

## Article

# Green Innovation through Green and Blue Infrastructure Development: Investigation of Pollution Reduction and Green Technology in Emerging Economy

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**Abstract:** Green and blue infrastructure has gained importance for energy firms around the globe due to increased focus on addressing emerging challenges raised in the achievement of green innovation (GI) and the protection of the environment. Pollution reduction and green technology are key factors that help to accomplish GI. The aim of the current research was to examine how green and blue infrastructure and green technologies impact and improve energy firms' business GI in Pakistan. Quantitative methods were used for the collection of data from 475 managers, policymakers, senior employees, owners, and CEOs. Findings demonstrated that green and blue infrastructure and GI were positively linked. The results also showed that pollution reduction played a mediating role between blue infrastructure and GI. Furthermore, findings also revealed that green technology played a moderating role between green and blue infrastructure and GI. Pollution reduction is a crucial factor in developing the GI performance of energy firms. These new outcomes extend green and blue infrastructure and GI literature and provide empirical proof for practitioners and policymakers. Our study suggests that green technology positively influences green and blue infrastructure, which in turn is associated with GI. This study is based on critical factors that have encouraging impacts on GI.

**Keywords:** green and blue infrastructure; pollution reduction; green technology; green innovation; energy firms



**Citation:** Nassani, A.A.; Yousof, Z.; Radulescu, M.; Balsalobre-Lorente, D.; Hussain, H.; Haffar, M. Green Innovation through Green and Blue Infrastructure Development: Investigation of Pollution Reduction and Green Technology in Emerging Economy. *Energies* **2023**, *16*, 1944. <https://doi.org/10.3390/en16041944>

Academic Editors: Luigi Aldieri and Beata Zofia Filipiak

Received: 20 January 2023

Revised: 10 February 2023

Accepted: 10 February 2023

Published: 15 February 2023



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## 1. Introduction

GI has gained strategic importance in the business world in recent decades [1]. In today's business world, it has been largely acknowledged that stakeholders demand the incorporation of green operational strategies [2]. Stakeholders' tendency toward the protection of the natural environment exerts pressure on business organizations to implement GI strategies in order to respond to various stakeholders' growing demands for environmentally friendly products and fulfill regulatory requirements [3]. Most of the research in the field of the natural environment has extensively considered GI; however, limited empirical studies have focused on its preconditions and determinants.

Green and blue infrastructure receives scholarly attention and stimulates organizations to concentrate on GI. Green and blue infrastructure is an idea/approach that has gained

special attention in land development, landscape design, and land conservation, not just among urbanists, landscape architects, and planners but also politicians, environmental groups, and natural scientists [4]. This concept is now broadly considered new, although its historical origin reverted from the 19th and 20th centuries. Preserving and restoring green natural resources can help integrate ecological system integrity and human welfare [5]. Green and blue infrastructure (GBI) is an approach that helps in deploying systematically and strategically green natural elements, such as green lands and water bodies, etc. in urban environments [6]. GBI is considered a pollution reduction solution for urban areas or cities that support promoting ecological services and improving climate resilience. The notion of green and blue infrastructure systems is the fundamental code arising from manifold disciplines for the attainment of GI [7]; though, in the contemporary era, business organizations have depended on green natural resources to meet their basic requirements. Recently, it is also understood that designing green and blue infrastructure can optimize natural resources that lead to high GI performance while simultaneously uplifting socio-economic benefits through better GI strategies [8]. The association between green and blue infrastructure and GI has rarely been deliberated in the existing literature. Therefore, this is an emerging area in the field that requires in-depth empirical inquiry to recognize the clear relationship between green and blue infrastructure and GI. The aim of this study was to consider this research gap.

Furthermore, the current study extends the boundaries of prior literature by recognizing how green technology positively moderates the relationship between green and blue infrastructure and GI. This study contributes to the literature in two ways. Firstly, our study evaluates the impacts of a theoretical model combining the variables of green and blue infrastructure, pollution reduction, and green technologies in predicting official civic behaviors aimed toward the attainment of GI. Secondly, it exposes relevant green technology attributes by describing how green and blue infrastructure, in practice, support the attainment of GI.

It is self-evident that modern organizations achieve GI with the help of corporate-level practices that support social, economic, and environmental stances [1,5]. Therefore, a new approach, named pollution reduction, has emerged due to the incorporation of green and blue infrastructure as one of the important elements of strategic business decisions [9]. Existing studies have deliberated that organizations have gained sustainable improvement for GI through pollution reduction [10,11]. Although there is emergent scholarly attention in studying pollution reduction mechanisms and their possible benefits for communities, so far, limited studies have been undertaken to explore the outcomes of pollution reduction. GI has appeared as an emerging ecological stance that is essential for the protection of the natural environment, which is the outcome of pollution reduction [10].

GI becomes necessary for organizations to protect the natural environment [12]. GI has gained strategic importance in the business world in recent decades [13]. However, for the achievement of GI, organizations must incorporate environmental thinking into pollution reduction strategies for all operational processes, such as material procurement, product design, production process, product end-of-life, and delivery and packaging [9].

The aim of the current study was to highlight the role of green and blue infrastructure and pollution reduction for the enhancement of GI for energy concerns. This study analyzed the role of green and blue infrastructure in the formulation of pollution reduction, which in turn helps the business gain GI. This study is helpful for the management of energy concerns in response to various stakeholders' demands regarding the environment and the improvement of GI. The current study proposed a direct effect of green and blue infrastructure on pollution reduction and GI. Furthermore, this study also highlights the intervening role of pollution reduction between green and blue infrastructure and the GI link. Finally, the moderating role of green technology has also been tested on the relationships between green and blue infrastructure and pollution infrastructure.

## 2. Literature Review

### 2.1. Green and Blue Infrastructure and GI

Many scholars are now increasingly paying attention to drawing on green and blue infrastructure for the promotion of environmentally friendly business strategies [8,14,15]. Business organizations have aimed to make efforts comprised of green paths and green lands for the protection of natural environments and environmental performance [16]. Green and blue infrastructure is a strategically planned setup of semi-natural and natural regions with other ecological characteristics considered, and it manages to distribute a wide variety of ecological services that facilitate the achievement of GI [17]. Green and blue infrastructure has made optimal use of natural resources, for instance, wetlands, greenways, blue streams, forests etc., to protect biodiversity and enhance the ecological environment that helps support GI in the green economy [18]. Green and blue infrastructure comprises various scales, for instance, community, regional, and urban levels; it provides green spaces and natural green environmental support [19]. Meanwhile, GI achievement is a supportive tool for regional growth accompanying manifold advantages, including educational, health, and environmental improvements, while resisting climate change and natural disasters. It helps enhance GI in cultural services [11]. The challenges that arise in the way of green and blue infrastructure development are well understood to occur due to a lack of sustainable strategies. However, high-quality green spaces support the development of a green industrial chain and also provide economic advantages and ecological protection. Green and blue infrastructure is a modern approach that integrates water cycles and green infrastructure to protract natural water management systems, which facilitates environmental renewal and leads to GI [20]. Green and blue infrastructures are mainly designed to achieve economic and environmental benefits through reduced ecological costs and resource consumption with an efficient flow of urban/regional green resources. These grasslands and green spaces help attain GI [19]. Green and blue infrastructure is a primary concern that affects the GI of firms in a more positive way [17,19]. Therefore, green and blue infrastructures are significant predictors of GI. Hence, we hypothesized that:

**H1:** *Green and blue infrastructure has a positive relationship with GI.*

### 2.2. Mediating Role of Pollution Reduction

Green and blue infrastructure is also one of the important factors facilitating the implementation of green strategies by business organizations. Existing studies have explained various factors that encourage organizations to formulate green strategies that support the natural environment [21]. Green and blue infrastructure compels organizations to formulate pollution reduction strategies [22]. Pollution reduction is the process of developing products that reduce negative impacts on the environment throughout the utilization, disposal, and renewable stages of the life cycle [23]. Green and blue infrastructure is the source of competitive economic benefits to attain the satisfaction of customers, leading to high levels of performance in GI [24]. GI is a significant factor that aids in reducing costs, increasing profits, and lowering the consumption of resources [25]. Pollution reduction act as a bridge between green and blue infrastructure and the GI link. Pollution reduction refers to the firm's strategy of focusing on green and blue infrastructure development that affects production process performances involving GI [7]. The pollution reduction approach is a multifaceted process that requires the support of the green and blue infrastructure practices of a firm to generate products and perform processes that lead to the achievement of high GI [26,27]. However, pollution reduction plays a mediating role in the association between green and blue infrastructure and GI. Moreover, green and blue infrastructure practices can be looked at as a mechanism that facilitates the execution of different, new processes and supports the attainment of positive GI outcomes [28]. Pollution reduction strategies perform a fundamental key function in promoting positive outcomes of green and blue infrastructure and GI. Green and blue infrastructure helps in pollution reduction efforts to overcome the costs of production, wastage, and pollution and increase green natural resource usage that can boost the overall performance of the GI [29]. Accordingly, this

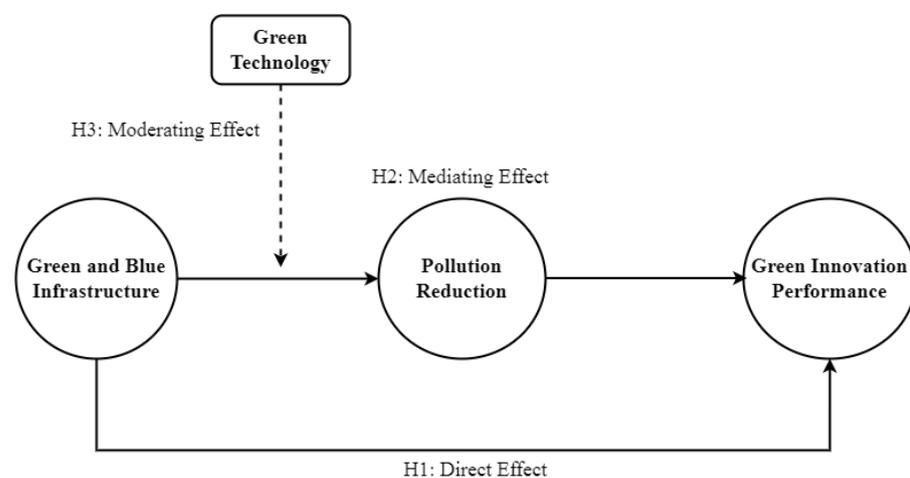
study suggests that the link between green and blue infrastructure and GI is mediated by pollution reduction. Firms implement their pollution reduction strategies by adopting green and blue infrastructure; this could lead to further enhancements in GI practices and dimensions. Thus, it was hypothesized that:

**H2:** *The association between green and blue infrastructure and GI is mediated by pollution reduction.*

### 2.3. Moderating Role of Green Technology

In the current study, we formulated the moderating role of green technology on the relationship between green and blue infrastructure and pollution reduction. Green technology facilitates business organizations' adoption of green and blue infrastructure practices, environmental preservation efforts, and codified mission statements that lead to GI [30]. As businesses operate in external surroundings, the firm's actions may also be affected by environmental situations. Ecological aspects must be integrated to increase significant insights into how green technology strengthens the impact of green and blue infrastructure on improving GI [31]. In this study, we selected green technology as a critical factor that describes the ecological condition of unpredictability and vagueness in terms of GI. Green natural resources are the main sources used for the expansion of successful green and blue infrastructure development, which contributes to increased high GI performance through the adaptation of the latest green technology [32,33]. Technology refers to the application of scientific knowledge and the speed of the transformation in a market or industrialized setting, signifying uncertainty and threats from technological market changes [33]. Green technology can be invented, developed, and adapted by management in an attempt to design green and blue infrastructure practices that will facilitate the firm to enhance employees' behavior toward the attainment of GI [34]. Therefore, green technology can be viewed as a strategic gain that supports firms in designing green and blue infrastructure and proactive environmental policies, which directly contribute to improved performance and increased GI [35]. Hence, we argue that green technology is a moderator in the association between green and blue infrastructure and GI. Strong green technology permits firms to apprehend benefits linked with green and blue infrastructure practices and GI performance [32]. Green technology implementation across functional levels supports firms in designing green and blue infrastructure and routines needed to successfully achieve GI [31]. Specifically, we anticipated that green technology would work as a complementary source that makes the influence of green and blue infrastructure on GI performance more substantial [35]. Figure 1 shows the association among study constructs and direction of study hypotheses.

**H3:** *Green technology strengthens the linkage between green and blue infrastructure and GI.*



**Figure 1.** Theoretical Framework.

#### 2.4. Methodology

The current study was based on a cross-sectional design, and we tested the study hypotheses with the help of the SEM (structural equation modeling) approach. Furthermore, correlation analyses were conducted to confirm correlations among the study constructs. The coefficient of correlation determined the direction of the relationship between variables in one-to-one relation irrespective of their significance level or to what extent one variable depended upon the other variable. After the confirmation of the relationship directions, in the next step, we conducted SEM to find the significance and strength of the dependency of one variable on other variables.

#### Sample and Procedure

For the purpose of the current study, we approached the Ministry of Chamber of Commerce, Government of Pakistan, in order to elucidate the research objectives and obtain data collection permission. Managers, policymakers, senior employees, owners, and CEOs within energy sectors with 2 years of experience were included in the sampling frame. A list of 1820 managers, policymakers, senior employees, owners, and CEOs was provided by the representatives of the Ministry of Chamber of Commerce. The list contained the names, mailing addresses, email addresses, and designations of the respondents. With the help of systematic random sampling, every fifth respondent was selected as a study sample. The current study considered the privacy of the selected participants regarding the information they shared during data collection.

Questionnaires were distributed to 475 participants from energy firms. Questionnaires were distributed with the assistance of two research associates, and our targeted sample of the study was managers, policymakers, senior employees, owners, and CEOs who emphasized the enhancement of the energy firms' business in Pakistan. After one and half months of effort, out of 475 questionnaires, only 347 questionnaires were returned, of which, just 322 questionnaires met the study criteria and were used for further analysis, which was a return rate of 67.78%. The other questionnaires were incomplete, so they were discarded.

#### 2.5. Measurement

To measure the study variables, such as green and blue infrastructure (independent variable), green technology (moderator), pollution reduction (mediator), and GI (dependent variable), different items were adapted from prior studies (see Appendix A). Each item's validity was tested using a 5-point Likert scale, which ranged between 1 = strongly disagree and 5 = strongly agree.

##### 2.5.1. Green and Blue Infrastructure

For the measurement of green and blue infrastructure, 9-item scales were adapted from [36]. This construct provides a deeper understanding of green infrastructure implementation policies and processes. An example item is "green leaves and flower give pleasant scent in air".

##### 2.5.2. Pollution Reduction

Pollution reduction was measured using a 4-item scale, which was adapted from [37]. This variable measured how pollution reduction strategies helped management in the acquisition of GI. A sample question is "in our firm, we redesigned our policies to meet pollution reduction goals".

##### 2.5.3. Green Technology

Green technology was measured using a 4-item scale, which was adapted from [38]. The example item is "it is tricky to anticipate green technology advancement direction in our targeted industry".

### 2.5.4. GI

GI was measured through a 5-item scale, which was adapted from [12]. This construct measured how green innovative policies and procedures facilitated firms' attainment of GI. An example item is "in our firm we used latest technology for savings waste, gas and water". Appendix A contains the measurement items.

## 3. Results

### 3.1. Reliability and Validity

SPSS 18.0 and structural equation modeling were utilized in this study. Table 1 shows the results of convergent validity, average extraction, and Cronbach's alpha. Fornell and Larcker's (1981) [39] technique was utilized to test discriminant validity. Results indicated that (Table 1) CR and AVE were not problematic, i.e., they were within the acceptable range.

**Table 1.** Validity and Reliability.

Variable Details	Items	FL	Cronbach's Alpha	CR	AVE
Green and Blue Infrastructure	9	0.74–0.87	0.88	0.92	0.74
Pollution Reduction	4	0.78–0.82	0.85	0.96	0.77
Green Technology	4	0.79–0.86	0.82	0.99	0.76
Green Innovation	5	0.77–0.84	0.86	0.94	0.72

### 3.2. Correlation

Correlation results indicated that the theory developed in this research was articulated on valid assumptions. Table 2 shows that the associations between the variables were significant and positive. VIF scores < 10.0 also indicate that multi-collinearity was not problematic.

**Table 2.** Correlations.

Variable	Mean	SD	Alpha	1	2	3	4	5	6	7
1 Age	33	—	—	1						
2 Experience	1.06	0.35	—	0.021	1					
3 Education	1.22	0.55	—	0.057	−0.165	1				
4 Green Blue Infrastructure	3.55	0.46	0.85	0.145 **	0.021	−0.18	1			
5 Pollution Reduction	3.27	0.51	0.44	−0.29	0.063 **	−0.14	0.313 **	1		
6 Green Technology	3.76	0.85	0.78	0.018	−0.012	0.084 **	0.312 **	0.176 **	1	
7 Green Innovation	3.14	0.52	0.86	0.034	−0.014	−0.03	0.212 **	0.367 **	0.256 **	1

Note: \*\*  $p < 0.01$ , two tailed.

### 3.3. Hypotheses Testing

After obtaining satisfactory correlation, reliability, and validity results for the study constructs, in the next step, we tested the study hypotheses with the help of SEM. The outcomes of the SEM analysis are presented in Table 3.

**Table 3.** Results of path analysis using structural equation modeling.

Specification	Estimate	LL	UP
Standardized Direct Impact			
Green and Blue Infrastructure → Green Innovation	0.33 **	0.18	0.35

Note: \*\*  $p < 0.01$ , two tailed.

The current study formulated three hypotheses. Table 3 contains the outcome of the direct relationship between green and blue infrastructure and GI. The findings of the path analysis confirmed that green and blue infrastructure had a direct and significant positive effect on GI (0.33 \*). These findings support the proposed relationship of this study's H1.

Furthermore, the present study's H2 formulated the mediation effect of pollution reduction between green and blue infrastructure and GI. The mediating role of pollution reduction was tested by analyzing the indirect effect of pollution reduction using SEM with the help of path analysis. The findings, presented in Table 4, show that the standardized indirect effect of pollution reduction was significant for the direct effect of green and blue infrastructure and GI (0.19 \*). On the basis of outcomes generated through the path analysis of the indirect effect of pollution reduction, we accepted the study's H2.

**Table 4.** Results for the indirect effect of pollution reduction.

Specification	Estimate	LL	UP
Standardized direct impact			
Green and Blue Infrastructure → Green Innovation	0.13	−0.05	0.27
Standardized indirect effects			
Green and Blue Infrastructure → Pollution Reduction → Green Innovation	0.19 *	0.07	0.27

Note: \*  $p < 0.05$ , two tailed.

The findings regarding the moderating effect of green technology are presented in Table 5. The outcomes of hierarchical regressions revealed that green technology significantly moderated the association between green and blue infrastructure and pollution reduction. The findings showed the interaction term, i.e., green and blue infrastructure × pollution reduction, in the regression to observe the strength of the moderating effect of GI, i.e., (0.22 \*\*). Hence, we accepted the study's H3.

**Table 5.** Outcomes of moderation analyses using hierarchical regressions.

	Step 1	Step 2	Step 3
Moderation of Pollution Reduction			
Green and blue infrastructure		0.30 **	0.33 **
Green technology		0.22 **	0.26 **
Green and blue infrastructure × Pollution reduction			0.22 **
R <sup>2</sup>	0.009	0.191	0.198
Adjusted R <sup>2</sup>	0.003	0.159	0.175
ΔR <sup>2</sup>	0.007	0.163	0.028
ΔF	4.172	79.63	17.13

Note: \*\*  $p < 0.01$ , two tailed.

#### 4. Discussion

The aim of the current study was to determine how other factors influence the GI activities of energy firms with the help of SEM analysis. In line with the study findings, we establish a comprehensive tendency toward GI. The primary contribution of the current is the extension of the existing literature on green and blue infrastructure strategies and practices by incorporating theoretical perceptions of GI to recognize factors that affect the attitudes of different policymakers, managers, and other community officials toward the implementation of green and blue infrastructure. This research assimilates empirical results showing that green and blue infrastructure positively affects GI, thus supporting H1. The outcomes support prior research showing that green and blue infrastructure is critical for innovation activities within an organization [10]. Green and blue infrastructure made optimal use of organizational resources to protect natural environments that help in supporting GI in the green economy [11]. Meanwhile, GI achievement is a supportive tool for regional growth accompanying manifold advantages, including educational, health, and environmental improvements, while resisting climate change and natural disasters. It helps enhance GI in cultural services [13]. The challenges that arise in the way of green and blue infrastructure development are well understood to occur due to a lack of environmental strategies. These hurdles are a barrier to the achievement of GI [14]. The positive impacts

of green and blue infrastructure recommend that GI is simple to achieve and increases environmental performance. Accordingly, the outcomes of H1 are consistent with the existing studies.

Furthermore, H2 highlighted that pollution prevention plays a mediating role in positively impacting green and blue infrastructure and GI. Our findings are in line with prior research showing that pollution reduction is the process of developing products that reduce negative impacts on the environment throughout the utilization, disposal, and renewable stages of the product [17]. Green and blue infrastructure is a source of competitive economic benefits that can be used to attain the satisfaction of customers, leading to high levels of performance in GI [18]. GI is an important factor that aids in reducing costs, increasing profits, and lowering the consumption of resources [19]. Pollution reduction acts as a bridge between green and blue infrastructure and GI. Pollution reduction is the strategy of the firm to focus on green and blue infrastructure development that affects production process performances involving GI [20]. The pollution reduction approach is a multifaceted process that requires the support of the green and blue infrastructure practices of a firm to generate products and perform processes that lead to the achievement of high GI [21]. However, pollution reduction plays a mediating role in the association between green and blue infrastructure and GI. Moreover, green and blue infrastructure practices can be looked at as a mechanism that facilitates the execution of different, new processes and supports the attainment of positive GI outcomes [22]. Pollution reduction strategies perform a key function in promoting positive outcomes of green and blue infrastructure and GI. Pollution prevention indirectly mediates the relationship between green and blue infrastructure and GI.

Moreover, H3 formulated that green technology played a moderating role in the association between green and blue infrastructure and GI. In this study, we select green technology as a critical factor that describes the ecological condition of unpredictability and imprecision in terms of GI. Thus, our research evaluated the moderating effect of green technology as it instigates green and blue infrastructure practices and GI performance. The findings provide adequate evidence to support the idea that as businesses operate in external surroundings, the firm's actions may also be affected by environmental situations. Ecological aspects must be integrated to increase significant insights into how green technology strengthens the impact of green and blue infrastructure on improving GI [25]. Green natural resources are the main sources used for the expansion of successful green and blue infrastructure development, which contributes to increased GI performance through the adaptation of the latest green technology [26]. Technology refers to the application of scientific knowledge and the speed of the transformation in a market or industrialized setting, signifying uncertainty and threats of technological market changes [27]. Green technology can be invented, developed, and adapted by management as an attempt to design green and blue infrastructure practices that facilitate firms' and employees' behavior toward the attainment of GI [28]. Therefore, green technology can be viewed as a strategic gain that supports firms in designing green and blue infrastructure and proactive environmental policies, which facilitate improved performance and increased GI [29]. Hence, we argue that green technology is a moderator in the association between green and blue infrastructure and GI. Strong green technology permits firms to apprehend benefits linked with green and blue infrastructure practices and GI performance [30]. Green technology implementation across functional levels supports firms in designing green and blue infrastructure and routines needed to successfully achieve GI [31]. Overall, this study's results show the relevance of the incorporated elements of green and blue infrastructure and green technology that have relatively high significance towards GI achievement in agricultural firms. Pollution prevention is also a key factor in attaining GI.

#### *4.1. Theoretical Contribution*

Energy firms' concerns operate in an open system, where these concerns are in response to various stakeholders, including customers, suppliers, and government institutes.

Therefore, this research theoretically contributes to the existing literature on pollution reduction that plays a dominant role in the improvement of GI. Our study provides mainstream knowledge on the accomplishment of GI practices. Firstly, the green and blue infrastructure model addresses the challenges and scarcity in the field of GI. We believe that our study is the first to explore factors, such as green and blue infrastructure, pollution reduction, green technology, etc., that help in the achievement of GI. Secondly, this research divulges the direct impacts of green and blue infrastructure on GI. Furthermore, it also reveals the mediating effects of pollution reduction on GI. Thirdly, our study measured the moderating role of green technology in the attainment of GI. This study eloquently adds to prior literature knowledge and provides a critical, comprehensive means of promoting GI.

#### *4.2. Practical Contribution*

This research provides several insights which help managers and policymakers. Firstly, the results show the relevance of green and blue infrastructure impacts on decision-making factors in improving GI, which permits practitioners and firms to accomplish targeted goals through the promotion of GI. Our study recognizes that green and blue infrastructure is a supportive tool to convince energy firms to think about the latest innovative technologies in their operational activities and overcome environmental load by choosing among strategic plans. Green and blue infrastructure aids firms in offering sustainable consumption/production models concerning stakeholders' GI performance attainment. Secondly, to obtain the benefits of GI, we put an emphasis on investing in the latest green innovative technologies. Every government must take effective actions and promote green climate business to help firms decrease fossil fuel dependence and increase the use of renewable waste and energy. This assists in increasing environmental awareness among different sectors and will improve economic growth. Aside from this, green technology is also a supportive tool for providing solutions and assisting in the implementation of inventive green technologies at a reasonable price. Thirdly, energy firms should offer a good working state and persuade employees to obtain the latest specialized technology knowledge via education, instruction, and training, which help them tackle software/hardware problems. These latest innovative technologies can assist in the achievement of GI. Government, policymaker, and top management support are required to solve these rising problems. A high level of investment is required for employee skill-building regarding green and blue infrastructure development, which increases operational and profitability performance.

#### *4.3. Limitation and Future Recommendation*

The study at hand has valuable theoretical and practical implications. However, the current study also has some limitations. First, the current study was conducted within the tourism sector, collected data were self-reported, and there is a possibility of inflated correlations. Secondly, in this study, quantitative study methods were used for data collection due to a lack of resources; a qualitative or longitudinal approach could provide more precise results. Moreover, research findings were limited to the energy sector; in the future, researchers should expand its scope by including other geographies, SMEs, industries, etc., to ensure generalizability. Finally, this paradigm will be checked by including other mediating and moderating variables; however, outcomes may be different in other areas. The findings of the current study rely on hypothetical consequences and self-reporting analyses, which is also a methodological drawback. In addition, the current study only focused on the tourism sector, which is a limitation of generalizability.

### **5. Conclusions**

The green and blue infrastructure debate is increasing in momentum as many undeveloped countries attempt to reach GI goals in the upcoming decade. This study provides insight into different outcomes that should be considered key factors in the mainstream literature. A comprehensive framework was offered in the current study based on green and blue infrastructure, pollution reduction, and green technology's role in influencing

GI performance in emerging challenging energy firms' business environments to enhance GI. We used a quantitative method for the collection of data and to corroborate the study variables' relative significance. Green and blue infrastructure made a significant contribution by enlightening noteworthy impacts of pollution reduction's mediating role and green technology's moderating role on GI. Further, GI cannot become factual without the key role of green technology and advanced innovative technologies.

**Author Contributions:** A.A.N.: conceptualization and data curation; Z.Y.: conceptualization and formal analysis; M.R.: investigation; D.B.-L.: supervising, visualization, and writing—original draft; H.H.: investigation and validation; M.H.: reviewing and editing. All authors have read and agreed to the published version of the manuscript.

**Funding:** Researchers Supporting Project number (RSP2023R87), King Saud University, Riyadh, Saudi Arabia.

**Data Availability Statement:** Data are available on request from the corresponding authors.

**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A

### Green and blue infrastructure

1. This setting scale is pleasing for us.
2. In this place objects seem to be acceptable.
3. This place has diverse coherent elements and create harmonious atmosphere.
4. This place is attractive, interesting and provide exciting environment.
5. This place discovers feeling and mysterious.
6. Green-blue materials magnetize with surprises.
7. Green leaves and flower give pleasant scent in air.
8. This place is outstanding, striking and have beautiful nature in pleasant.
9. This scenario is easy to recognize and fits with their surroundings.

### Pollution prevention

1. Our firm focused on pollution reduction strategies.
2. Our firm put emphasize on housekeeping best practices to reduce in house pollution.
3. In our firm, we redesigned our policies to meet pollution reduction goals.
4. Our firm used latest technologies and modified traditional methods to attain pollution reduction targets.

### Green Technology

1. Our firm used advance green technology.
2. Our firm constantly builds up potentials for the achievement of green technology.
3. In our firm we set up in house research and development units.
4. It is tricky to anticipate green technology advancement direction in our targeted market.

### Green innovation

1. Our firm used low consumption of the water, gas etc. during production.
2. Our firm reuse, remanufacture and recycle our materials.
3. In our firm we used latest technology for savings waste, gas and water.
4. Our firm redesigns our operational or production processes to enhance green innovation.
5. Our firm use innovative ways to enhance products and services that meets the demand of new customers.

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