

OUTLINING THE QUALITY MANAGEMENT PRACTICES IN THE OPERATIONAL AND CONSTRUCTION ACTIVITIES OF THE ENERGY COMPANY “GREN”

Andris BACKURS^{1*}, Aigars LAIZANS², Ilze LATISONOKA³

^{1,2}*Latvia University of Life Sciences and Technologies, Jelgava, Latvia*

³*Riga Technical University, Riga, Latvia*

**Corresponding author's e-mail: andris.backurs@gmail.com*

Received 01.09.2025; accepted 15.10.2025

Abstract. This study investigates the quality management priorities and operational practices of the energy company “Gren”, focusing on how standardised management systems, sustainability principles, and construction project development are integrated into its strategic and day-to-day activities. Using qualitative document analysis, the research examines corporate reports, regulatory frameworks, project descriptions, and relevant ISO standards to identify recurring patterns in how quality, safety, environmental considerations, and risk management are embedded within the company’s operations. The findings reveal five dominant thematic areas: quality management systems, environmental and safety practices, construction project development, sustainability initiatives, and risk management processes. Construction activities and technological modernisation appear as the most prominent themes, reflecting ongoing focus of “Gren” on infrastructure upgrades and energy efficiency improvements. The company’s extensive use of ISO standardisation demonstrates a structured, integrated approach to quality and compliance, while risk management practices show a proactive alignment with environmental and operational challenges. Sustainability, although less frequently referenced, functions as a cross-cutting strategic principle shaping long-term development. The study concludes that the effectiveness in quality management of “Gren” derives from integrating standardised systems with continuous technological advancement and sustainability-oriented project planning. Limitations include reliance on secondary data and the evolving nature of several ongoing construction projects. The findings provide insights relevant to energy companies navigating modernisation, regulatory compliance, and sustainable development objectives.

Keywords: *Construction project development, energy sector, risk management, sustainability, quality management.*

INTRODUCTION

Quality management has become a central component of sustainable development strategies across highly regulated industries, especially in the energy sector, where operational reliability, environmental responsibility, and service continuity are essential for societal well-being (Mahmood et al., 2022; Daroń & Górska, 2023; Duong Thi Binh et al., 2024). Energy companies also face increasing pressure to deliver stable, safe, and environmentally sound services while simultaneously responding to stricter regulatory frameworks and rising expectations from customers and stakeholders (Fometescu et al., 2024; Osiichuk, 2023).

In this context, the integration of comprehensive quality management systems, including ISO-based standards covering quality, environment, occupational safety, and energy efficiency, has become a prerequisite for long-term competitiveness (Matias & Coelho, 2002; Rebelo et al., 2015; Rehak et al., 2025). The energy company “Gren” represents a contemporary example of how a multi-national operator implements structured quality management practices while simultaneously developing new construction and infrastructure projects aimed at improving energy efficiency, system resilience, and regional sustainability goals. Established in 2021, “Gren” is a Northern European energy company that develops and provides environmentally friendly energy solutions, including sustainable district heating, cooling, and renewable and industrial energy services. The company operates in Estonia, Finland, Latvia, Lithuania and the United Kingdom with plans to expand its operations in search of new effective solutions and growth opportunities (Gren (1), n.a.).

In Latvia, “Gren” operates in several cities:

- *Jelgava*: Jelgava biomass cogeneration plant (CPH) is the largest and most modern such CPH plant in Latvia. It can provide up to 85 % of the city’s district heating (DH) load, replacing the existing production capacity, where natural gas was used. The electrical power of the plant amounts to 23 MW but the thermal power – to 45 MW. “Gren” in Jelgava supplies the heat produced to more than 16 000 households and around 200 legal customers, as well as maintaining a 75 km DH network (Gren (2), n.a.);
- *Riga*: in Riga “Gren” administers a biomass cogeneration CHP, which is connected to Riga’s DH system (Gren (3); n.a.);
- *Gulbene*: “Gren” provides DH services serving both households and legal customers (Gren (2); n.a.).

Despite the widespread application of international management standards, the energy sector still encounters challenges related to risk management, technological modernisation, workforce competence, environmental compliance, and supply-chain reliability.

Existing studies highlight that quality management in energy companies is often constrained by rapidly aging infrastructure, the complexity of large-scale construction projects, and the increasing importance of decarbonisation strategies (Mohamed et al., 2025; Stegnar, 2025). However, scientific literature provides

limited empirical insight into how quality management priorities are operationalised within medium-sized regional energy companies undergoing simultaneous modernisation and expansion. This gap is particularly visible in relation to construction project planning, integration of sustainability requirements, and the alignment of technical quality measures with corporate strategic objectives (Losada-Agudelo & Souyris, 2024; Misztal & Ratajszczak, 2025).

The present study aims to examine quality management priorities in the energy company “Gren”, focusing on how quality systems are implemented, monitored, and improved within ongoing operational processes and newly initiated construction projects. Building on the company’s activities in district heating, biomass cogeneration, and large-scale investments, such as the planned waste recovery plant in Acone, this research evaluates how quality management principles translate into practical organisational behaviour, risk mitigation, and stakeholder value creation (Investinlatvia, 2024).

The study is based on the following hypothesis: The effectiveness of quality management in an energy company is significantly determined by the integration of standardised management systems with continuous technological improvement and sustainability-oriented planning in construction projects.

To test this hypothesis, the study addresses the following research questions:

- What are the key quality management priorities in operational and construction activities of “Gren”?
- In what ways do new construction projects, such as biomass-based and waste-to-energy facilities, shape the company’s strategic approach to quality and sustainability?
- What organisational, technological, and environmental factors act as barriers or facilitators to effective quality management?

The methodology is subject to certain limitations. The study relies on secondary information without direct access to confidential operational data, internal performance indicators or interviews with company personnel. Consequently, the analysis reflects documented practices rather than unobserved internal dynamics. Furthermore, because the research is situated in the Latvian operational context, the findings may not be fully generalizable to other regions, in which “Gren” operates. Despite these limitations, the chosen methodological approach provides a robust framework for evaluating quality management priorities and practices in a complex, sustainability-oriented energy company.

Through the structured research, the study contributes to a deeper understanding of how quality management principles are integrated into the strategic and technical operations of a contemporary energy company and identifies critical factors influencing the advancement of sustainable, safe, and efficient energy services.

1. MATERIALS AND METHODS

The materials and methods used in this study are based primarily on the qualitative analysis of sources aimed at examining the quality management priorities, operational practices and construction project approaches of “Gren” in

Latvia. The study draws extensively on the detailed descriptive material contained in the attached document, which outlines the company's management systems, ISO certifications, sustainability initiatives, construction project plans and risk management practices. Additional supporting materials were gathered from publicly available corporate sources, the European Union (EU) and national regulatory documents, and sectoral guidelines related to environmental management, occupational safety and energy production. Together, these sources form a comprehensive dataset for understanding how quality management is implemented within "Gren's" operational and developmental activities.

The data collection followed a structured multi-phase process. First, all relevant sources were compiled and organised into thematic groups related to quality systems, environmental and safety practices, construction projects and strategic sustainability goals. Second, a systematic data extraction procedure was applied using a coding template to identify key statements, descriptions and concepts. Extracted data included descriptions of ISO standards, technical parameters of construction projects, operational improvement initiatives, sustainability commitments and risk mitigation strategies. This ensured consistency of interpretation and allowed the material to be analysed in a structured and replicable way. Third, the obtained information was verified through cross-checking with publicly accessible sources and corporate publications to ensure accuracy and reduce the risk of misinterpretation arising from reliance on a single source.

For the analysis, the study applied qualitative thematic analysis, an established method suitable for identifying patterns across textual material and for interpreting organisational processes. The thematic analysis followed three main stages: open coding to assign descriptive labels to relevant study segments; axial coding, in which these labels were grouped into broader analytical categories linked to the research questions; and selective coding, where overarching themes were developed to interpret the material in light of the research hypothesis regarding the relationship between quality systems, technological development, and sustainability-oriented planning. This approach enables the identification of structural links between strategic objectives of "Gren", its operational practices, and the design and implementation of new construction projects.

A qualitative approach was selected due to the nature of the research subject, which involves management systems, organisational decision-making, and sustainability strategies rather than measurable technical outputs. Many of the examined construction projects, such as the Acone waste recovery plant, are still in planning or early implementation stages, making quantitative evaluation of outcomes impossible. Qualitative analysis, therefore, provides the most appropriate method for examining the alignment between stated quality management intentions and the structures supporting their implementation. To enhance validity and reliability, several measures were implemented, including triangulation across multiple sources, transparent documentation of the coding and theme development process, clear criteria for material inclusion, and reflexive evaluation to minimise researcher bias during interpretation.

2. RESULTS

The qualitative analysis of the collected sources produced a comprehensive set of themes that collectively illustrate the operational focus, strategic priorities, and quality management orientation of the energy company “Gren”. Systematic coding of the primary data supplemented by industry standards and public information revealed a structured, multifaceted approach to quality and sustainability.

Five primary themes emerged during the research process: quality management systems, environmental and safety practices, construction project development, sustainability initiatives, and risk management processes. Their frequency across the data set reflects not only the company’s stated priorities but also the interdependence between its strategic goals and operational realities.

The frequency of emergence of the five primary themes is presented in Fig. 1.

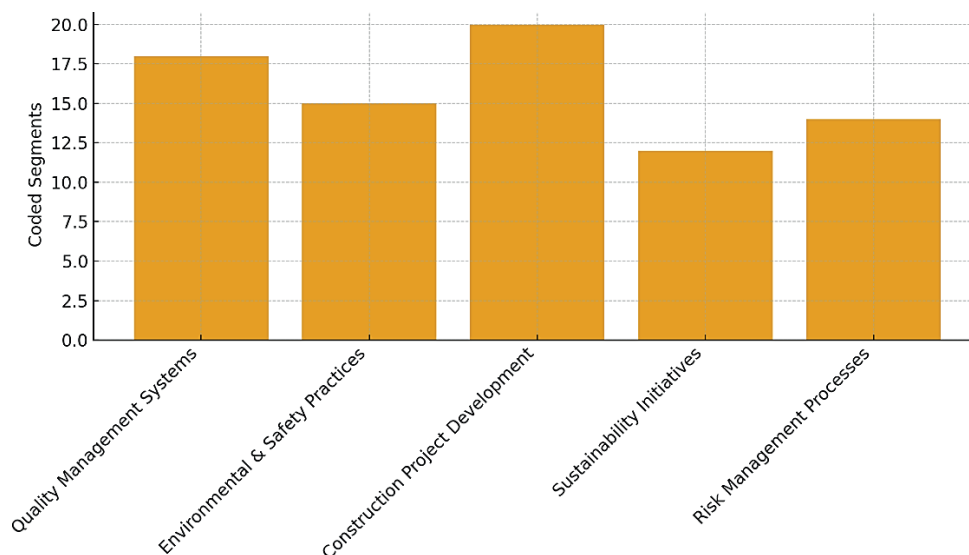


Fig. 1. Frequency of emergence of five primary themes (created by the authors).

Construction project development theme appeared most frequently (20 coded segments), underscoring the company’s ongoing large-scale infrastructure activities, which include advanced technologies such as biomass-based energy production, waste recovery systems, and high-efficiency heating solutions. These recurring references indicate a company in a phase of active expansion and modernisation. Such emphasis also suggests that major investments in construction and technology form the backbone of the company’s competitive strategy and long-term value creation.

Quality management systems recorded the second highest frequency with 18 coded items. These include frequent references to ISO management systems, standardised internal procedures, and systematic monitoring processes. The prominence of this theme highlights the commitment of “Gren” to structured, internationally recognised frameworks for quality, environmental protection, occupational safety, and energy efficiency. ISO standards serve not only as compliance requirements but also as core structural mechanisms that guide the

company's daily practices, audit cycles, documentation routines, and process improvements. The analysis indicates that these systems are integrated into nearly all aspects of operations, from procurement to project execution.

Environmental and occupational safety practices constitute another essential theme, with 15 coded items. This thematic presence reflects the regulatory intensity of the energy sector and the necessity for companies like "Gren" to maintain rigorous safety, emissions management, and environmental monitoring practices. The data reveal consistent emphasis on preventing environmental harm, improving air quality, and reducing exposures to occupational hazards.

These findings suggest that the company approaches environmental and safety compliance not merely as regulatory obligations but as integral components of its operational philosophy. Such integration is reflected in continuous monitoring of emissions, implementation of safety protocols, employee training programs, and adherence to national and EU environmental directives.

Risk management appeared in 14 coded items and showed substantial overlap with quality, safety, and construction themes. The identified risk categories include operational risks related to equipment reliability, environmental risks associated with emissions or waste generation, project risks related to delays or budget deviations, and strategic risks linked to long-term sustainability and resource availability. The analysis highlights that "Gren" employs a formalized approach to risk identification, assessment, and mitigation. Such practices include contingency planning, safety audits, continuous surveillance of operational systems, and evaluation of external factors such as supply chain volatility. The frequency and descriptive depth of this theme indicate that risk management is a core function of the company's governance structure and is interconnected with its decision-making processes. In all, risk management appears to be a unifying theme that intersects with all other categories. The frequency and diversity of risk-related sub-codes as shown in Table 1 indicate that "Grens" maintains a structured approach to identifying and mitigating operational, environmental, and strategic risks.

Table 1. The Frequency and Diversity of Risk-Related Items (created by the authors)

Theme	Sub- code
Quality Management Systems	ISO compliance, audits, process control, documentation
Environmental and Safety Practices	Emissions control, safety training, hazard monitoring
Construction Project Development	Project planning, technology upgrades, infrastructure expansion
Sustainability Initiatives	Carbon dioxide (CO ₂) reduction, resource efficiency, circular economy efforts
Risk Management Processes	Operational risk, environmental risk, project delays, supply chain risk

Sustainability initiatives, while representing the lowest frequency category (12 coded items), are nevertheless significant. These references describe long-term commitments to CO₂ reduction, energy efficiency, resource conservation, and circular economy principles. Several identified projects, including the development of waste recovery capacity and efficiency-oriented modernisation of district heating systems, reflect substantive movement toward environmental sustainability. Although mentioned less frequently, sustainability themes function as cross-cutting elements, informing construction strategies, quality standards, and environmental practices. This suggests that sustainability operates as a strategic layer influencing multiple operational domains rather than as a standalone set of activities.

When examining the relationships between themes, the results reveal intricate interdependence. For example, construction projects are consistently presented in relation to quality and environmental requirements, indicating that technical development is inseparable from quality compliance and regulatory obligations. Similarly, risk management frequently appears in conjunction with both safety and project development, showing that “Gren” views risk not only as a potential disruption but also as an operational parameter that must be actively managed throughout the project lifecycle. This combination of themes indicates a holistic approach, in which quality, safety, sustainability, and risk are integrated into a unified management framework.

The extended analysis also reveals temporal patterns in the data. Older components of the company’s infrastructure and legacy systems tend to be associated with references to modernisation needs, safety upgrades, and process improvements. In contrast, newer or planned projects emphasise innovation, efficiency, and sustainability. This suggests that “Gren” is undergoing a gradual transition toward more technologically advanced and environmentally sustainable operations. Such evolution aligns closely with the EU-level policy developments such as energy transition roadmaps, emissions reduction targets, and circular economy directives.

The dominance of construction project development as a theme reflects both the technological demands of the sector and the strategic direction of “Gren”. Large-scale infrastructure upgrades, like the planned waste recovery facility in Acone central to the company’s energy provision model. These projects require coordinated application of quality standards, environmental guidelines, and risk assessments, underscoring the interconnected nature of the identified themes. The data highlights that such projects involve detailed planning, stakeholder engagement, environmental impact assessments, and alignment with national regulatory requirements.

The expanded results demonstrate that the internal data of “Gren” reveal a consistent, structured approach to integrating quality management with environmental responsibility, safety practices, and sustainable development. The prominence of each theme and their interrelated nature indicate that the company’s operations are guided by a comprehensive framework that prioritises reliability, environmental stewardship, and long-term resilience. These findings form the basis for subsequent discussion regarding the value of integrated management systems,

the maturities of the company's operational processes, and the potential alignment between strategic goals and documented practices.

3. DISCUSSION

The analysis uncovers the documented activities and strategic priorities of "Gren" aligned strongly with contemporary expectations for quality-driven, sustainable, and risk-resilient operations in the energy sector. The dominance of construction project development in thematic coding reflects a company undergoing significant transformation and modernization.

This emphasis is consistent with the technical nature of the company's business model, where infrastructure upgrades, efficiency improvements, and new waste-to-energy projects play central roles in meeting regulatory requirements and long-term sustainability goals. The strong representation of project-related themes suggests that "Gren" is strategically investing in advanced technologies and capacity expansion, aligning its operations with the EU energy directives and the broader transition toward cleaner, more efficient energy systems.

In the context of the energy sector, where safety, reliability, and environmental impact carry high societal stakes, the integration of these standards contributes to operational stability, reputational credibility, and long-term risk mitigation. The results of this study indicate that these standards are not presented merely as formal certifications but are operationalised as routine practices embedded in daily workflows.

Environmental and safety practices form another central theme, and their strong presence in the data supports the growing importance of environmental stewardship and employee protection in energy production. The data indicate that "Gren" consistently incorporates environmental considerations into planning, monitoring, and project execution. This aligns with sectoral best practices, where emissions management, hazard prevention, and compliance with environmental regulations are essential elements of responsible energy production. The overlap between environmental practices and risk management suggests a maturity in the company's operational approach, where environmental sustainability is closely tied to operational risk reduction.

Sustainability initiatives, although coded less frequently, appear to function as cross-cutting principles embedded in several operational areas. Rather than forming a standalone domain, sustainability influences construction planning, project justification, and quality standards. This indicates that the sustainability approach of "Gren" is integrated rather than superficial, a finding consistent with the company's stated commitments to energy efficiency, resource conservation, and circularity. The more modest frequency of sustainability references may reflect the nature of the analysed documents, which emphasise operational processes more than corporate strategy.

The integration of risk management with construction and quality processes supports the view that the company employs a proactive rather than reactive approach. This is significant, given the technical complexity and potential environmental impact of energy infrastructure. Effective risk management is

especially critical in the context of combustible technologies, high-temperature systems, emissions control, and public safety considerations.

CONCLUSIONS

This study examined the quality management priorities and operational practices of the energy company “Gren” through a qualitative analysis of organisational data, project descriptions, and relevant regulatory frameworks. The findings show that activities of “Gren” are grounded in a well-structured quality management approach supported by international standards, comprehensive environmental and safety practices, and coordinated risk management processes. The results confirm the central role of construction project development in shaping the company’s strategic direction, reflecting an ongoing transition toward more efficient, sustainable, and technologically advanced energy systems.

The study provides evidence that the operational model of “Gren” is strongly aligned with integrated management principles. Quality standards are embedded across operational processes, environmental considerations are consistently incorporated into planning and monitoring, and risk management is actively practiced as a cross-cutting organisational function. Sustainability initiatives, while less frequently referenced, contribute strategically to project justification, resource efficiency, and long-term resilience. Together, these elements demonstrate that the commitment of “Gren” to quality and sustainability is substantive and operationally embedded.

The findings support the hypothesis that effective quality management in an energy company depends on the integration of standardised management systems with continuous technological development and sustainability-focused project planning. The thematic interrelationships identified in the analysis reinforce the view that quality, safety, environmental protection, and risk governance operate not as isolated components, but as interconnected elements of a unified management framework.

Nevertheless, the research conclusions are subject to several limitations. Reliance on a limited data set limits insight into internal practices that may not be publicly disclosed. Additionally, some projects described in the documents are ongoing or in early development phases, limiting the availability of measurable outcomes. Despite these limitations, the study contributes valuable insights into the operational structure of a modern energy company committed to sustainability and quality excellence. It highlights how integrated management systems support strategic project development, regulatory compliance, and long-term organisational resilience. These findings may serve as a reference for other companies navigating the challenges of energy transition, infrastructure modernisation, and sustainability governance.

REFERENCES

- Daroń, M., & Górska, M. (2023). Relationships between selected quality tools and energy efficiency in production processes. *Energies*, 16(13), Article 4901. <https://doi.org/10.3390/en16134901>
- Duong Thi Binh, A., Akbari, M., Le Thi Cam, H., Nguyen Canh, L., & Truong Quang, H. (2024). Forging pathways to circular economy excellence: Integrating industry 4.0 with quality management. *Sustainability*, 16(7), Article 3053. <https://doi.org/10.3390/su16073053>
- Fometescu, A., Hategan, C.-D., & Pitorac, R.-I. (2024). How responsible are energy and utilities companies in terms of sustainability and economic development? *Energies*, 17(23), Article 6209. <https://doi.org/10.3390/en17236209>
- Gren. (2024). *Northern European district heating company relaunches as Gren*. <https://gren.com/news/northern-european-district-heating-company-relaunches-as-gren/>
- Gren (1). (n.a.). *Gren Biomass CPH Plant*. <https://www.visit.jelgava.lv/en/sightseeing/adventure/farm-tours/item/2166-gren-biomasas-kogeneracijas-stacija>
- Gren (2). (n.a.). *Klientiem Gulbenē*. <https://gren.com/lv/klientiem-gulbene/>
- Gren (3). (n.a.). *Gren Riga*. <https://gren.com/lv/gren-riga/>
- Investinlatvia.lv. (2024). *'Gren' to invest in regeneration plant in Acone, Latvia*. <https://investinlatvia.org/en/news/gren-to-invest-in-regeneration-plant-in-acone-latvia>
- Losada-Agudelo, M., & Souyris, S. (2024). Sustainable operations management in the energy sector: A comprehensive review of the literature from 2000 to 2024. *Sustainability*, 16(18), Article 7999. <https://doi.org/10.3390/su16187999>
- Mahmood, N. S., Ajmi, A. A., Sarip, S. B., Kaidi, H. M., Jamaludin, K. R., & Talib, H. H. A. (2022). Modeling the sustainable integration of quality and energy management in power plants. *Sustainability*, 14(4), 2460. <https://doi.org/10.3390/su14042460>
- Matias, J., & Coelho, D. (2002). The integration of the standards systems of quality management, environmental management and occupational health and safety management. *International Journal of Production Research*, 40(15), 3857–3866. <http://doi.org/10.1080/00207540210155828>
- Misztal, A., & Ratajszczak, K. (2025). Possibilities of using contemporary quality management methods and tools for the sustainable development of the organization. *Sustainability*, 17(2), Article 617. <https://doi.org/10.3390/su17020617>
- Mohamed, A.-M. O., Mohamed, D., Fayad, A., & Al Nahyan, M. T. (2025). Environmental management and decarbonization nexus: A pathway to the energy sector's sustainable futures. *World*, 6(1), Article 13. <https://doi.org/10.3390/world6010013>
- Osiichuk, D. (2023). The obstacles to the growth of the renewable energy industry in the European Union. *Sustainability*, 15(19), Article 14612. <https://doi.org/10.3390/su151914612>
- Rebelo, M. F., Santos, G., & Silva, R. (2015). Integration of standardized management systems: A dilemma? *Systems*, 3(2), 45–59. <https://doi.org/10.3390/systems3020045>
- Rehak, D., Hromada, M., Jemelkova, S., Brumarova, L., & Haring, I. (2025). Strengthening the sustainability of energy critical entities through a business continuity management system. *Sustainability*, 17(6), Article 2766. <https://doi.org/10.3390/su17062766>
- Stegnar, G. (2025). Bridging the gap to decarbonization: Evaluating energy renovation performance and compliance. *Energies*, 18(5), Article 1146. <https://doi.org/10.3390/en18051146>