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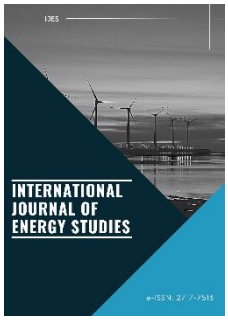


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# Human resources and green competencies in combating climate change: A study in the energy sector

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**Highlights**

- The study demonstrates that environmental sustainability in the energy sector is increasingly shaped by the transformation of human capital rather than solely by technological investments.
- Green competencies emerge as a strategic human resource function, integrating training, reskilling, and leadership development with sustainability objectives.
- Digital transformation and environmental competencies jointly reshape workforce structures, job design, and skill requirements in energy companies.
- Corporate learning and environmental leadership play a critical role in embedding sustainability into organizational culture and long-term management vision

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## ABSTRACT

The increasing impacts of climate change necessitate profound transformations in organizations, not only in their environmental practices but also in their managerial and cultural structures. In this process, Human Resource Management (HRM) plays a critical role in implementing sustainability goals at the institutional level. This study aims to reveal how HRM is positioned around the concept of green competencies in the adaptation process to climate change by examining the 2024 sustainability reports of large-scale enterprises operating in Türkiye's energy sector. Designed in a qualitative research design, the study analyzes the 2024 sustainability reports of the ten largest energy production companies in Türkiye, as listed in the MW100 (2025) report, through document analysis. The data were evaluated using thematic content analysis with the MAXQDA 20 software, identifying three main themes: "green competency development," "workforce transformation," and "organizational learning and leadership." The findings indicate that environmental sustainability strategies in the energy sector are increasingly integrated with HR processes, yet green competencies remain largely at a symbolic level in many organizations. Bringing together the Green Human Resource Management (GHRM), resource-based view, and learning organization approaches, the study provides a theoretical perspective on organizational transformation in the energy sector.

**Keywords:** Climate change, Green competency, Human resource management, Energy sector

## 1. INTRODUCTION

Climate change is not merely an environmental threat but a multidimensional transformation process that reshapes organizations' strategic management approaches, production models, and human resource policies. Today, organizations are increasingly adopting holistic management frameworks that integrate environmental, economic, and social responsibilities in order to achieve sustainability goals. In this context, Human Resource Management (HRM) has evolved beyond a function focused solely on efficiency and has become a key determinant of corporate environmental sustainability strategies.

The Green Human Resource Management (GHRM) approach aims to enable organizations to develop environmentally responsible policies, align employee behaviors with sustainability principles, and embed environmental awareness into organizational culture. Within this framework, the concept of *green competency* refers to the knowledge, skills, and attitudes individuals possess in areas such as energy efficiency, resource management, and sustainable innovation. Accordingly, organizational responses to climate change are closely linked not only to technological investments but also to the transformation of human capital [1].

Green Human Resource Management, which involves restructuring HR policies and practices through an environmental lens to support sustainability, is grounded in the rational and efficient use of natural resources while promoting an environmentally responsible management culture within organizations. Practices such as the use of telecommunication tools, reduction of paper consumption, flexible and shared working models, video conferencing systems, and online communication platforms aim to reduce travel needs and, consequently, carbon emissions. In this context, the carbon footprint is considered an indicator that measures the environmental impact of greenhouse gas emissions resulting from human activities. Overall, GHRM represents a holistic management approach that both disseminates environmentally friendly organizational practices and strengthens employees' environmental responsibility awareness and organizational commitment [2].

The energy sector stands out as both a domain of responsibility and opportunity in the fight against climate change. The transition to renewable energy, carbon reduction initiatives, and sustainability policies require HR units to develop policies aligned with environmental objectives. In this regard,

training, green leadership, and organizational learning processes constitute fundamental components of sustainable transformation [3].

This study examines the 2024 sustainability reports of ten large-scale companies operating in Türkiye's energy sector and analyzes the role of Human Resource Management in the climate change adaptation process from a *green competencies* perspective. By integrating the frameworks of Green Human Resource Management, the Resource-Based View (RBV), and the learning organization approach, the study provides a comprehensive perspective on how HR policies grounded in environmental sustainability are shaped within the energy sector. In this context, the following research questions have been formulated:

**Research Question 1:** How do large-scale companies in the energy sector frame climate change in their sustainability reports from a Human Resource Management perspective?
**Research Question 2:** Through which knowledge, skill, and behavioral dimensions is the concept of green competencies represented in corporate HR discourses?
**Research Question 3:** What future-oriented trends regarding sustainable Human Resource Management in the energy sector are reflected in the discourse on green competencies?
Accordingly, the study aims to contribute to both theoretical discussions and policy-oriented implications by comparatively analyzing, through corporate sustainability reports, the strategic effects of sustainability and digital transformation processes on Human Resource Management in the energy sector.

## 2. THEORETICAL FRAMEWORK

The increasing economic and societal impacts of climate change have directed organizations not only toward environmental sensitivity but also toward a broader understanding of sustainable management. In this context, corporate sustainability encompasses not only environmental performance but also a transformation process shaped by the knowledge, skills, and attitudes embedded within human resources. From a management science perspective, this process requires organizations to establish a dynamic relationship among environmental learning, innovation, and human capital development. Accordingly, sustainability is not merely a matter of technical compliance; rather, it represents a paradigm in which organizational behavior, leadership, and competency management are redefined [4].

### 2.1. Sustainable Management and Corporate Transformation Approaches

Today, sustainability has become central to organizations' long-term success and competitive advantage objectives. The origins of the idea of sustainability can be traced back to the twelfth century, when it was codified as an economic principle of household management in the Mauermünster monastery in Southwest Germany. Beginning in the sixteenth century and particularly toward the end of the eighteenth century, this idea was applied in forestry practices based on the principle that timber resources should be used only at a level that allows regeneration within the natural renewal cycle [5].

The concept of sustainable management refers to balancing organizations' economic performance with environmental and social responsibility principles. One of the theoretical foundations of this approach is the "triple bottom line" model, which emphasizes that firms should manage economic, environmental, and social dimensions simultaneously and calls for the development of production processes that do not harm the environment, the enhancement of resource efficiency, and the establishment of ethically grounded stakeholder relationships [6].Sustainable management also requires environmental risks to be addressed at the strategic level and business decisions to be made by considering long-term ecological consequences [7].

Corporate transformation, in turn, refers to the structural and cultural reshaping of organizations in response to environmental pressures such as climate change. Within this transformation process, concepts such as environmental leadership, green innovation, and organizational learning come to the forefront [8]. Environmental leadership facilitates the adoption of sustainability goals by transforming employee behaviors [9]. Particularly in the energy sector, sustainable management practices materialize through carbon footprint reduction, promotion of renewable energy investments, and systematic monitoring of environmental performance indicators [10].

The success of corporate sustainability depends on the extent to which organizations internalize environmental objectives. When sustainability is not genuinely embedded within the organizational culture, transformation efforts tend to remain symbolic and superficial rather than producing deep structural change [4]. Therefore, energy companies increasingly adopt systematic approaches that not only implement environmental policies but also transform human resources through green training programs and awareness-based leadership models. In this context, corporate transformation should be understood as a multilayered process that embeds sustainability

consciousness not only in management strategies but also in employee behaviors.

### 2.2. Environmental Competency-Based Approaches in Human Resource Management

Human Resource Management plays a decisive role in organizations' sustainability strategies and emphasizes that integrating human resources with environmental management enhances the durability of environmental policies [10]. Within this scope, the Green Human Resource Management (GHRM) approach advocates the systematic integration of environmentally responsible practices into recruitment, training, performance appraisal, and reward systems [3]. GHRM not only supports environmental policies but also aims to strengthen employees' pro-environmental behaviors, thereby contributing to the development of a green organizational culture [12].

Competency Theory [13] explains the knowledge, skills, attitudes, and motivational components that enable individuals to successfully perform specific tasks. When adapted to the environmental context, this approach gives rise to the concept of green competency. Green competencies are associated with cognitive (knowledge), affective (attitude), and behavioral (skill) dimensions that support environmentally responsible behavior, and these competencies are reflected in practices such as energy conservation, waste reduction, environmentally friendly technology use, and awareness of renewable energy [14]. The Resource-Based View (RBV) [15] argues that sustainable competitive advantage must be based on resources that are valuable, rare, and difficult to imitate. Human capital is regarded as one of the most strategic resources possessing these characteristics. Employees' environmental knowledge and awareness thus become significant assets that enhance organizational competitiveness [16].

Senge's learning organization approach provides an important model for explaining the sustainable development of environmental competencies [17]. According to this model, environmental learning should become part of organizational culture rather than remain at the level of individual efforts. Through shared vision, team learning, and systems thinking principles, organizations can increase environmental knowledge sharing and evolve into continuously learning systems. In this way, Human Resource Management becomes a strategic mechanism that supports environmental renewal in the energy sector.

### 2.3. The Concept of Green Competencies and Their Importance in the Energy Sector

Green competencies refer to a set of behaviors that enhance individuals' sensitivity to environmental issues, support sustainable practices, and integrate environmental awareness with organizational objectives. This concept encompasses various elements such as environmental awareness, resource utilization, energy efficiency, recycling consciousness, and adaptability to renewable energy technologies [3]. Three core dimensions of green competencies—cognitive (environmental knowledge), affective (environmental attitudes), and behavioral (sustainable actions)—are identified as forming a holistic structure that guides environmentally responsible decision-making [14].

The energy sector is particularly critical in terms of environmental impact due to its high carbon emissions and intensive use of natural resources. Consequently, the importance of green competencies in this sector is more pronounced compared to others. While adopting environmentally friendly production technologies, organizations must simultaneously enhance their employees' environmental awareness and knowledge levels. Environmental training and green awareness programs in energy companies positively influence employee motivation and organizational commitment [18].

The development of green competencies should be addressed not merely as an individual responsibility but as a corporate strategy. The success of corporate sustainability is directly linked to cultivating a workforce profile characterized by environmental awareness, and in this regard, energy companies increasingly incorporate green competencies into performance indicators, thereby constructing management cultures in which environmentally responsible behaviors are institutionally rewarded; ultimately, the strategic management of green competencies has become a fundamental determinant of both environmental performance and competitive advantage in the energy sector [10].

## 3. LITERATURE REVIEW

Climate change not only affects organizations' environmental performance but also transforms managerial processes, human resource policies, and corporate culture. In the literature, this transformation is addressed within the frameworks of sustainable management, Green Human Resource Management (GHRM), and environmental competencies. The "triple bottom line" model emphasized that organizations should manage economic, environmental, and social

responsibilities in an integrated manner; this perspective later formed the foundation for discussions on sustainable leadership and environmental learning [6,7].

Green Human Resource Management has rapidly evolved into a significant field for fostering environmentally aligned organizational behavior and building a sustainable workforce culture. GHRM is defined as the integration of environmental objectives into recruitment, training, performance appraisal, and reward systems [12,3]. Such practices are argued to strengthen both organizational environmental performance and employees' pro-environmental behaviors [18], while the role of transformational leadership in facilitating this process is emphasized by [9]. Additionally, the competency-based model offers an important theoretical framework for explaining how environmental objectives are reflected at the individual performance level [13].

The GHRM literature began to take shape through early studies emphasizing the integration of human resource management with environmental management approaches. Initial research demonstrated the role of HR practices in influencing environmental performance, thereby making visible the link between environmental management and the human factor [12]. From the late 2000s onward, this perspective became more pronounced as GHRM was increasingly associated with sustainability goals, highlighting the need to systematically align HR functions with environmental objectives [3, 19).

Since the mid-2010s, the global literature has expanded through empirical studies examining the organizational and individual outcomes of GHRM practices. These studies indicate that green training, green performance appraisal, and green reward systems positively influence employees' environmentally friendly behaviors and environmental performance [20,21]. Recent empirical studies have also highlighted the role of green competencies in strengthening business sustainability, emphasizing that employees' environmental awareness, knowledge, and behavioral capabilities contribute directly to organizations' long-term sustainability performance [46]. During the same period, the strategic role of GHRM in sustainability has been emphasized, portraying it as a key managerial instrument in reducing carbon footprints and enhancing sustainable performance [22].

More recently, the literature has gained a more comprehensive perspective through systematic reviews and bibliometric analyses examining the structure and trends of GHRM research [23,24].

These studies reveal that GHRM has been predominantly examined in relation to environmental performance, while research integrating the social and economic dimensions of sustainability remains limited. Consequently, contemporary literature underscores the need for more comprehensive models that examine the holistic contribution of GHRM practices to the triple dimensions of organizational sustainability (economic, environmental, and social) [25].

In their bibliometric analysis of the GHRM literature, 89 studies published over the past decade that met Q1, Q2, and Q3 indexing criteria were identified, and the findings indicate a significant increase in publications particularly after 2020 reflecting a growing research focus on sustainability-oriented HR practices [26]. This upward trend demonstrates that developing employee competencies, enhancing green skills, and promoting pro-environmental behaviors have become critical components of organizations' efforts to achieve environmental sustainability goals. Accordingly, the analyzed literature shows that, on a global scale, HR policies aimed at developing green competencies are increasingly recognized as essential for achieving competitive advantage and sustainable performance.

In the Turkish literature, studies on Green Human Resource Management have also shown a marked increase in recent years. Scale development and empirical research have contributed significantly to measuring the concept within the Turkish context and testing its organizational outcomes. A Green Human Resource Management Scale tailored to Turkish enterprises was developed, contributing to the methodological infrastructure of the field [27]. The positive effects of environmentally oriented HR policies on employee performance and organizational commitment were demonstrated [28]. From a strategic management perspective, the central role of green competencies in organizations' long-term competitive advantage and sustainability strategies has been emphasized [29]. However, the analysis of sustainability reports published in Türkiye revealed that the integration of environmental objectives into HR processes remained limited and that practices often stayed at the reporting level rather than achieving deep institutionalization [30].

Advanced search results from DergiPark further confirm that GHRM has become a rising research trend in the Turkish literature. A keyword search for "green human resources" reveals 1 study in 2019, 5 in 2021, 2 in 2022, 4 in 2023, 4 in 2024, and 11 studies as of 2025. This upward trend indicates that sustainability-oriented HR approaches are attracting increasing scholarly attention

in Türkiye and have gained notable momentum in recent years.

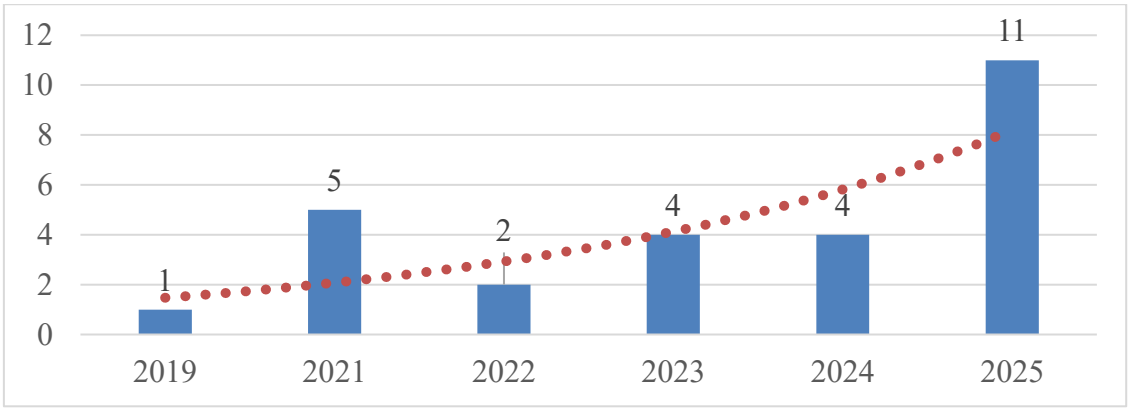


**Figure 1.** Distribution of "Green Human Resources" Studies in Türkiye by Year (DergiPark Data)

When studies focusing on the energy sector are examined, it becomes evident that research has largely concentrated on technical transformation, energy efficiency, and carbon reduction technologies, while the dimensions of Human Resource Management and green competencies have received comparatively limited attention. Green core competencies encompass environmental management capabilities such as energy efficiency, pollution prevention, and recycling practices. These competencies are widely regarded as organizational capabilities that can generate sustainable competitive advantage. [45]. Reports by the International Energy Agency and the International Renewable Energy Agency emphasize that sustainable energy transition cannot be achieved solely through technological investments; it also requires workforce reskilling, upskilling, and the strengthening of organizational learning processes [31,32].

In this context, the limited number of sector-specific qualitative analyses and content-based examinations of sustainability reports within the Turkish context points to a significant research gap. Accordingly, the present study aims to address this gap by examining green competencies and workforce transformation together in the energy sector, offering a perspective grounded in corporate learning and leadership to contribute to the existing literature.

## 4. METHODOLOGY

### 4.1. Research Design

This study adopts a qualitative research design to examine how large-scale companies operating in Türkiye's energy sector position Human Resource Management within the climate change

adaptation process. By analyzing HR-related and environmental sustainability discourses in corporate sustainability reports, the study investigates how the concept of green competencies is represented at the organizational level. The research design is grounded in a qualitative approach that combines document analysis and thematic content [33,34].

The primary rationale for selecting document analysis lies in the fact that sustainability reports constitute institutional texts reflecting companies' strategic priorities, corporate discourses, and formal policy orientations. Such documents provide standardized and accessible data sources that allow for the comparative examination of HR policies and environmental sustainability approaches across organizations. Thematic content analysis, in turn, enables the systematic exploration of the meaning structures embedded in sustainability reports, allowing the concept of green competencies to be analyzed across knowledge, skill, and behavioral dimensions. Therefore, the combined use of document analysis and thematic content analysis offers a methodologically appropriate framework for examining the research questions at the level of corporate discourse.

### 4.2. Population and Sample

The population of the study consists of electricity generation companies operating in Türkiye's energy sector. The sample includes the ten largest energy generation companies in Türkiye in terms of installed capacity and production volume, as identified in the MW100 (2025) report. These companies are Elektrik Üretim A.Ş. (EÜAŞ), ENKA, Enerjisa Üretim, Cengiz Enerji, Limak Enerji, Eren Enerji, Çelikler Holding, Aydem Enerji, İçdaş Enerji, and Bilgin Enerji.

These companies were selected because they represent the most influential actors in terms of energy supply security, carbon emission volume, and sectoral transformation impact in Türkiye. Moreover, they have institutionalized sustainability or integrated reporting practices and publicly disclose environmental performance and HR-related data. Accordingly, the sample demonstrates high analytical representativeness in reflecting the general sustainability trends of the energy sector, both in terms of data accessibility and institutional visibility.

A purposive sampling strategy was employed [35] enabling the selection of information-rich cases capable of addressing the research questions. The MW100 list provides an objective sampling framework by ranking companies based on quantitative sectoral indicators such as capacity, production, and investment. Selecting firms with the highest production capacity allows for the

analysis of key institutional actors shaping sustainability policies in the energy sector, thereby enhancing the analytical representativeness of the sample in reflecting sectoral transformation dynamics.

### 4.3. Data Sources and Data Collection Process

The primary data source of the study consists of the 2024 sustainability and integrated reports of the ten selected energy companies. These reports were obtained from the companies' official websites and publicly accessible reporting platforms. The documents include sections related to environmental performance, Human Resource practices, corporate governance, and sustainability strategies.

Data collection was completed between October and November 2025. Each report was imported in PDF format into the qualitative data analysis software MAXQDA 20. Prior to analysis, the documents were cleaned to remove tables, visuals, and repetitive content, and only textual sections were included in the analysis.

Sustainability and integrated reports were chosen as the primary data source because they provide systematic, standardized, and verifiable information regarding companies' environmental performance indicators, HR practices, and sustainability strategies. Furthermore, these reports present corporate discourses and practices within the context of long-term strategic objectives, making them suitable and reliable sources for analyzing how Green Human Resource policies are structured at the organizational level.

### 4.4. Data Analysis

The data were analyzed using thematic content analysis [36]. The analytical process followed a multi-stage structure. In the first stage, textual statements in the sustainability reports were examined through open coding, and meaningful data units were inductively coded. In the second stage, codes with similar meanings were grouped into sub-categories. In the third stage, these categories were classified under broader themes based on conceptual proximity. As a result of this process, three main themes were identified**:** Green Competency Development**,** Workforce Transformation, and Organizational Learning and Leadership**.** The analytical flow of the coding and thematic structuring process is presented in Figure 1.

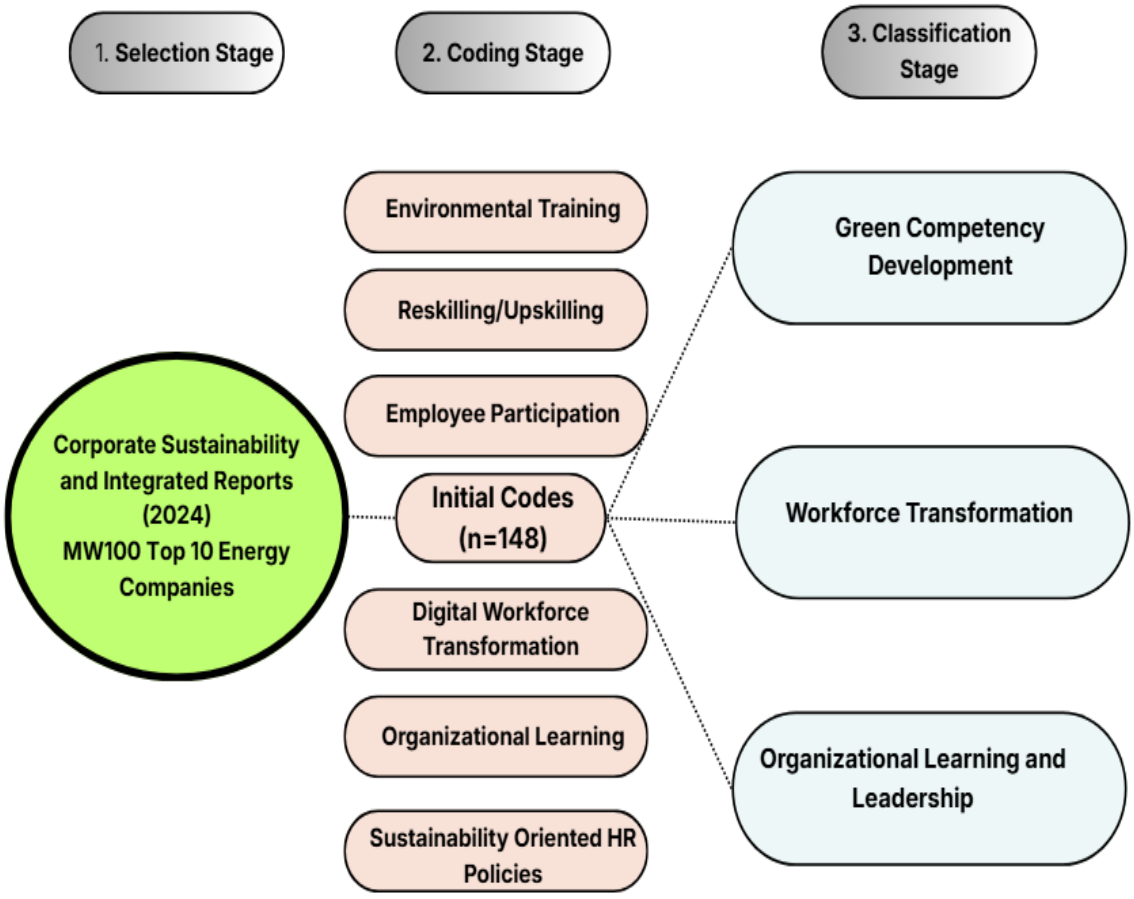


**Figure 2.** Coding and thematic analysis pathway illustrating the transformation from raw textual data to themes.

The coding process was conducted entirely through an inductive approach, and no predefined codebook was used prior to analysis. Coding was carried out independently by two researchers, and the results were subsequently compared using the Intercoder Agreement module of MAXQDA 20. The comparison yielded a Cohen's Kappa coefficient of 0.81, which indicates a high level of inter-coder reliability in qualitative research [37]. This finding demonstrates that the analytical process achieved an adequate level of methodological consistency and reliability.

### 4.5. Validity and Reliability

In qualitative research, validity refers to the extent to which the findings accurately reflect the research purpose, while reliability concerns the consistency of data collection and analysis processes [34]. In this study, multiple methodological strategies were employed to enhance validity and reliability.

First, data triangulation was ensured by analyzing sustainability and integrated reports from multiple companies, thereby preventing reliance on a single data source. Second, the coding process was conducted independently by two researchers, and inter-coder agreement was statistically tested. Third, direct textual excerpts were included in the findings section to ensure that analytical interpretations were clearly grounded in the data. Finally, the analytical procedure was reported step by step to strengthen methodological transparency.

The thematic code maps and analytical outputs generated during the study were archived in MAXQDA 20 and stored in a manner open to independent verification if required. Since the study is based solely on publicly available corporate documents, ethical approval was not required. Nevertheless, no confidential company information was used; only publicly disclosed corporate statements were analyzed.

### 4.6. Limitations of the Study

This study has several limitations. First, the analysis is limited to the top ten energy generation companies listed in the MW100 / 2025 report. Therefore, the findings cannot be generalized to the entire sector; however, they may represent institutional trends among large-scale enterprises. Second, the data source is limited to sustainability reports published in 2024, which restricts the ability to examine long-term changes. Third, the qualitative analysis approach inherently involves interpretative evaluation, which may reflect the researchers' analytical perspectives. Finally, since sustainability reports are corporate communication documents, some statements may carry a symbolic or reputation-oriented character. Although these limitations do not invalidate the findings, they should be considered when interpreting the results.

## 5. FINDINGS

Within this section, the qualitative data obtained from the 2024 sustainability reports of the energy companies examined were categorized under three main themes: **"**Green Competency Development," "Workforce Transformation," and "Organizational Learning and Leadership."

**Table 1.** Thematic Scope Map: Company–Theme Alignment

| Company | Green Competency Development | Workforce Transformation | Corporate Learning and Leadership |
|---|---|---|---|
| EÜAŞ | ○ | ○ | ● |

| Company | Green Competency Development | Workforce Transformation | Corporate Learning and Leadership |
|---|---|---|---|
| ENKA | ○ | ● | ○ |
| Enerjisa Üretim | ● | ○ | ● |
| Cengiz Enerji | ● | ● | ● |
| Limak Enerji | ○ | ● | ○ |
| Eren Enerji | ● | ○ | ● |
| Çelikler Holding | ○ | ○ | ○ |
| Aydem Enerji | ● | ● | ○ |
| İÇDAŞ | ● | ○ | ○ |
| Bilgin Enerji | ○ | ● | ○ |

**● : Companies with direct data (expression, application, example) in the theme**
**○ : Indirect relationship with the theme (data limited or indirect reference)**

The table not only illustrates how the ten energy companies included in the research are positioned across the three main themes, but also *serves as a response to the study's first research question:* "How do large-scale companies in the energy sector frame climate change from a human resource management perspective in their sustainability reports?"

Filled circles in the themes indicate that the relevant company's sustainability report contains direct data, practices, or explicit statements related to that theme, whereas empty circles represent limited or indirect associations. The resulting distribution reveals that companies in the energy sector adopt differing institutional priorities in their climate change adaptation processes. While some organizations stand out with approaches focused on green competency development and organizational learning, others place greater emphasis on digitalization and workforce transformation. This variation indicates that the green transition in the sector is not pursued through a homogeneous pathway, but rather through differentiated approaches shaped by organizational strategies and resource structures.

### 5.1. Green Competency Development

Companies in the energy sector emphasize that the green transition requires not only technological change but also a restructuring centered on human capital. Enerjisa Üretim has diversified its talent development programs with the aim of "equipping employees with the skills required by the green transition" and positions its workforce as the "carriers" of this transformation [38]. The company's Leader Next and Power MBA programs strengthen environmental awareness and strategic thinking capabilities, thereby aligning green competencies with organizational objectives. Similarly, Eren Enerji (2024) integrates green skills into its annual training planning in line with long-term corporate goals and embeds environmental awareness as a component of organizational culture [39]. Across the sector, reskilling and upskilling practices contribute to the institutionalization of green innovation by enabling the simultaneous development of digital and environmental competencies.

**Table 2.** Findings Related to the Theme of Green Competency Development

| Company | Practice / Program | Core Content | Objective |
|---|---|---|---|
| Enerjisa Üretim | Leader Next, Power MBA | Environmental awareness, strategic thinking, leadership development | Active employee participation in the green transformation process |
| Eren Enerji | Corporate Training Plan | Technical skills, environmental awareness, alignment with long-term goals | Embedding a sustainable production culture among employees |
| Aydem Enerji | Environment-Oriented Training Modules | Renewable energy awareness, data-driven process management | Development of green workforce competencies |
| Cengiz Enerji | Training, Development, and Career Management | Technical and managerial development, mentoring, performance management | Enhancing employees' continuous learning and adaptation to green processes |
| İÇDAŞ | Competency Development and Change Management Programs | Skill development for low-carbon production, change management | Re-adaptation of human resources |

Table 2 indicates that practices aimed at developing green competencies in the energy sector are predominantly structured around leadership programs, environment-oriented training modules,

and reskilling strategies**.** Moreover, the table also addresses the study's second research question: *"Through which knowledge, skills, and behavioral dimensions is the concept of green competency represented in corporate human resource discourses?"* The findings demonstrate that the green transition process in the energy sector is addressed not only as a technical transformation but also as a multidimensional restructuring occurring at the levels of employees' knowledge, skills, and attitudes. In addition, companies integrate their environmental objectives with human resource policies, thereby extending the sustainability vision beyond an operational focus to a domain of cultural transformation.

The analyses reveal that Enerjisa Üretim assumes a pioneering role in the sector through its leadership-oriented training programs, while Eren Enerji enhances employee awareness through long-term learning strategies. Aydem Enerji disseminates environmental consciousness at the organizational level through renewable energy–focused training initiatives; Cengiz Enerji promotes continuous learning by integrating conventional technical training with a sustainability vision; and İÇDAŞ stands out through its change management approach in the transition to low-carbon production. Collectively, these findings indicate that green competencies in the Turkish energy sector are increasingly evolving into a strategic human resource function and that employee training has become a fundamental instrument of sustainability policies.

### 5.2. Workforce Transformation

Under this theme, transformations implemented in workforce structures in line with digitalization and sustainability objectives are examined. The findings indicate that digital technologies reshape not only production processes but also job design, role definitions, and performance management systems. Companies providing direct and strong evidence under this theme include ENKA, Cengiz Enerji, Limak Enerji, Aydem Enerji, and Bilgin Enerji. ENKA has expanded the use of digital monitoring systems in production and maintenance processes, thereby establishing data-driven task definitions. At Cengiz Enerji, analytical responsibilities increase with a focus on process optimization and loss reduction, while manual tasks decrease. Limak Enerji integrates smart monitoring systems into workforce planning within renewable energy projects, restructuring task allocation in accordance with carbon targets. Aydem Enerji transforms employment models through remote operations and data-centered management practices, whereas Bilgin Enerji strengthens reskilling programs through predictive maintenance and performance analytics applications.

**Table 3.** Findings Related to the Theme of Workforce Transformation (Companies Providing Direct and Strong Evidence)

| Company | Digitalization Practices | Impact on Human Resources | Transformation Objective |
|---|---|---|---|
| ENKA | Automation, digital monitoring, data collection | Updating role definitions, increased need for digital skills | Process efficiency and operational reliability |
| Cengiz Enerji | Energy/water loss monitoring, process optimization | Reduction of manual tasks, increase in analytics and monitoring responsibilities | Reducing inefficiencies and improving performance |
| Limak Enerji | Smart monitoring in hybrid/renewable energy projects | Redesign of shift structures and task allocation | Integrated workforce planning aligned with carbon reduction |
| Aydem Enerji | Smart monitoring, remote operations | Expansion of operational roles, increase in data-centered positions | Production optimization and resource efficiency |
| Bilgin Enerji | Predictive maintenance and digital performance management | Need for reskilling, role transformation in maintenance and operations | Reducing failures and capacity losses, ensuring continuity |

At ENKA and Cengiz Enerji, the increasing emphasis on process optimization and analytical responsibilities has become more pronounced; meanwhile, at Limak Enerji and Aydem Enerji, monitoring capabilities and remote operation enabled by renewable energy portfolios have led to significant changes in employee roles. At Bilgin Enerji, predictive maintenance practices have triggered reskilling processes and transformed the technical knowledge domains of the workforce. This pattern indicates that digital transformation is not merely a technical investment but also a process that fundamentally reshapes human resource architecture through evolving skill profiles and job design.

### 5.3. Organizational Learning and Leadership

This theme illustrates how companies in the energy sector institutionalize learning processes and restructure leadership approaches in line with sustainability objectives. EÜAŞ, Enerjisa Üretim, Cengiz Enerji, and Eren Enerji emerge as prominent organizations in this regard. EÜAŞ addresses learning within the framework of corporate knowledge management and adopts a public responsibility–oriented leadership model through in-service training programs focused on

renewable energy, efficiency, and environmental sustainability [40]. Enerjisa Üretim integrates environmental responsibility with leadership development through programs such as Power MBA and NextChanger, positioning learning as a collective value rather than a hierarchical process [41].

Cengiz Enerji incorporates environmental awareness and innovative energy solutions into organizational culture through platforms such as the Transformational Leadership Summit, conceptualizing leadership not merely as a managerial function but as a cultural driver of change [42]. Eren Enerji, through the Eren Enerji Academy, provides digital learning opportunities and adopts a leadership approach that prioritizes environmental sensitivity and continuous development [43]. Overall, the findings indicate that the learning organization approach in the energy sector is increasingly integrated with environmental leadership and that knowledge sharing has become a central instrument of corporate transformation.

**Table 4.** Findings Related to the Theme of Organizational Learning and Leadership

| Company | Learning Approach and Platforms | Leadership Emphasis | Strategic Objective |
|---|---|---|---|
| EÜAŞ | In-service training, corporate knowledge management, alignment with public strategies | Public leadership and environmental responsibility | Institutional knowledge accumulation and social awareness |
| Enerjisa Üretim | Power MBA, NextChanger, environmental leadership programs | Collective leadership and learning organization culture | Developing competencies aligned with a sustainability vision |
| Cengiz Enerji | Transformational Leadership Summit, stakeholder participation, circular economy–focused training | Transformational leadership and environmental awareness | Sustainability-oriented transformation of corporate culture |
| Eren Enerji | Eren Enerji Academy, digital learning platforms, visible leadership practices | Participatory leadership and continuous development | Employee engagement and a sustainable learning culture |

Table 4 demonstrates that corporate learning and leadership practices in the energy sector are concentrated along three main dimension**s.** First, learning is integrated into knowledge management processes, thereby ensuring the institutionalization of corporate knowledge accumulation. Second, leadership programs are aligned with environmental and social responsibility values in order to strengthen employee commitment. Third, learning activities are

positioned as strategic instruments that go beyond individual skill development and enable the transformation of organizational culture. In this respect, the table also addresses the study's third research question: *"What trends does the green competency discourse reveal regarding the future of sustainable human resource management in the energy sector?"* The findings indicate that environmental sustainability objectives in energy companies are transformed into a future-oriented management vision through corporate learning, leadership development, and the transformation of organizational culture.

In the case of EÜAŞ, corporate learning is integrated within a framework of public responsibility; at Enerjisa Üretim, it is aligned with the learning organization approach; at Cengiz Enerji, it is embedded within an environmental leadership culture; and at Eren Enerji, it is associated with the principle of continuous development. Collectively, these findings suggest that corporate learning has become a fundamental component in the construction of a sustainable leadership culture in the energy sector and that organizations increasingly integrate their environmental objectives with their management approaches.

### 5.4. Comparative Thematic Evaluation

The comparative analysis across themes indicates that companies operating in the energy sector structure their Green Human Resource practices in line with differing strategic priorities and levels of institutional capacity. The theme of Green Competency Development appears to be more systematically institutionalized in organizations that invest in structured corporate training and leadership development programs. In contrast, in some companies, green competency practices remain limited to awareness-raising initiatives and short-term training activities, without being fully integrated into core HR processes such as performance management, career planning, and reward systems. This variation suggests that the level of institutionalization of Green Human Resource practices differs significantly across firms within the sector.

With regard to the Workforce Transformation theme, companies that have adapted more rapidly to digitalization and data-driven production processes demonstrate faster changes in job design, task definitions, and competency requirements. In these organizations, digital competencies and environmental competencies are addressed jointly, and workforce planning is restructured in alignment with sustainability objectives. Conversely, in some firms, digital transformation initiatives remain confined to technical production processes and are not strategically reflected in

HR policies. This divergence indicates that sustainable transformation depends not only on the presence of technological investments but also on the degree to which such investments are integrated into Human Resource systems.

The theme of Organizational Learning and Leadership is more strongly represented in companies that align their sustainability vision with top management strategies. In these organizations, environmental leadership discourse is supported through corporate training programs, learning platforms, and knowledge-sharing mechanisms, and sustainability objectives are embedded within organizational learning processes. In contrast, in other firms, leadership and learning activities are only loosely connected to environmental transformation goals, and sustainability discourse remains largely at the level of reporting-oriented corporate communication.

Overall, the comparative thematic findings reveal that Green Human Resource practices in the energy sector do not follow a homogeneous pattern of development. Instead, their depth of institutionalization varies according to firms' strategic orientations, investment priorities, and organizational learning capacities. While in some organizations green competencies are strategically integrated into HR systems, in others they remain largely symbolic or reporting-oriented.

These findings further demonstrate that in firms where green competencies are addressed primarily through environmental awareness and training activities, practices tend to assume a symbolic character. In contrast, when green competencies are embedded in performance management, workforce planning, and leadership development processes, they become strategically institutionalized. This suggests that, in order to generate sustainable competitive advantage, Green Human Resource practices must be structured not merely as reporting discourse but as an integral component of the HR system. In this respect, the findings are consistent with the human capital–based sustainable competitive advantage arguments proposed by the Resource-Based View and the Learning Organization perspective.

## 6. DISCUSSION

The findings of this study indicate that Human Resource Management is assuming an increasingly strategic role in the sustainability policies of companies operating in the energy sector. In today's business environment, possessing green competencies is increasingly regarded as a critical

requirement for employees in achieving sustainability goals at both the individual and organizational levels [44]. The integration of green competencies into HR systems through corporate training programs, reskilling initiatives, and leadership development mechanisms aligns with prior studies emphasizing the need to develop workforce policies consistent with environmental objectives within the Green Human Resource Management (GHRM) literature [3,18]. These results suggest that sustainability is no longer defined solely through environmental performance indicators but has become a core component of corporate strategy through the transformation of human capital. Similarly, the alignment of knowledge–skill–attitude components emphasized in [13] competency-based model finds concrete expression in the development of green competencies in the energy sector, thereby supporting literature highlighting the influence of individual competency structures on organizational sustainability performance.

At the same time, the study extends and partially differentiates itself from existing research. While previous empirical studies [47] have examined the relationship between green competencies and business sustainability through quantitative models in sectors such as mining, focusing on constructs such as green creativity and sustainable business model innovation, the present study adopts a qualitative approach and examines how green competencies emerge within organizational learning, leadership practices, and human resource transformation in the energy sector. While much of the international literature focuses on the positive effects of GHRM practices on environmental performance, the present findings reveal that the level of institutionalization of green competencies varies considerably among firms in the energy sector. In some companies, Green Human Resource practices are strategically integrated into performance management, workforce planning, and leadership development processes, whereas in others they remain largely confined to reporting activities and awareness-based initiatives. This finding provides sector-specific empirical evidence supporting previous research conducted in Türkiye that pointed to the limited integration of environmental objectives into HR processes within sustainability reports [30]. Moreover, it demonstrates that GHRM practices exhibit varying degrees of institutional depth across organizations.

The study further demonstrates that green competencies extend beyond environmental awareness and training activities and function as strategic human capital assets that reshape job design, skill structures, and role definitions in conjunction with digital transformation processes. This finding is consistent with the Resource-Based View [15], which posits that environmental knowledge and

digital competencies can constitute strategic resources capable of generating sustainable competitive advantage. In addition, the integration of organizational learning and leadership processes with sustainability strategies supports the explanatory relevance of the Learning Organization perspective in the context of environmental transformation [17]. By jointly addressing GHRM, the Resource-Based View, and the Learning Organization framework within the energy sector, this study proposes a comprehensive analytical model that conceptualizes sustainable transformation as fundamentally rooted in human capital dynamics.

The findings also reveal that environmental sustainability policies in the energy sector do not follow a homogeneous trajectory of development. Rather, their depth of institutionalization varies depending on corporate strategy, investment priorities, and organizational learning capacity. In firms where green competencies remain at the reporting level, practices tend to assume a symbolic character; conversely, in organizations where green competencies are embedded within HR systems, sustainable transformation becomes more strategic and enduring. This suggests that achieving sustainable competitive advantage requires Green Human Resource practices to be systematically integrated with training, performance management, leadership development, and organizational learning processes.

## 7. CONCLUSION AND RECOMMENDATIONS

This study analyzed the 2024 sustainability reports of large-scale companies operating in Türkiye's energy sector to examine the role of Human Resource Management in the climate change adaptation process from a green competencies perspective. The findings indicate that environmental sustainability in the energy sector is no longer shaped solely by technical investments but increasingly by the transformation of human capital. Companies have begun to recognize employees' awareness, competencies, and learning capacities as fundamental determinants of corporate sustainability, alongside environmentally responsible production processes. Nevertheless, Green Human Resource practices and organizational learning strategies have not reached the same level of maturity across all firms; in some cases, these policies remain largely symbolic.

The findings are consistent with international discussions in the GHRM literature [3,18] particularly regarding the role of training, reskilling, and leadership programs in enhancing environmental awareness. The knowledge–skill–attitude alignment defined in [13] competency

model also finds concrete representation in the energy sector. Furthermore, the integration of digital transformation processes with environmental competencies supports the Resource-Based View's [15] argument that such capabilities constitute sources of sustainable competitive advantage. Recent studies also indicate that digital technologies such as artificial intelligence–driven big data analytics can strengthen the development of green competencies; however, their effectiveness depends largely on the presence of a data-driven organizational culture and responsible leadership practices that translate technological capabilities into sustainability outcomes [46]. The themes of organizational learning and leadership correspond with the principles of systematic knowledge sharing and transformational leadership emphasized in Learning Organization model [17].

Based on these findings, three primary recommendations are proposed for organizations operating in the energy sector: Green competencies should be linked not only to environmental performance indicators but also to corporate efficiency and competitive strategies.Organizational learning mechanisms should be integrated with leadership development programs to embed environmental awareness as a permanent component of organizational culture. Sustainability reports should be designed not merely as external image-building tools but as mechanisms for internal transformation and accountability.

This study contributes to the GHRM literature in three principal ways. First, while much of the existing research focuses on the effects of GHRM practices on employee behavior and environmental performance, this study provides sector-specific qualitative evidence demonstrating how green competencies are structured in relation to workforce transformation, digitalization processes, and organizational learning mechanisms within the energy sector. Second, it offers empirical evidence that the institutionalization of Green Human Resource practices does not occur at the same strategic depth across organizations, highlighting symbolic versus strategic integration patterns that remain underexplored in the literature. Third, by integrating Green Human Resource Management, the Resource-Based View, and the Learning Organization framework within the energy sector context, the study proposes a comprehensive analytical model that conceptualizes sustainable transformation as a human capital–based process.

For future research, multi-layered qualitative analyses incorporating internal policy documents, training materials, and employee interviews—alongside sustainability reports—would provide

deeper insights into the institutionalization of green competencies. Additionally, comparative studies across different sectors would enable a more comprehensive understanding of how green competencies influence organizational learning and leadership dynamics. In this respect, the study offers an original contribution to the literature by integrating GHRM, RBV, and Learning Organization perspectives within the Turkish context, thereby advancing scholarly discussions at the intersection of environmental sustainability and Human Resource Management.

## DECLARATION OF ETHICAL STANDARDS

The author of the paper submitted declares that nothing which is necessary for achieving the paper requires ethical committee and/or legal-special permissions.

## CONTRIBUTION OF THE AUTHORS

**Ahmet Sarnıç:** Conceptualization, Analysis; Writing- review & editing.

## CONFLICT OF INTEREST

There is no conflict of interest in this study.

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