshold to systematically record, assess, and control their energy consumption (Bundesgesetzblatt, 2023). Against this backdrop, numerous organisations have established an EnMS in accordance with ISO 50001:2018 within a short period of time (Barbosa, 2023).

The effectiveness of such systems largely depends on the extent to which key analytical and control elements are functionally integrated into the organisation's decision-making processes beyond mere compliance with normative requirements. This study examines whether the consistent and context-sensitive implementation of strategic analytical elements - particularly context analysis, stakeholder integration, and risk assessment - leads to significantly greater effectiveness of energy management systems.

1. Review of scientific literature

The standard ISO 50001:2018 is an international standard that sets out the requirements for an effective energy management system (EMS). The standard aims to help organisations calculate and improve energy efficiency, reduce costs and greenhouse gas emissions, and promote sustainable energy-related practices (Barbosa, 2023). The ISO 50001 standard consists of 10 sections: Scope, Normative references: shows the references, Terms and definitions, Context of the organisation, Leadership, Planning, Support, Operation, Performance Evaluation, Improvement.

The international standard ISO 50001:2018 explicitly requires a context-specific and risk-based design of the energy management system (Deutsches Institut für Normung, 2018). In this regard, particular importance is attached to the analysis of the organisational environment (Understanding the organisation and its context, Section 4.1), the consideration of relevant stakeholders (Understanding the needs and expectations of interested parties, Section 4.2), and the evaluation of risks and opportunities (Actions to address risks and opportunities, Section 6.1).

Analysis of the organisational environment: The organisation is required to identify both external and internal issues as well as the needs and expectations of stakeholders and interested parties, and to demonstrate how value is created. In some cases, the concept of value creation is also explicitly addressed. The term "issue" in this context refers not only to problems or potential problems, but also to key aspects the system must take into account, such as changing circumstances, legal requirements, and other obligations. Furthermore, the scope of the energy management system is intended to clearly define the boundaries and applicability of the EnMS.

Consideration of interested internal and external parties: customers, employees, regulatory bodies, owners, shareholders, suppliers, certifiers, trade associations, certifiers (NQA Global, 2019).

Assessment of Risks and Opportunities: The consideration of risks and opportunities forms an integral part of strategic decision-making at the highest level within an organisation. By identifying risks and opportunities during the planning phase of the EnMS, an organisation can anticipate potential scenarios and consequences and detect undesirable impacts at an early stage. Likewise, favourable aspects or circumstances that offer potential benefits or positive outcomes can be identified and systematically pursued.

The effectiveness of an EnMS is therefore not primarily measured by the formal fulfilment of standard requirements, but by the degree to which these strategic elements are integrated into corporate governance along the PDCA cycle (Plan-Do-Check-Act) (Damasceno et al., 2024).

The isolated documentation of individual requirements - such as a static legal register - is insufficient to meet these demands. Instead, a systemic perspective is required that consolidates normative obligations, stakeholder requirements, and internal influencing factors into a coherent analytical model (Kurth et al., 2018). Within the framework of the present study, a purpose-designed analytical tool is employed to systematically link the relevant standard requirements. The aim is to ensure that the identification, evaluation, and prioritisation of requirements are not merely formal, but strategically effective.

2. Research methodology

The study follows a qualitative comparative research approach. It analyses 19 organisations from various energy-intensive sectors that implemented an energy management system in accordance with ISO 50001:2018 as a response to regulatory requirements. The objective was to identify differences in system effectiveness depending on the implementation of strategic elements - namely, context analysis, stakeholder integration, and risk-based planning.

2.1 Hypothesis

Organisations that implement strategic elements - such as context analysis, stakeholder integration, and risk-based planning - in a systematic and context-specific manner demonstrate higher effectiveness in their energy management systems compared to organisations that primarily pursue formal implementation.

2.2 Research Design and Case Selection

The accompanying data collection process extended over a period of eight months. The case organisations were differentiated into two distinct implementation types:

- **Group A:** Organisations with a primarily formal implementation (isolated documentation of the organisation's context, stakeholders, and risks).
- **Group B:** Organisations with a strategically integrated implementation of context analysis, stakeholder integration, and risk-based planning, based on a methodologically consolidated analysis tool.

The analysis tool incorporates legal, strategic, and financial dimensions and enables a context-specific prioritisation of action areas. Table 1 provides an overview of the sectors, the German Classification of Economic Activities (Klassifikation der Wirtschaftszweige - WZ), employee structure, and energy-related relevance (Significant Energy Use - SEU) of the organisations examined.

Table no. 1: Overview of the Analysed Organisations: Industry Classification, Employee Structure, and Energy Relevance (SEUs)

No. and	Group	Sector	Classification according to WZ-2008	Number of Employees and Energy-Effective Staff in 2024		SEUs
1	A1	Public Road Transport	49.31	853	9 (1,1 %)	Fossil fuels
2	A2	Freight Forwarding	49.41	927	10 (1,1 %)	Fossil fuels
3	A3	Furniture Retail with Fleet	47.59	841	8 (1,0 %)	Fossil fuels
4	A4	Combined Transport Logistics	49.21	1.052	12 (1,1 %)	Fossil fuels
5	A5	In-House Transport Wholesale	46.90	881	9 (1,0 %)	Fossil fuels
6	B1	Regional Bus Operations	49.31	868	9 (1,0 %)	Fossil fuels
7	B2	Courier Services with Fleet	53.20	820	8 (1,0 %)	Fossil fuels
8	B3	Furniture and Kitchen Logistics	47.59	849	7 (0,8 %)	Fossil fuels
9	A6	Banking Institution	64.19	598	9 (1,5 %)	HVAC[1]
10	A7	Retail (Non-Food Branches)	47.19	612	8 (1,3 %)	HVAC[1]
11	A8	Retail (Food Branches)	47.11	583	8 (1,4 %)	HVAC[1]
12	B4	Bank Branch Operations	64.19	605	9 (1,5 %)	HVAC[1]
13	B5	Municipal Administration	84.11	597	8 (1,3 %)	HVAC[1]
14	B6	Retail (Non-Food)	47.19	602	7 (1,2 %)	HVAC[1]
15	A9	Swimming Pool Operations	93.11	187	7 (3,7 %)	Electric Drives
16	A10	Water Supply	35.30	143	6 (4,2 %)	Electric Drives
17	B7	Leisure Pool & Spa	93.11	275	9 (3,3 %)	Electric Drives
18	B8	Leisure Pool/Wellness Centre	93.11	328	8 (2,4 %)	Electric Drives
19	B9	Public Utility Company	35.11	176	7 (4,0 %)	Electric Drives

Source: Author's own depiction based on anonymised data provided by participating organisations
[1]*Heating, Ventilation, and Air Conditioning*

For a more detailed characterisation, the annual total energy consumption (GWh, TJ), the number of energy carriers used, and the primary energy carriers (covering 80% of total consumption) were recorded. Table 2 presents these energy-related characteristics and illustrates the heterogeneity of the energy systems. All organisations examined exceed the threshold of 7.5 GWh set by the German Energy Efficiency Act (EnEfG) and are therefore subject to the obligation to implement an energy management system (EnMS).

Table no. 2: Overview of the Analysed Organisations: Energy Consumption, Energy Carrier Diversity, and Primary Energy Carrier Structure

No. and Group		Total Energy Consumption in 2024		Number of Energy Carriers and Primary Energy Carriers in 2024		Primary Energy Carrier(s)
1	A1	143,04 GWh	514,94 TJ	5	1	Diesel / HVO[2]
2	A2	98,01 GWh	352,84 TJ	6	1	Diesel / HVO[2]
3	A3	65,03 GWh	234,11 TJ	6	1	Diesel / HVO[2]
4	A4	84,04 GWh	302,54 TJ	6	1	Diesel / HVO[2]
5	A5	45,02 GWh	162,07 TJ	5	1	Diesel / HVO[2]
6	B1	50,01 GWh	180,04 TJ	6	1	Diesel / HVO[2]
7	B2	35,02 GWh	126,07 TJ	6	1	Diesel / HVO[2]
8	B3	30,03 GWh	108,11 TJ	6	1	Natural Gas
9	A6	15,03 GWh	54,11 TJ	4	2	Natural Gas, Electricity
10	A7	14,02 GWh	50,47 TJ	4	2	Natural Gas, Electricity
11	A8	16,02 GWh	57,67 TJ	4	1	Natural Gas
12	B4	15,03 GWh	54,11 TJ	3	2	Biogas, Electricity
13	B5	14,04 GWh	50,54 TJ	3	2	Natural Gas, Electricity
14	B6	13,03 GWh	46,91 TJ	3	2	Natural Gas, Electricity
15	A9	8,54 GWh	30,74 TJ	3	2	District Heating, Electricity
16	A10	7,82 GWh	28,15 TJ	4	1	Electricity
17	B7	9,52 GWh	34,27 TJ	4	1	District Heating, Electricity
18	B8	8,2 GWh	29,52 TJ	3	2	District Heating, Electricity
19	B9	12,05 GWh	43,38 TJ	3	1	Biomass, Electricity

Source: Author's own depiction based on anonymised data provided by participating organisations
[2]*Hydrotreated Vegetable Oil*

2.3 Data Collection, Analysis and Evaluation

Data collection was carried out through interviews with project managers, analysis of relevant EnMS documentation, and ongoing project observations. Particular attention was paid to the design of the context analysis, the quality of the stakeholder assessment, and the integration of binding obligations into risk and action planning.

The evaluation was based on a deductively developed category structure. In addition, qualitative indicators of system effectiveness were taken into account, including:

- Clarity and quality of implemented measures;
- Strategic alignment;
- Audit findings;
- Observable performance improvement.

A standardised assessment instrument supported the analysis of the relevance of requirements and the evaluation of risks and opportunities based on the probability of occurrence and potential impact.

3. Results and discussion

Based on the data collection and evaluation methodology described above, this section presents the key observations from the case studies examined. The focus lies on the depth of implementation of strategic EnMS elements and their impact on overall system effectiveness. The findings are first presented by group, followed by a comparative evaluation.

3.1 Observations on the Implementation in Group A

Organisations in Group A exhibited a predominantly formal implementation of the standard requirements. Context analysis, stakeholder requirements and risk-based planning were typically carried out in isolation and oriented toward documentation, without a systemic integration into strategic decision-making processes.

Quote 4-1: Stakeholder requirements as an audit obligation

„We created the stakeholder list for the certification audit, but it plays no operational role." – Interviewee,

Organisation A3

Actions were primarily prioritised based on technical considerations, with no discernible derivation from a strategic context or risk assessment.

Quote 4-2: Risk Assessment without Impact

„The risk assessment was more of a formality – we filled out the table, but nothing concrete resulted from it." – Energy Manager, Organisation A2

3.2 Observations on the Implementation in Group B

Organisations in Group B demonstrated a consolidated and strategically integrated implementation of the normative requirements. Context analysis, stakeholder requirements evaluation, risk-based planning and compliance obligations were methodically interlinked and systematically assessed.

Quote 4-3: Multidimensional Assessment Creates Clarity

„Jointly evaluating legal, strategic, and financial relevance finally brings clarity to the classification of requirements." – Project Manager, Organisation B2

Quote 4-4: Structured Analysis Tool Provides Clarity

„The Excel matrix provides us with a structured overview of which requirements are relevant – and on what basis this assessment is made." – Operations Manager, Organisation B5

The action planning in these organisations was characterised by greater traceability, improved prioritisation, and stronger strategic alignment.

3.3 Comparative Evaluation: Group A vs. Group B

The comparative analysis reveals significant differences in energy management system effectiveness. Group B achieved notably better results in terms of transparency, strategic integration, and the implementability of EnMS-relevant processes. Table 3 presents a comparison of the implementation depth of the key EnMS elements.

Table no. 3: Comparative Table – Comparative Evaluation of EnMS Implementation: Group A vs. Group B (Scale 1–5)

Evaluation Criteria	Group A	Group B
Depth of Context Analysis	2,1	4,2
Stakeholder Requirements Evaluation	1,8	4,0
Integration of Legal Requirements	2,3	4,5
Risk-based Planning with Traceable Assessment	1,5	4,1
Action for Improvement	2,0	4,3

Source: Author's own depiction based on anonymised data provided by participating organisations

3.4 Results of the Case Analysis

The systematic evaluation of the case studies highlights that the manner in which strategic elements of the EnMS are implemented has a significant impact on system effectiveness. Organisations that embedded context analysis, stakeholder evaluation, and risk assessment in a methodically consistent and structured way demonstrated measurably higher effectiveness across multiple dimensions compared to organisations that adopted a primarily formal implementation approach.

In detail, the following key findings can be highlighted:

- **Integrated System Implementation:** Organisations in Group B established a consistent linkage between context analysis, stakeholder requirements, and action planning. This methodological coherence significantly enhanced the alignment of energy-related control processes with overarching corporate strategies.
- **Systematic Prioritisation and Derivation of Measures:** In Group B, identified risks and opportunities systematically formed the basis for deriving energy-related measures. In contrast, organisations in Group A often defined actions without a strategic analytical foundation, which significantly reduced overall system effectiveness.

- **Integrated Risk Analysis:** Risk assessments in Group B were closely linked to both context and stakeholder analyses. Rather than being considered in isolation, risks were systematically assigned to business-relevant action areas, thereby facilitating targeted resource allocation.
- **Measurable Improvement of Energy Performance:** Even without the explicit use of specific EnPIs, it became evident that organisations in Group B identified and documented improvements in energy performance more consistently and transparently. The derivation of objectives and measures was based on context-driven analysis and enabled demonstrable performance enhancement.

The findings of this study confirm the initially stated hypothesis and clearly demonstrate that mere compliance with formal requirements - such as the creation of context analyses or stakeholder lists without functional integration—is insufficient to achieve a substantial improvement in energy performance. Only through the systematic and consistent integration of these strategic elements into both operational and strategic decision-making processes can the full effectiveness potential of an energy management system in accordance with ISO 50001:2018 be realised. Figure 1 illustrates, by way of example, the differences between the organisations under study with regard to the integration of context analysis and the strategic derivation of actions.

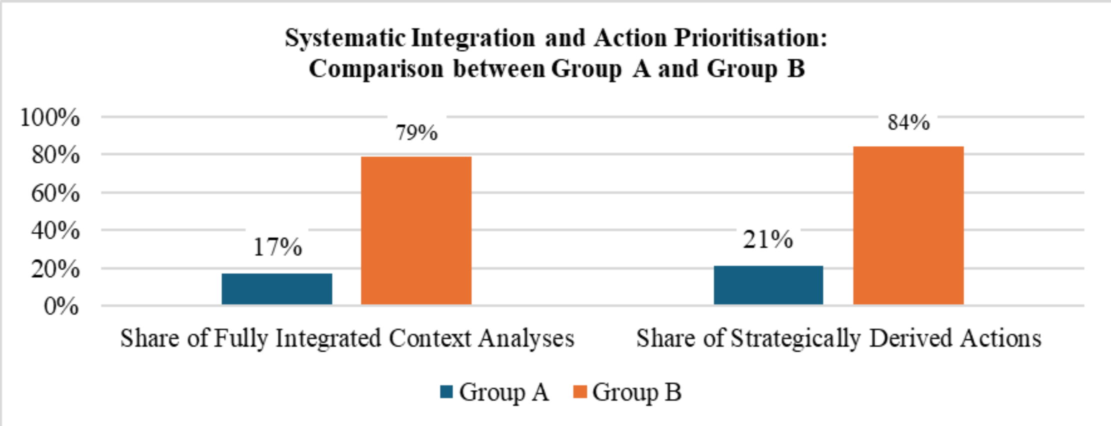

Figure no. 1: Comparison of the Systematic Integration of Strategic Elements (Context Analysis, Stakeholder Requirements Evaluation, Risk-based Planning) and Prioritisation of Actions between Group A and Group B
Source: Author's own depiction

The differences illustrated in Figure 1 further emphasise the central role of strategic integration in determining the effectiveness of corporate energy management systems and form the basis for the subsequent conclusions.

Conclusions

The present analysis clearly demonstrates that the effectiveness of corporate energy management systems is largely determined by the manner in which strategic elements are implemented. The case study analysis confirms that organisations which systematically and consistently integrate context analysis, stakeholder evaluation, and risk assessment into their decision-making processes achieve significantly higher system effectiveness than those with primarily formal implementation.

Key success factors include the systematic linkage of strategic analysis components, a robust prioritisation of measures, and the consistent consideration of risks and opportunities in relation to overarching corporate strategic domains. Only through such an integrated approach can an energy management system realise its full potential for the continuous improvement of energy performance.

The mere creation of documents—such as context analyses or stakeholder lists—without their functional integration into operational and strategic processes remains largely ineffective and results in increased bureaucratic effort without delivering meaningful control benefits.

From a practical perspective, this leads to a clear recommendation: when implementing and further developing energy management systems, organisations should go beyond mere formal compliance with standards and place strategic integration consistently at the forefront. Particular attention should be given to the coherent linkage of context analysis, stakeholder requirements, risk assessment, and action planning.

Overall, the findings of this study confirm that a sound strategic analysis is not merely a supplementary component but a critical success factor for effective and sustainable energy management.

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