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Towards a Smarter Grid: Technological and Policy Interventions to Reduce T&D Losses in Pakistan

Salman Nazar*[1], Hira Salman[2]

[1*]PhD Scholar, Government & Public Policy, National Defence University, Islamabad, Pakistan.
[2]BS Scholar, Government & Public Policy, National Defence University, Islamabad, Pakistan.

Corresponding author: salman.nazar1973@gmail.com

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The energy system in Pakistan is in a constant state of crisis since demand is growing and transmission and distribution (T&D) losses are always happening. Pakistan's energy sector is an aging network that fails to meet modern reliability standards. During the last twenty years, the electricity demand has risen over 70 percent, and the system inefficiencies including line losses, power theft and poor billing recovery have only exacerbated the difference between the supply and the demand. The aim of the present research was to explore technological and policy solutions that can mitigate T&D losses and aid the shift to a smarter and more resilient grid. The research comprises a combination of policy analysis and technology using secondary data of the National Electric Power Regulatory Authority (NEPRA), Pakistan Electric Power Company (PEPCO), World Bank reports and international energy agencies. The analysis shows several structural impediments such as circular debt of more than PKR 2.6 trillion, old equipment and non-technical losses compressed within the distribution networks with relatively low voltages. Results indicate that stealing, tampering of meters, poor fault detection, and poor communication infrastructure continue to be the major cause of inefficiency. Technical losses due to failure of transformers, power loss in transmission lines and lack of automated monitoring make these issues more complicated. Digital metering, supervisory control and data acquisition (SCADA) systems, phasor measurement units (PMUs) and advanced communication platforms become important in real-time monitoring, quick fault detection, and demand-side control. Technological preparedness is present in the form of wireless communication technologies (ZigBee, WiMax, GSM), information and communication technologies, and new energy storage solutions, but government regulatory clarity, monetary openness and political determination are needed to put them into practice. Policy measures such as tariff rationalization, incentives for private investment, capacity building within distribution companies, and public awareness campaigns are essential to create an enabling environment. The study concludes that a carefully sequenced strategy emphasizing low-cost, high-impact measures can stabilize Pakistan's grid, reduce T&D losses, and lay the groundwork for future integration of renewable energy resources and smart infrastructure.

1. Introduction and Literature

There is an essential role of green innovation (GI) in the maintenance of environmental management (He and Qiu,2025; Lin et al., 2024; Qi et al., 2023; Benkraiem et al., 2023; Bárcena-Ruiz et al., 2023) and is a relevant value in organizations and societies; studies in this area have manifested an increasing trend in the present age. Moreover, environmental degradation has become a significant threat to human life. Most institutions have chosen GI in terms of environmental conservation and economic growth. Green transformation can help firms attain sustainable competitive advantages (Chang, 2011), particularly as environmental sustainability and economic profitability are increasingly important (Jiang et al., 2023). GI is a vital tool for firms today, which strengthens their market share and ensures long-term sustainability. A compelling GI will improve market positions, build a customer base, offer lasting assistance, and gain a competitive advantage. These benefits make GI a choice of management strategy among most companies and scholars. Schumpeter's hypothesis of novelty is the primary basis for innovation studies (Schumpeter, 1983). Huang et al. (2024) assumes that green change can meet people expectations regarding environmental protection. Green innovation is a mechanism that helps create new modes of production and technologies to overcome environmental issues, including pollution and the harmful consequences of resource use (Singh et al., 2020). Innovation classification encompasses product/service novelty and process innovation. The core point of product and service is to make them more effective for the customers. Innovation process has led to the accumulation of cost effectiveness and organizational flexibility (Wong et al., 2020; Tian et al., 2023), which in turn can help reduce risks to the environment (Qin et al.,2024), enhance resource efficiency (Li et al., 2024; Yuan and Pan, 2023; Zhang et al.,2025), and consequently, lead to the creation of an environmentally friendly culture that makes companies gain competitive advantage and environmental sustainability to society. Green innovation has provided competitive positions in terms of differentiation of products, reduction of costs, and customization (Zhao et al., 2022).

In addition, green innovations improve environmental performance by boosting the performance of the organization (El-Kassar and Singh, 2019; Li et al.,2022; Wang et al.,2023), improving the quality of the services (Wu et al.,2025), and creating ecologically friendly products or services (Ye et al.,2023; Wong et al.,2020). Similarly, companies have focused more on adopting ecologically sustainable behaviors in recent decades than in the past (He & Qiu, 2025). The latter can be explained mainly by the fact that environmental threats are growing (Liu et al., 2025), posing a significant danger to human lives. Organizations are also committed to addressing the adverse ecological effects and mitigating them in accordance with stakeholder demands. Hence, companies are actively acquiring and moving to products with fewer pollutants and longer life cycle (Olson 2013), At this stage, green innovation can be defined as innovative hardware or software about products or processes that are more friendly to the environment and contain technical improvements or new administration strategies (Chin et al.,2022), promoting strategic objectives (Wang, 2022; Janjua et al.,2024), enhancing positive performance in an organization (Patwary et al., 2024; Bani-Melhemet Therefore, GI is a necessary tool that would support the

society, businesses, and organizations to be environmentally sustainable and hence, part of the competitive advantage (Dai et al., 2025), and enhance economic performance and mitigate GI challenges and environmental issues.

On the other hand, GI negates imitation opportunities (Lu et al., 2025). It is emphasized that this component holds great significance for organizations, corporations, and the broader community. Nevertheless; to achieve organizational success in terms of novelty, it requires the acceptance of green solutions (Guo et al., 2025), it requires the implementation of corporate culture through knowledge, experience and skills exchange among employees (Ma et al., 2024; Demastus et al.,(2025), it requires that senior management demonstrates the obligation (Sun et al., 2021; Sun et al., 2024), that the internal and external knowledge is assimilated by the nature of the systems used and concerns related to technological issues (Song et al.,2020). Nevertheless, the realization of these determinants is facing numerous obstacles, assessing the environmental concerns of green technologies (Lu et al., 2025), the risk of failure in the implementation process (Qin et al., 2025), high research and development expenses (Tian et al.,2023; Li and Lu 2023), issues with the collection of data (Han et al.,2024), increased workload and dissatisfaction with employees (Fazal-e-Hasan 2023), lack of funds of implementation of green. Most importantly, it may prevent the adoption of green activities by organizations and communities. The research objectives that were achieved through the reviewed literature within the organizations to fulfill the following criteria: (a) An addition to the growing understanding of the field of green innovation, as the total number of articles that used the keyword of green innovation in the Web of Science in the period between 2006 and 2025 is 28 articles; (b) This is because the field of green innovation is a developing area that lacks enough empirical and theoretical support. One of the authors' goals was to write this article and identify gaps in research on green innovation, as well as consider possible implications for the future. The article is a significant contribution to the body of literature on green innovation, as the authors identify gaps in research that serve as potential directions for future studies in green innovation. Second, the research offers significant insights into how managers can foster an environmental culture within an organization. Researchers have attempted to incorporate a sense of green innovation in various aspects of their work. Nevertheless, insufficient studies have been conducted to determine the current state of knowledge on green innovation. The research tries to answer the two research objectives: (a) to determine the current knowledge in the field of green innovation and to shed light on literature in the field using a systematic literature review (SLR), and (b) to determine the gaps in research in the field of green innovation.

This study is organized into six sections. The primary objective of the introductory section is to provide an initial description and definition of the research objectives. The second and third chapters concentrate on the research methodology, literature review, and research specifications, respectively. Section 4 summarizes the results, discussion and presents future thoughts on GI, followed by section 5, concluding with reference section.

2. Methodology

Given the multiplicity and discontinuity of the topic, where green innovation studies are written in Economics and Management journals, we used a thorough approach to our literature review (Qin et al., 2025). The review was conducted using a systematic review methodology developed by Javed et al. (2024). We have been extremely precise about what is needed in the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA). Systematic reviews do not necessarily have standard procedures on which they are based, and this leaves them open to doubts regarding validity and repeatability. PRISMA is an eligible approach that presents a framework of specific guidelines to ensure quality and reproducibility. According to these criteria, Moher et al. (2015) formulated the review procedures, stated the search strategy, and outlined the criteria to be applied during the selection of articles, methods, and data extraction and analysis.

The systematic review methods were applied in this research, as recommended by Javed et al. (2024). Systematic reviews make it easier to document, analyze, and synthesize all the studies related to a given issue (Petticrew and Roberts, 2008), and they also aid in determining gaps in the current literature.

Using the Web of Science database, we took the first step to identify the relevant literature. WoS is a highly popular database that is free and offers numerous functions that other databases, such as Scopus (Elsevier) and Google Scholar (Bakhmat et al., 2022). Moreover, a comparison of journal coverage between WoS and Scopus indicated a limited number of journals indexed solely in WoS, with around 97% of WoS journals also being indexed in Scopus.

3. Eligibility Criteria/Inclusion and Exclusion Criteria

We utilized a systematic methodology for selecting papers for our literature review, following five established screening criteria in Table 1.

Table No 1: Criteria for Inclusion and Exclusion of Articles

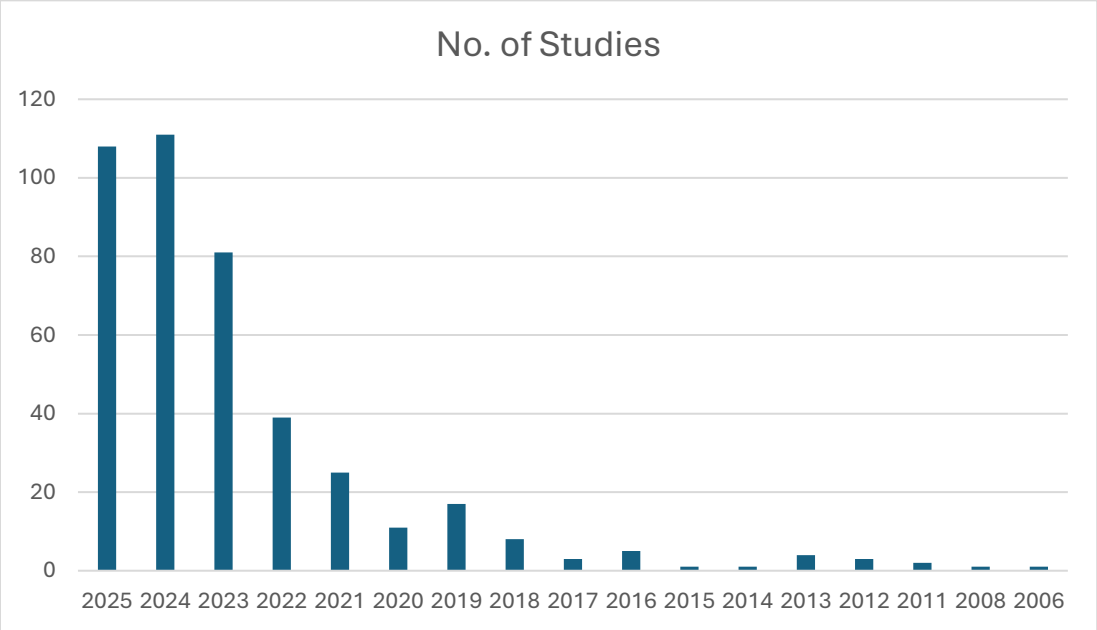
Inclusion criteria	Exclusion criteria
Articles published in English	Books, conference proceedings, newspapers, and magazine articles
Only full-length journal articles	Articles published in a language other than English
Articles published between 2006 and 2025 ABS 4*,4.	Articles published on related concepts, e.g., Eco Innovation
Articles published in peer-reviewed journals	
Empirical, conceptual work, and review articles	
Articles discuss Green Innovation as the central topical theme in ABS 4* and 4 Journals.	

3.1 Data Collection and Search Strategy

WoS has an impeccable reputation concerning systematic reviews (Martin-Martin et al., 2018). Second, the choice of keywords was organized according to the suggestions made by writers and colleagues. This literature endeavors to survey the field of green innovation (GI), and some articles may have used terms such as Corporate Green Innovation and Green Innovation Efficiency interchangeably, where green innovation is their primary focus. Therefore, we have entered the keyword "Green Innovation" into the Title and Abstract fields of the Web of Science database and received more than 1,969 articles in the Economics and Management field. Third, we searched only peer-reviewed journals that were blinded, which guaranteed a higher level of methodology compared to editorials, conference papers, and book chapters (Willmott, 2022); thus, our inventory narrowed down to 1547 articles. Fourth, we first examined the publication dates of the articles to extract the relevant publications that focus solely on the concept of GI.

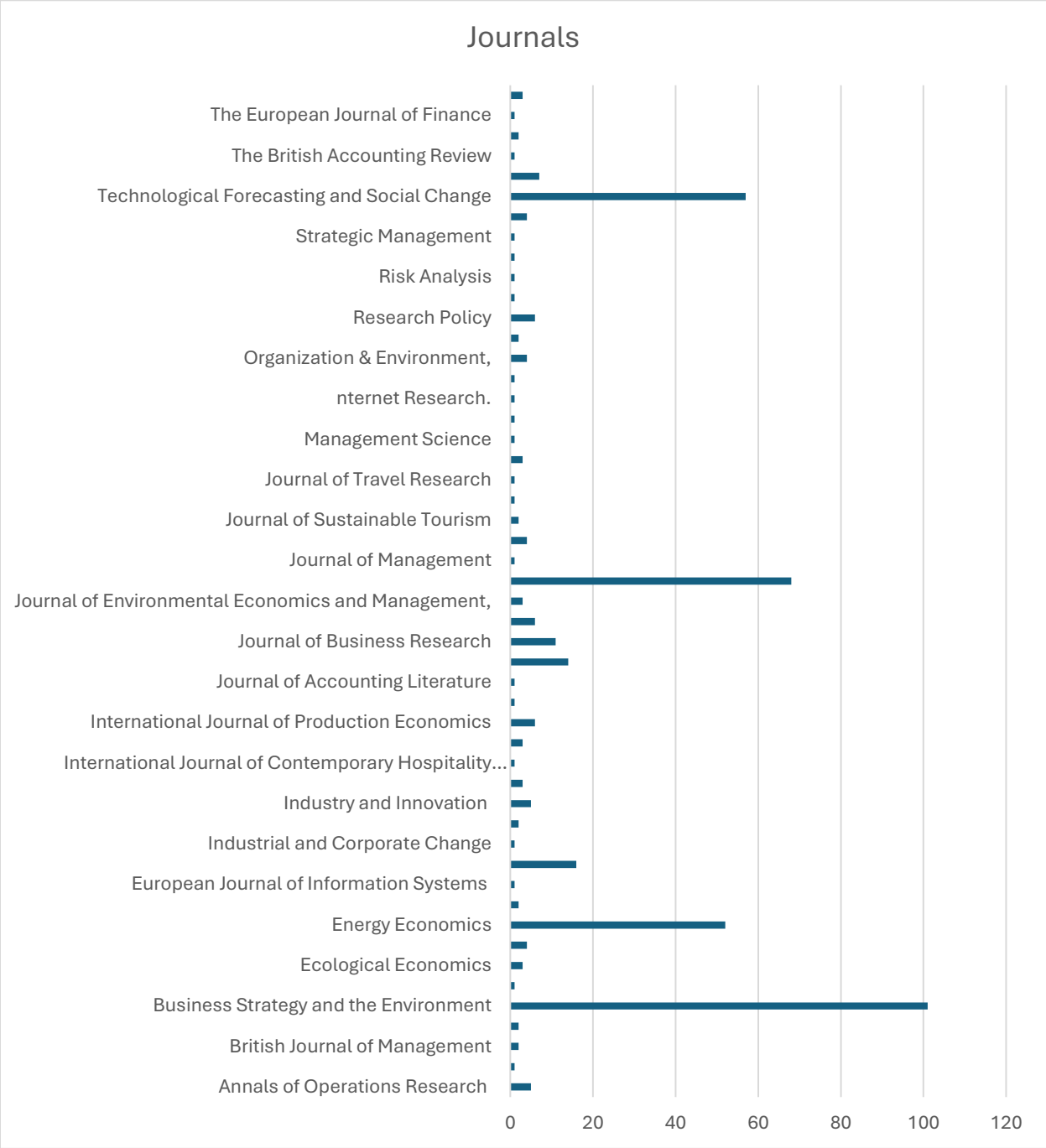
We then identified publications published as journal-driven strategies in the 4*, 4, and 3 category of ABS. This strategy of screening important articles helped us reduce the number to 422 items. The results, as depicted in Figure 1, are based on the number of studies published in journals.

Figure No 1: Number of Studies Published in ABS 4*,4, and 3 Journals



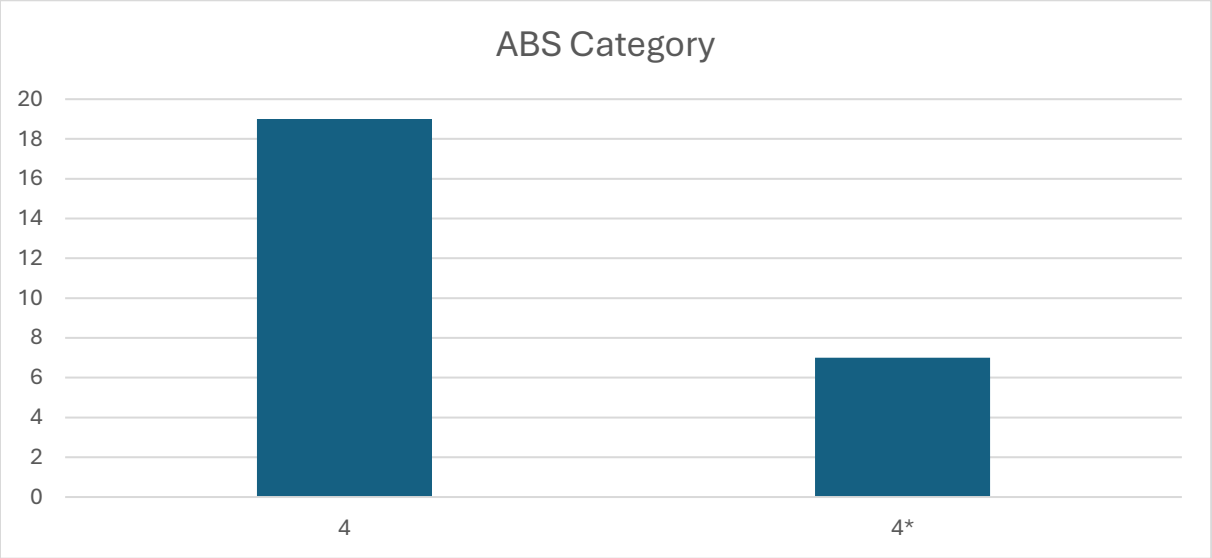
Then we filtered out the other 422 publications to determine their applicability to GI, such as corporate green innovation or green innovation efficiency, so that they were not considered similar and synonymous with GI. Figure 2 indicates the publications in a journal.

Figure No 2: Journal-wise Publication



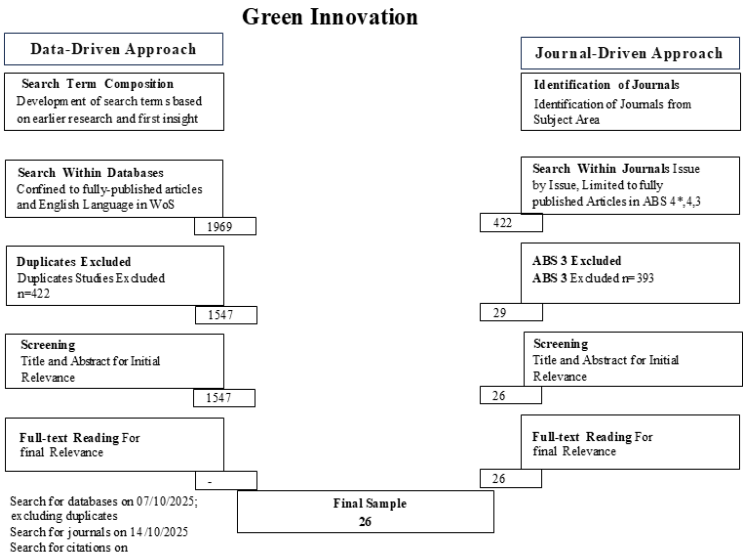
Reading and re-reading enabled us to identify 28 articles, which covered GI alone, published between 2006 and October 14, 2025, in the reputable sources ABS 4 and 4*.

Figure No 3: Publication in ABS 4* and 4



To evaluate the present situation and forecast the perspectives of the future, we performed a systematic descriptive review of the literature, following the framework proposed by Paul and Criado (2020), and used the method of qualitative thematic synthesis, as recommended by Moher et al. (2015). As recommended by Qin et al. (2025) and Javed et al. (2024), we summarized the literature to find the study themes and suggest future research topics, which are described in Figure 4.

Figure No 4: Search Strategy



3.2 Keywords and Search Terms

To identify the relevant papers, we developed keywords that aligned with our research objectives. With the help of informatics, these keywords and search terms were optimized and updated, and each was carefully combined with the WoS search to enhance the accuracy of the search. The list of the obtained keywords and search queries has been elaborated on. The better terms were used systematically to identify the appropriate studies in contemporary literature.

3.3 Search and Elimination of Duplicates

A preliminary stage (Qin et al., 2025) will be developed to extract keywords from titles and abstracts. The method resulted in 1969 articles. Additional research in critical journals ABS 4*, 4, and 3 identified 422 articles. During the initial stage of a systematic review of the literature, duplication is likely to be rampant (Takalo and Tooranloo, 2021). A sample size of 1,547 titles was obtained after eliminating duplicate articles from the list. To determine the relevance of each article, the remaining items were obtained as separate PDFs. The references used in the articles were also examined to ensure that all pertinent content had been covered.

3.4 Title and Abstract Analysis

Based on the methodology created by Quin et al. (2025), we then read the titles and abstracts of both studies to assess their compliance with the key criteria of relevance, as recommended by Takalo and Tooranloo (2021). The research that failed to meet the described criteria was filtered out, but this process was conducted carefully, as recommended by Rupasinghe et al. (2023). The final number of papers meeting the criteria was 422 and passed to the second step of the review.

3.5 Full Text Assessment

The third step involved searching for 422 articles and reading their texts using the methodology proposed by Takalo and Tooranloo (2021). After an extensive assessment, 26 studies were identified and included in the final sample.

3.6 Quality Assessment

The quality of the studies was assessed during the data extraction process, in relation to the four research objectives established. Among the 28 papers reviewed, high-quality papers were graded based on the following criteria: Has the research objective been well defined? Are the research methodologies embraced in the study properly articulated? Has the study got clear context information? Have the study results been briefly indicated?

3.7 Study Records

A folder was established to organize and appropriately store the studies located in the search. Four stages of screening, eligibility assessment, and inclusion took place. Independent coders ensured that the screening process was comprehensive and objective. Programmers independently retrieved the data on the factors of interest. This analysis occurred in several stages.

The former consisted of the coders making a list of key parameters. In selected studies, 75% of the parameters were unanimously agreed upon. A group consultation between the coders to make sure that the proper standards were achieved in terms of our research objectives, including the names of authors, names of articles, type of study, and theories. The data were gathered gradually, and the individual coders created their tables using the retrieved information, applying the specified parameters separately. The tables were analyzed and assessed, and the obtained data was included. The agreement of the first coder was 88 percent, and then this was adjusted through discussions until an overall agreement on the chosen research was reached. The articles located were then categorized by date of publication, and a distinctive code was assigned to each article.

3.8 Data Synthesis

In the final phase, we systematically analyzed the pertinent content in the 26 selected articles and categorized the contents into themes to draw significant conclusions. The extraction was performed using a content analysis procedure in relation to pertinent theories. We synthesized the contents of all pertinent articles to identify similar findings that fit the study's aims and research questions. This was then to be followed by the development of a detailed database to rank the information in a systematic form. The following conclusions can be drawn from this synthesis.

4. Findings

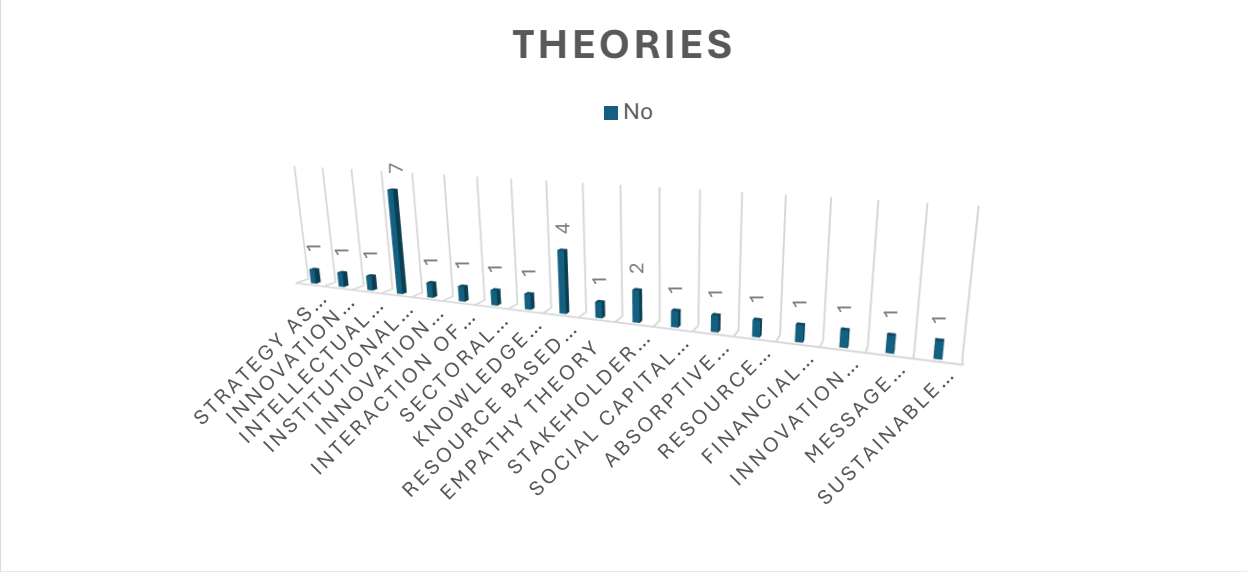
A critical analysis of the literature on green innovation, conducted by various scholars between 2006 and 2025, was undertaken to understand the diverse aspects that have been explored. The articles used in the studies were from academic journals. A certain amount of the research was conceptual, although some of it was empirical. The empirical studies examined the strategy of green innovation, the performance of companies or their competitive advantage, the drivers of green innovation, variables that influence the adoption of green innovation, and the determinants of green innovation. The effects of environmental orientation dimensions, green culture, stakeholder influence, green entrepreneurial orientation, a green innovation model, ecological practices, barriers to green innovation, sustainable development challenges, and the intention to adopt green innovation. The conceptual factors considered were related to the overall overview of the existing literature on green innovations and the meaning of green innovation. A review of the future, present, and past green products and innovations in various fields. Most review articles focused on the performance of firms. It has been correlated with firm performance in terms of green innovation, financial performance, and competitive advantage. The second dominant theme was the contribution of stakeholders to green innovation and the impact of different stakeholders, including customers, government, and competitors.

4.1 Theoretical Grounding of Green Innovation

Figure 5 presents the theoretical underpinnings of the relevant green innovation research, and most studies use institutional theory as their framework. The other theory most used is the resource-based perspective, and two articles utilize stakeholder theory. Other theories applicable

to a single study include the Strategy as Practice perspective, Innovation Employment Theory, Intellectual Property Rights (IPR) Theory, and the Innovation Performance Theory.

Figure No 5: Theories used in the figure



The Resource-Based View (RBV) posits that a firm's competitive advantage can be sustained through resources and capabilities that are unique, valuable, rare, inimitable, and non-substitutable. In the case of Green Innovation , RBV is used to explain how firms achieve high performance in terms of both environmental and economic outcomes. GI is not only viewed as a cost or compliance approach, but also as a practice of Green Innovation Capabilities, including green knowledge accumulation, R&D team specialization, knowledge of green processes, and the implementation of an environmental management system. Finding: The review repeatedly concludes that those companies that are integrating their conventional technology and organizational resources with new, intensive green capabilities (e.g., integrating green supply chains) are getting a two-fold payoff in improving their environmental performance, and in providing a competitive advantage that is difficult to replicate by their competitors, especially when digital technologies are supporting the capabilities.

The issue of the Institutional Theory (IT) focuses on how the forces of the environmental field (organization, society, government, and rival companies) influence firms to adopt the specific type of structure, practice, or innovation so that they can gain legitimacy and acquire the necessary resources. Those pressures are likely to influence each other (in the ways of similar successful peers in uncertain situations) through three forces: coercive (regulations and mandates), and normative (professional norms and societal expectations). IT is considered the most common prism for elucidating the factors and motives behind GI, especially in highly regulated or closely observed industries. The synthesis illustrates that coercive pressure (e.g., stringent environmental

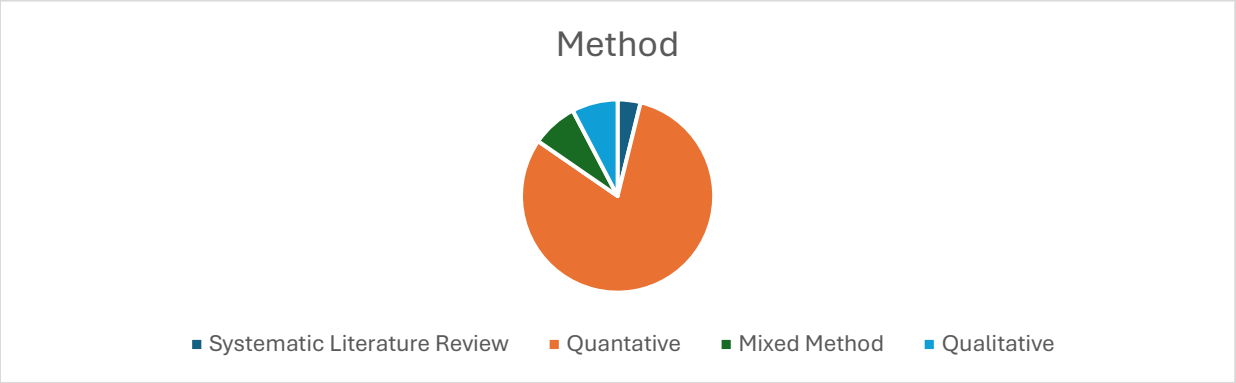
protection regulations and carbon taxation) is the most significant initial force that can likely initiate incremental GI compliance. However, a significant role is the normative influence (e.g., industry certifications, sustainability ratings), which promotes strategic and radical GI, the purpose of which is to increase organizational legitimacy.

The Stakeholder Theory (ST) is based on the premise that to become a successful organization, a company must create value for and respond to the expectations and interests of all its primary and secondary stakeholders (i.e., customers, employees, investors, local communities, NGOs). ST may help in the GI field to establish the focus and identify the players of the innovation process. To mitigate risks and secure stakeholder support, companies must prioritize GI projects that address the primary concerns of stakeholders. Finding: The review highlights that active interactions with demanding customers (green product) and environmental NGOs (process transparency) are key factors in determining the intensity and breadth of GI. In addition, the literature reviewed by ST confirms the significance of internal stakeholders, particularly employees. Internal training and remuneration of employees in accordance with environmental goals have a significant and positive impact on the effectiveness of GI implementation.

4.2 Research Method Displayed in Relevant Green Innovation Studies

This paper will review 26 selected articles that examine green innovation from various perspectives and discuss multiple aspects of the topic. The findings were synthesized by conducting an exhaustive analysis of every study and its content. The technique used grouped the studies into three basic categories: Literature Reviews, Qualitative, and Quantitative. As seen in Figure 6, there are 21 quantitative studies. To date, quantitative research has been widely applied as the primary methodology for studying firm-level panel data. In the context of qualitative research, two studies have employed in-depth surveys. Finally, one of the publications contains systematic literature reviews, and two have used mixed methods.

Figure No 6: Different Techniques used in Green Innovation Studies



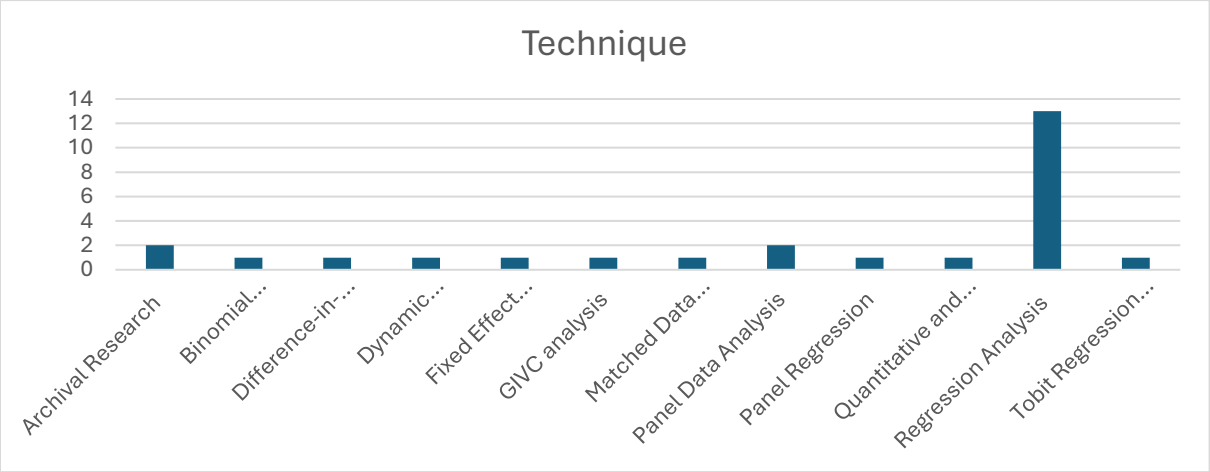
As shown in Figure 7, the bulk of research on green innovation (25 studies) has been conducted in manufacturing organizations, with only one study reviewing multiple studies. These

studies have involved the manufacturing and service businesses. Therefore, it is evident that a gap exists in the empirical research on green innovation in the service sector.

The study employed a cross-sectional design to analyze the relationship between the research technique and the geographical focus of the studies. The subsequent investigation aimed to establish the research method used in the regional or geographical blocks. Although the numbers are not statistically significant, they indicate the level of analytical sophistication in the study of green innovation across key regional blocs and individual countries.

Additionally, we aimed to evaluate the research approaches employed by researchers in exploring the primary themes or research questions. A cross-sectional analysis was conducted to explore the relationship between the research methodology and thematic representation. The studies analyzed employ a methodological design that involves the use of regression analysis.

Figure No 7: Different Techniques used in Green Innovation Studies



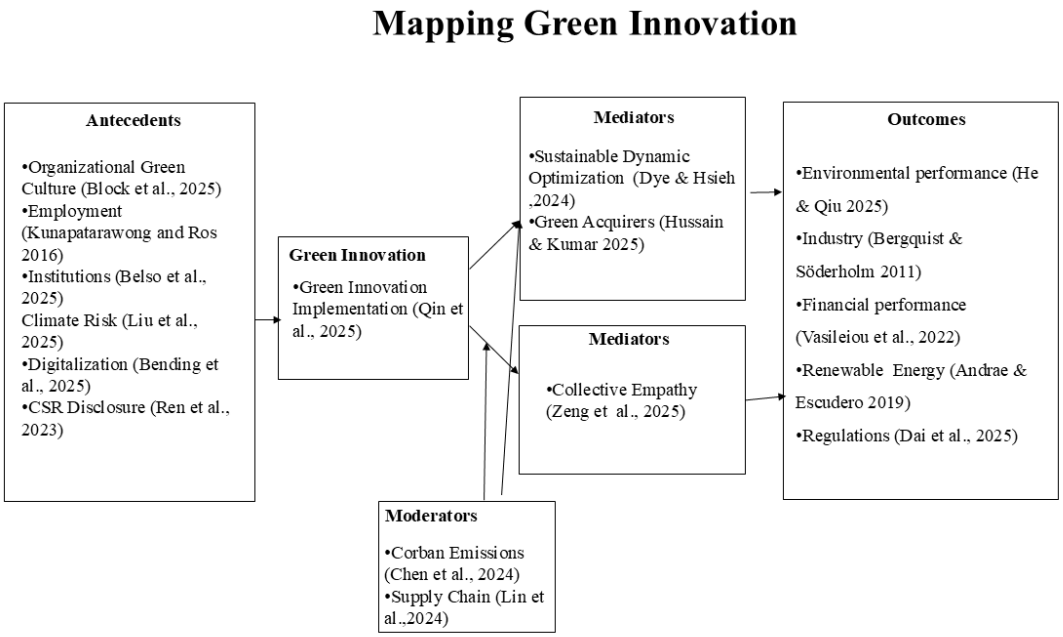
4.4 Segregation of Relevant Green Innovation Studies by Theme

According to the most recent research paper by Qin et al. (2025), the themes are divided into six areas: Institutional pressure, Barriers to Green Innovation Development, Structural changes, Benefits of Green Innovation, Organizational learning, and Organizational Competences. Figure 5 illustrates the thematic classification of relevant green innovation research, revealing that most analyzed articles have explored the benefits of green innovation. The benefits of green innovation have been discussed in relation to firm performance, firm value, and competitive advantage. The second and most common problem was the structural changes, which included the discourse of green management and managerial environmental consciousness. Minimal research has been done on impediments to the creation of green innovation.

4.5 Research on Antecedents, Moderators, Mediators, and Outcomes of Green Innovation

This review aims to establish the nomological context of responsible leadership. Figure 8 proposes an organizational structure that summarizes the existing research on instances of antecedents, mediators, moderators, and outcomes to date. There are two main things that we would like to do before discussing the individual elements. The framework is not intended to be exhaustive of all research on responsible leadership, but rather a reflection of the existing research. Secondly, variables and their relationships are not explicitly specified in the given research or in terms of our framework. We provide a rational classification of the mediators and results that may not be stated in the same way as in the studies used.

Figure No 7: Antecedents, Moderators, Mediators, and Outcomes of Green Innovation



4.5.1 Antecedents of Green Innovation

To date, scholars have found many important antecedents of green innovation. The antecedents primarily focus on green innovation, encompassing a broad range of concepts, including green culture (Block et al., 2025), employment (Kunapatarawong & Ros, 2016), organizational institutions (Belso et al., 2025), and climate risk (Liu et al., 2025). Macro-oriented organization factors have received much less attention. They include the CSR disclosure methodology (Ren et al., 2023) and the digitalization strategy (Bending et al., 2025). The macro-level problems that researchers have reviewed typically occur outside the organization, including external regulations, codes, and global governance (Block et al., 2025). Many macro-level factors discussed as antecedents are ubiquitous in the research on different spheres of green innovation. However, there are significant gaps in the analysis of dimensions, the role of external stakeholder

needs and requirements, as well as the impacts of organizational strategy and the global governance system (3.5.2 Mediators of Green Innovation).

The study of mediators in green innovation is progressive in relation to antecedents, but research concerning a combination of macro-level mediators is lacking. Mediation has been studied in terms of motivating models, including the Sustainable Dynamic Optimization (Dye and Hsieh, 2024) and Green Acquirers (Hussain and Kumar, 2025). Cognitive aspects, such as Collective Empathy, have been focused on by other scholars (Zeng et al., 2025). The researchers have also studied the exploration of relationship and identification systems. The study of macro-level mediators is becoming increasingly important in literature, including corporate social practices and organizational traits that support the optimization of firms' efforts to mitigate environmental threats (Dye and Hsieh, 2024). One of the most significant limitations of the present analysis of mediators is that it relies on cross-sectional designs, which do not adequately capture green innovation as a process where green innovation mediates the relationship between employee and organizational outcomes, based on intermediate variables. These aspects of processes cannot be captured using cross-sectional designs.

4.5.3 Moderators of Green Innovation

The literature review on examining the moderators of green innovation is still in its infant stage. The researchers have therefore explored dimensions such as organizational and wider contextual dimensions. The inclination towards factors specific to followers has already received considerable attention and includes green carbon emissions (Chen et al., 2024). The analysis of the determinants of green innovation has primarily focused on the supply chain structure, specifically the alignment of the firm (Lin et al., 2024). The analyses of moderators have so far brought minimal information on the factors that amplify or reduce the impacts of green innovation on environmental concerns and organizational outcomes. One of the significant gaps here is the lack of interaction with the less powerful attributes of organizations as moderators.

4.5.4 Outcomes of Green Innovation

The studies focus on the impacts of green innovation and, to a lesser degree, the study of macro-level impacts. The review of the findings primarily examined the environmental hazard and climate resilience results, but not the relational employee participation in green initiatives. The connection between ecological performance (He & Qiu, 2025) and its effect on industrial efficiency has been widely studied by researchers. The analysis of fiscal performance findings has primarily focused on positive returns from environmentally sustainable and innovative products (Vasileiou et al., 2022). Leading scholars have studied organizational performance, whereas the subjective measures of achieving renewable energy are used (Andrae and Escudero, 2019). For example, they include legislation that considers environmental performance (Dai et al., 2025). The current study presents a piecemeal image, and there is much left to be desired in terms of our understanding of the mechanism of green innovation and its impact on companies. Green innovation is viewed as a desirable strategy, although little research has been conducted on the potential adverse outcomes. This optimistic view is also reflected in the discussion of antecedents,

moderators, and mediators. Furthermore, the research methods employed in existing literature do not, in most cases, provide sufficient detail on the nature of green innovation processes and their outcomes.

4.6 Discussion

As our review has demonstrated, the literature on green innovation is vast and diverse, and it is currently garnering considerable scholarly interest. Finally, it can be concluded that although the number of papers located during our search is rather large, the studies on green innovation remain at an infantile stage. The reviewed literature suggests that green innovation can develop and prosper as a distinct field of study within management, business, and economics, which warrants further attention to its conceptualization. We clearly proposed a holistic concept of green innovation, which focuses on numerous stakeholder relationship orientations and their viability as a distinctive framework for green innovation. Although green innovation has received significant focus and reputation as a leadership paradigm, other unexplored areas remain open to investigation. Our research agenda for future green innovation studies encompasses several important sub-themes. The sub-themes include: (1) alternative modalities of green innovation and its effects; (2) synergies with theoretical frameworks; (3) synergies with known concepts of green innovation; (4) analyses of various economies and enterprises; (5) green innovation and eco-innovation; and (6) methodological issues. This paper focuses on these areas and key research questions. Other possible Determinants of Green Innovation and their Effects. As demonstrated earlier, it is possible to consider numerous criteria or dimensions of green innovation, depending on nature and the scope of its perceived contribution to one or more dimensions of environmental performance. One of the weaknesses of the research is the lack of established determinants of green innovation. Despite initial attempts (e.g., Qin et al., 2024), further research is necessary to develop a new concept and generate original ideas.

5. Conclusion

This Systematic Literature Review has provided an international insight into the world of green innovation, delineated its limits, and established a working methodology to advance to the next level. This study is a valuable resource, as it helps interpret its conceptual core, consolidates its theoretical foundations, and thoroughly examines its antecedents and implications, which are of interest to both academics and professionals. The framework above needs to address the identified gaps, particularly those related to multilevel dynamics and the intersection of digital transformation and green performance, which ultimately yield a more comprehensive and viable body of knowledge to achieve the objectives of global sustainability.

5.1 Synthesis of Findings and Theoretical Contribution

The Systematic Literature Review (SLR) on Green Innovation (GI) synthesizes more than 26 articles published since 2006, offering a comprehensive overview of how the conceptual components of GI work, what drives it, and the results it delivers, as well as the theoretical framework on which it is based. Figure 7 represents the main conceptual contribution, specifically,

the creation of a comprehensive GI model; it defines the antecedent mechanism (macro, meso, and micro levels), variables of the processes (types of GI and digital mediation), and the firm-level and societal outcomes (economic, environmental, and social performance). The review demonstrates that currently, the literature on GI is founded on three theoretical perspectives represented in figure 5, which include the Resource-Based View (RBV), where GI capabilities are explained in the context of long-term sustained competitive advantage; the Institutional Theory (IT) where the importance of regulative, normative, and cognitive pressures that compel the firms to GI implementation are considered; and the Stakeholder Theory (ST) where the interaction with the external environment (e.g., customers, NGOs) effects on GI priorities are explained. Applying these theories to aspects of the GI process, this review makes an excellent contribution to theory, filling an existing gap in the literature associated with the haphazard application of theory. It provides a single theoretical framework for future studies. Moreover, our results enable us to understand how GI works, indicating that the driver effect is not linear, but rather depends on internal organizational conditions (e.g., Figure 7). We reveal the ignorant yet indispensable nature of the digital economy and technologies (AI, Blockchain) as brokers, in which GI processes are even quicker, larger, and more efficient. Instead of adoption, they will be interconnected entirely, which will be a so called digital green change.

5.2 Managerial and Policy Implications

This review will serve as a valuable lesson for managers and policymakers. The results indicate to managers the relevance of a multidimensional approach to GI. The organizations must not merely concentrate on the technological R&D (product/process innovation) but also have a sound green organizational culture (the micro-level requirement) and maintain intense cooperation in the supply chain (the meso-level requirement). According to this argument, environmental performance becomes sustainable when GI programs are aligned with the institutional requirements and the company's special assets. The review highlights the efficacy of regulatory pressure (e.g., high environmental standards, price on carbon) as one of the driving forces of innovation to policymakers. Nonetheless, the implication of this is significant in that such strategies need to be complemented with other strategies, e.g., R&D subsidies and tax subsidies, particularly regarding the diffusion and adoption of GI to SMEs, which are not currently performing as well as large businesses. The two fold strategy yields both compliance and competitive advantage, which is beneficial in accelerating the transition to a sustainable economy.

5.3 Limitations and Future Research

Although this SLR is a comprehensive literature review of green innovation, it has weaknesses that are worth mentioning. To begin with, a narrow selection of peer-reviewed articles in the WoS, and in English, may lead to bias in geographical setting (e.g., North America and Europe) and an inadequate sample of the gray literature or non-English scholarship. Second, our examination, although conducted over a long period, is determined by the quality and methodology of the primary works; these inconsistencies in measurement scales and research designs could not help but influence the overall applicability of some of the results. Finally, the character of

systematic reviews, which necessitates following quickly growing ideas that have not yet been presented in literature, presupposes that very novel and progressive theoretical discourse can be underrepresented.

5.4 Future Research

Given the existing information and literature gaps, we suggest the following practical recommendations for future research. Future research should not only emphasize the top-down approach at the firm level but also extend to individual, organizational, and institutional levels. Studies in this direction must examine the relationship between responsible leadership (on the micro-level) and national policy of innovations (on the macro-level) to activate the level and character (radical vs. incremental) of GI. The gap is acute with respect to the knowledge about the harmful or unwanted effects of GI. The perspectives that critical theory researchers should explore include the resistance of an organization to green transformation, the greenwashing phenomenon reinforced by digital tools, and the impact of GI on job displacement and social equity. More longitudinal and qualitative research studies are needed to open the black box of the GI process. It entails analysis of how specific dynamic capabilities are required to integrate the application of digital technologies (e.g., AI in R&D) into green processes and how these processes can provide a long-term competitive advantage. Given that climate change is an international problem, the studies on this topic should be increased to compare the effects of institutional variations (e.g., planned economies and market economies) on the efficiency of GI. The research areas, geographical areas, and industries that are underrepresented (e.g., the services sector, heavy industrial sector) should also be considered.

6. References

Agyekum, Kofi, et al. "Obstacles to green building project financing: an empirical study in Ghana." *International journal of construction management* 22.15 (2022): 2922-2930.

Akhtaruzzaman, M., Banerjee, A. K., & Boubaker, S. (2025). Government intervention and green innovation in renewable energy. *Energy Economics*, *145*, 108185.

Andrae, B. E., & Escudero, N. A. (2019). Green innovation from the global south: Renewable energy patents in Chile, 1877–1910. *Business History Review*, *93*(2), 379-395.

Bakhmat, N., Kolosova, O., Demchenko, O., Ivashchenko, I., & Strelchuk, V. (2022). Application of international scientometric databases in the process of training competitive research and teaching staff: opportunities of Web of Science (WoS), Scopus, Google Scholar. *Journal of Theoretical and Applied Information Technology*, *100*(13), 4914-4924.

Bammens, Y., & Hünermund, P. (2023). Ecological community logics, identifiable business ownership, and green innovation as a company response. *Research Policy*, *52*(8), 104826.

Bani-Melhem, S., Al-Hawari, M. A., & Mohd. Shamsudin, F. (2022). Green innovation performance: A multilevel analysis in the hotel sector. *Journal of Sustainable Tourism*, *30*(8), 1878-1896.

Bárcena-Ruiz, J. C., Garzón, M. B., & Sagasta, A. (2023). Environmental corporate social responsibility, R&D and disclosure of "green" innovation knowledge. *Energy Economics*, *120*, 106628.

Bendig, D., Schäper, T., Strehlow, M., & Foege, J. N. (2025). Leveraging digital alliances for green innovations: a pathway to becoming green. *European Journal of Information Systems*, 1-25.

Benkraiem, R., Dubocage, E., Lelong, Y., & Shuwaikh, F. (2023). The effects of environmental performance and green innovation on corporate venture capital. *Ecological Economics*, *210*, 107860.

Chang, C. H. (2011). The influence of corporate environmental ethics on competitive advantage: The mediation role of green innovation. *Journal of business ethics*, *104*(3), 361-370.

Chin, T., Shi, Y., Singh, S. K., Agbanyo, G. K., & Ferraris, A. (2022). Leveraging blockchain technology for green innovation in ecosystem-based business models: a dynamic capability of values appropriation. *Technological Forecasting and Social Change*, *183*, 121908.

Cui, R., Xia, E., & Guo, X. (2025). Antecedent configurations toward radical green innovation: Based on resource orchestration theory. *Technological Forecasting and Social Change*, *214*, 124038.

Dai, R., Duan, R., & Ng, L. (2025). Innovating green: competition meets regulation. *Management Science*.

Dai, R., Duan, R., & Ng, L. (2025). Innovating green: competition meets regulation. *Management Science*.

Demastus, J., Ohsowski, B. M., & Landrum, N. E. (2025). Exploring the nexus of organisational culture and sustainability for green innovation. *Industry and Innovation*, *32*(1), 108-138.

El-Kassar, A. N., & Singh, S. K. (2019). Green innovation and organizational performance: The influence of big data and the moderating role of management commitment and HR practices. *Technological forecasting and social change*, *144*, 483-498.

Fazal-e-Hasan, S. M., Ahmadi, H., Sekhon, H., Mortimer, G., Sadiq, M., Kharouf, H., & Abid, M. (2023). The role of green innovation and hope in employee retention. *Business Strategy and the Environment*, *32*(1), 220-239.

Guo, R., Zhang, Y., Chen, K., Wang, Y., & Ning, L. (2025). Heterogeneous impact of green finance instruments on firms' green innovation novelty: Policy mix or mess?. *Energy Economics*, *144*, 108315.

Han, Y., Li, Z., Feng, T., Qiu, S., Hu, J., Yadav, K. K., & Obaidullah, A. J. (2024). Unraveling the impact of digital transformation on green innovation through microdata and machine learning. *Journal of Environmental Management*, *354*, 120271.

He, Q., & Qiu, B. (2025). Environmental enforcement actions and corporate green innovation. *Journal of Corporate Finance*, *91*, 102711.

He, Q., & Qiu, B. (2025). Environmental enforcement actions and corporate green innovation. *Journal of Corporate Finance*, *91*, 102711.

Hossain, M. R., Rao, A., Sharma, G. D., Dev, D., & Kharbanda, A. (2024). Empowering energy transition: Green innovation, digital finance, and the path to sustainable prosperity through green finance initiatives. *Energy Economics*, *136*, 107736.

Hu, D., Qiu, L., She, M., & Wang, Y. (2021). Sustaining the sustainable development: How do firms turn government green subsidies into financial performance through green innovation?. *Business Strategy and the Environment*, *30*(5), 2271-2292.

Huang, D., Cheng, J., Quan, X., & Wu, Y. (2024). Managerial attention to environmental protection and corporate green innovation. *Review of Quantitative Finance and Accounting*, *63*(3), 1047-1081.

Huang, W., Tao, J., & Wei, Z. (2025). Participate in My Green: How and When Supplier Concentration Affects Firm Green Innovation. *Journal of Product Innovation Management*.

Janjua, N. A., Shi, D. A., & Sahibzada, U. F. (2024). Harnessing green innovation via green transformational leadership in Italian luxury hotels: key strategic takeaways. *International Journal of Hospitality Management*, *120*, 103739.

Jiang, W., Wang, K., & Zhou, K. Z. (2023). How political ties and green innovation co-evolve in China: Alignment with institutional development and environmental pollution. *Journal of Business Ethics*, *186*(4), 739-760.

Kraus, S., Rehman, S. U., & García, F. J. S. (2020). Corporate social responsibility and environmental performance: The mediating role of environmental strategy and green innovation. *Technological forecasting* Ai, H., Islam, N., Mangla, S. K., Song, M., & Tan, X. (2024). Circular economy, open innovation, and green innovation: Empirical evidence from prefecture-level cities in China. *IEEE Transactions on Engineering Management*, *71*, 5706-5719. *and social change*, *160*, 120262.

Li, H., & Lu, J. (2023). Temperature change and industrial green innovation: cost increasing or responsibility forcing?. *Journal of Environmental Management*, *325*, 116492.

Li, H., Du, G., Qamri, G. M., & Li, S. (2024). Green innovation and natural resource efficiency: The role of environmental regulations and resource endowment in Chinese cities. *Journal of Environmental Management*, *370*, 122338.

Li, H., Du, G., Qamri, G. M., & Li, S. (2024). Green innovation and natural resource efficiency: The role of environmental regulations and resource endowment in Chinese cities. *Journal of Environmental Management*, *370*, 122338.

Li, H., Du, G., Qamri, G. M., & Li, S. (2024). Green innovation and natural resource efficiency: The role of environmental regulations and resource endowment in Chinese cities. *Journal of Environmental Management*, *370*, 122338.

Li, L., Shan, S., Dai, J., Che, W., & Shou, Y. (2022). The impact of green supply chain management on green innovation: A meta-analysis from the inter-organizational learning perspective. *International Journal of Production Economics*, *250*, 108622.

Lin, J., Cao, X., Dong, X., & An, Y. (2024). Environmental regulations, supply chain relationships, and green technological innovation. *Journal of Corporate Finance*, *88*, 102645.

Liu, R., Zhu, X., & Chen, J. (2025). Climate risk and green innovation-ESG disconnect: Firm-level evidence from China. *Risk Analysis*.

Liu, R., Zhu, X., & Chen, J. (2025). Climate risk and green innovation-ESG disconnect: Firm-level evidence from China. *Risk Analysis*.

Lu, H., Zhang, Y., Jiang, J., & Cao, G. (2025). Do market-based environmental regulations always promote enterprise green innovation commercialization?. *Journal of Environmental Management*, *375*, 124183.

Lu, Q., Deng, J., Chen, S., & Hussain, Y. (2025). Managerial myopia and its barrier to green innovation in high-pollution enterprises: A machine learning approach. *Journal of Environmental Management*, *376*, 124477.

Lu, Q., Deng, J., Chen, S., & Hussain, Y. (2025). Managerial myopia and its barrier to green innovation in high-pollution enterprises: A machine learning approach. *Journal of Environmental Management*, *376*, 124477.

Lu, Q., Deng, J., Chen, S., & Hussain, Y. (2025). Managerial myopia and its barrier to green innovation in high-pollution enterprises: A machine learning approach. *Journal of Environmental Management*, *376*, 124477.

Ma, J., Li, Q., Zhao, Q., Liou, J., & Li, C. (2024). From bytes to green: The impact of supply chain digitization on corporate green innovation. *Energy Economics*, *139*, 107942.

Martín-Martín, A., Orduna-Malea, E., Thelwall, M., & López-Cózar, E. D. (2018). Google Scholar, Web of Science, and Scopus: A systematic comparison of citations in 252 subject categories. *Journal of informetrics*, *12*(4), 1160-1177.

Moher, D., Shamseer, L., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., ... & Prisma-P Group. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. *Systematic reviews*, *4*(1), 1.

Olson, E. L. (2013). Perspective: the green innovation value chain: a tool for evaluating the diffusion prospects of green products. *Journal of Product Innovation Management*, *30*(4), 782-793.

Patwary, A. K., Tosun, C., Sharif, A., Ismail, N. A., & Abuelhassan, A. E. (2024). Measuring sustainable business performance in Malaysian hotels: The roles of green information, green innovation strategic orientation, and digital technology implementation. *International Journal of Hospitality Management*, *123*, 103935.

Petticrew, M., & Roberts, H. (2008). *Systematic reviews in the social sciences: A practical guide*. John Wiley & Sons.

Qi, X., Wu, Z., Xu, J., & Shan, B. (2023). Environmental justice and green innovation: A quasi-natural experiment based on the establishment of environmental courts in China. *Ecological Economics*, *205*, 107700.

Qin, L., Kirikkaleli, D., Hou, Y., Miao, X., & Tufail, M. (2021). Carbon neutrality target for G7 economies: Examining the role of environmental policy, green innovation and composite risk index. *Journal of environmental management*, *295*, 113119.

Qin, X., Muskat, B., Ambrosini, V., Mair, J., & Chih, Y. Y. (2025). Green innovation implementation: a systematic review and research directions. *Journal of Management*, 01492063241312656.

Qin, X., Muskat, B., Ambrosini, V., Mair, J., & Chih, Y. Y. (2025). Green innovation implementation: a systematic review and research directions. *Journal of Management*, 01492063241312656.

Rosa, F. S., Compagnucci, L., Lunkes, R. J., & Monteiro, J. J. (2023). Green innovation ecosystem and water performance in the food service industry: The effects of environmental management controls and digitalization. *Business strategy and the environment*, *32*(8), 5459-5476.

Rosa, F. S., Lunkes, R. J., Codesso, M., Mendes, A. C. A., & Costa, G. D. (2025). Effects of green innovation ecosystem coopetition, environmental management practices and digital innovation on carbon footprint reduction. *International Journal of Contemporary Hospitality Management*, *37*(3), 722-739.

Schumpeter, J. A. (1983). *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle* (Vol. 55). Transaction publishers.

Shuwaikh, F. (2024). Towards Net Zero Emissions: The Impact of Green Innovation, GHG and CSR on the Financial Success of US Corporate Venture Capital Parents. *The Energy Journal*, *45*(1_suppl), 261-294.

Singh, S. K., Del Giudice, M., Chierici, R., & Graziano, D. (2020). Green innovation and environmental performance: The role of green transformational leadership and green human resource management. *Technological forecasting and social change*, *150*, 119762.

Song, M., Yang, M. X., Zeng, K. J., & Feng, W. (2020). Green knowledge sharing, stakeholder pressure, absorptive capacity, and green innovation: Evidence from Chinese manufacturing firms. *Business Strategy and the Environment*, *29*(3), 1517-1531.

Sun, D., Zeng, S., Lin, H., Yu, M., & Wang, L. (2021). Is green the virtue of humility? The influence of humble CEOs on corporate green innovation in China. *IEEE Transactions on Engineering Management*, *70*(12), 4222-4232.

Sun, X., Cifuentes-Faura, J., Xiao, Y., & Liu, X. (2024). A good name is rather to be chosen: The impact of CEO reputation incentives on corporate green innovation. *Business Strategy and the Environment*, *33*(3), 2413-2431.

Takalo, S. K., & Tooranloo, H. S. (2021). Green innovation: A systematic literature review. *Journal of Cleaner Production*, *279*, 122474.

Takalo, S. K., & Tooranloo, H. S. (2021). Green innovation: A systematic literature review. *Journal of Cleaner Production*, *279*, 122474.

Tang, L., Guo, Y., Zha, J., & Zheng, W. (2024). Acquiescence or redemption: CEO's early-life experience of environmental pollution and corporate green innovation. *Journal of Business Research*, *173*, 114479.

Tian, J., Dong, Y., Vagnani, G., & Liu, P. (2023). Green innovation and the stock market value of heavily polluting firms: The role of environmental compliance costs and technological collaboration. *Business Strategy and the Environment*, *32*(7), 4938-4953.

Tian, J., Dong, Y., Vagnani, G., & Liu, P. (2023). Green innovation and the stock market value of heavily polluting firms: The role of environmental compliance costs and technological collaboration. *Business Strategy and the Environment*, *32*(7), 4938-4953.

Vasileiou, E., Georgantzis, N., Attanasi, G., & Llerena, P. (2022). Green innovation and financial performance: A study on Italian firms. *Research Policy*, *51*(6), 104530.

Wang, C. H. (2020). An environmental perspective extends market orientation: Green innovation sustainability. *Business strategy and the environment*, *29*(8), 3123-3134.

Wang, J. (2022). Building competitive advantage for hospitality companies: The roles of green innovation strategic orientation and green intellectual capital. *International Journal of Hospitality Management*, *102*, 103161.

Wang, J., Xue, Y., & Yang, J. (2023). Can proactive boundary-spanning search enhance green innovation? The mediating role of organizational resilience. *Business Strategy and the Environment*, *32*(4), 1981-1995.

Willmott, H. (2022). Critical essay: Blinding faith–Paradoxes and pathologies of opacity in peer review. *Human Relations*, *75*(9), 1741-1769.

Wong, C. Y., Wong, C. W., & Boon-itt, S. (2020). Effects of green supply chain integration and green innovation on environmental and cost performance. *International Journal of Production Research*, *58*(15), 4589-4609.

Wong, C. Y., Wong, C. W., & Boon-itt, S. (2020). Effects of green supply chain integration and green innovation on environmental and cost performance. *International Journal of Production Research*, *58*(15), 4589-4609.

Wu, C., Shao, J., Lai, K. H., & Shou, Y. (2025). Radical or incremental? The effects of green innovation on the supply base stability of logistics service providers. *IEEE Transactions on Engineering Management*.

Wu, L., Zhu, C., & Wang, G. (2024). The impact of green innovation resilience on energy efficiency: A perspective based on the development of the digital economy. *Journal of environmental management*, *355*, 120424.

Ye, F., Ouyang, Y., & Li, Y. (2023). Digital investment and environmental performance: The mediating roles of production efficiency and green innovation. *International Journal of Production Economics*, *259*, 108822.

Yuan, S., & Pan, X. (2023). Inherent mechanism of digital technology application empowered corporate green innovation: Based on resource allocation perspective. *Journal of Environmental Management*, *345*, 118841.

Zhang, Y., Li, Y., Wu, H., & Peng, Y. (2025). Evaluating the role of green innovation and global supply chain digitization in natural resource utilization for energy resilience: An empirical evidence from panel quantile regression. *Energy Economics*, *144*, 108401.

Zhao, J., Qu, J., Wei, J., Yin, H., & Xi, X. (2023). The effects of institutional investors on firms' green innovation. *Journal of Product Innovation Management*, *40*(2), 195-230.

Zhao, X., Nakonieczny, J., Jabeen, F., Shahzad, U., & Jia, W. (2022). Does green innovation induce green total factor productivity? Novel findings from Chinese city level data. *Technological Forecasting and Social Change*, *185*, 122021.