

## Article

# Pollution Reduction as Catalyst between Environmental Resources Conservation Efforts and Sustainable Development: Investigation of Energy Firms in Circular Economy

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**Abstract:** In the modern era societies adopt further restrictions imposed via climate or global changes and are engaged in a dynamic innovative set of dealings. The environment site is inhabited by numerous artists, who perform in a synergic manner by placing emphasis on and implementation of actual sustainable development. In this perspective, we value environmental resource-conservation efforts (ERCE) of all actors, populations, mass media and specialists. This paper aims to analyze how different energy firms accomplished sustainable development through environmental resource-conservation efforts. In this study we discover that pollution reduction is directly linked with both variables and also plays a mediating role. A cross-sectional data collection technique was used. For testing study hypotheses, we selected energy firms. Results showed that sustainable development of energy firms are forecasted by environmental resource-conservation efforts. The findings confirmed that ERCE are directly linked to pollution reduction, and pollution reduction is positively linked to sustainable development. The results also highlight how pollution reduction mediates between ERCE and sustainable development links. Energy firms play critical roles in pollution reduction. Current research contributes to prior literature knowledge through offering a sustainable development model by mutual influence of ERCE and pollution reduction. Accordingly, this study might be regarded as an encouragement for action and an authentic message for professionals in the energy firms to increase their sustainable development and give attention to their efforts on the optimal use of resources. This study can provide several critical practical policies and suggestions to management of energy firms for raising their sustainable development. Our research provides major implications through focusing on the role of ERCE and pollution reduction strategies and activities to enhance sustainable development of energy firms in a circular economy. A circular economy acts as a solution framework that helps in tackling global changes such as loss of biodiversity, pollution, climate challenges and recycling of waste. This study expands the prior literature knowledge through giving an empirical model for energy firms.

**Keywords:** pollution reduction; environmental resource-conservation efforts; sustainable development; energy firms; circular economy

## 1. Introduction

In the contemporary era, with every passing day natural resources are consumed rapidly and due to economic progression hazardous emissions discharged and this is an augmented burden on our environment and also on our climate/atmosphere [1]. ERCE are the processes/practices of preserving natural resources from collapsing as a result of

harmful human actions, for instance burning fossil-fuel, deforestation and unsustainable agriculture [2]. All over the world, as reported, numerous countries have failed to meet their performance goals regarding environmental pollution reduction and sustainable development [3]. Mounting technical evidences increased pressure on the SMEs to respond to the harmful/negative impacts of the environmental degradation and also to the emerging challenges of these propensities [4]. This pressure has fostered energy firms' focuses on green environmental resource-conservation efforts (ERCE) and sustainable development activities, and have promoted concerns about whether pollution reduction strategies can deal with these issues through improving sustainability [5]. Due to globalization, energy firms have recognized the importance of environmental resource-conservation efforts as an effectual means to measure pollution reduction practices [4]. The resource-conservation efforts from different stakeholders facilitate energy firms' management in designing strategic plans for making more profit-generating opportunities and support them to acquire sustainable development and achieve their objectives [6]. The environmental resource-conservation efforts allow energy firms to react to the vibrant changes and increase their operational sustainability and competitiveness, which support them to develop their sustainable development agenda [7]. Sustainable development has received greater attention from scholars in recent decades resulting from the scarcity of resources and due to environmental challenges [8]. It permits energy firms to design eco-friendly processes and products; therefore, pollution reduction can be attained [9]. Nevertheless, lack of pollution reduction strategies reinforced with an efficient implementation of environmental resource-conservation efforts, energy firms continuously face critical challenges in the achievement of sustainable development [10]. Environmental resource-conservation efforts are significant factors that contain characteristics which suggest adoption of sustainable practices and affect sustainable development [11]. Emerging economies can give better insights into how different environmental resources conservation efforts strategies can manage environmental deterioration and design eco-friendly products which reduce ecological pollution and prevent industrial waste. From the perspective of developing nations, lack of sufficient environmental resource-conservation efforts in the operational processes is an influential feature for the sustainable development is a major problem, as it disturbs pollution reduction activities in industries and energy firms. Furthermore, implementation of pollution reduction strategies is an essential factor for sustainable development, which could be turned into higher competitive performance in the global market. In present circular economies, facts demonstrate that energy firms in developed countries have altered their traditional methods of production to customer-oriented innovative means by revamping natural systems, because they are more concerned with their environment, society and health. A circular economy is a circularity model which supports the production and consumption processes, and also involves leasing, refurbishing, sharing and repairing processes through reusing available materials [12]. It is a change to the approach in which resources are mined, made into products and then become waste [13]. According to the Paris (2015) contract, governments are also noticeably active in passing strict rules and laws for industries and energy firms for causing environmental deterioration. In the current arena, with every passing day competitiveness is increasing, thus various scholars explored different factors which impact on sustainable development. Several prior studies have explored various factors which influence energy firms' abilities to achieve sustainable development, such as strategic planning, socio economic principles in practice [14,15], etc. However, the researchers overlooked the more promising factors which determine sustainable development, i.e., environmental resource-conservation efforts and pollution reduction. Previous studies have given limited consideration to this multifaceted phenomenon that explores the impact of environmental resource-conservation efforts and pollution reduction on sustainable development [14,16,17]. This study extends the boundaries of literature knowledge through empirical findings that energy firms should understand the value of both ERCE and pollution reduction strategies to adopt advanced innovative techniques

for achieving sustainable development. Current research focuses on the following study questions:

- What is the impact of ERCE on sustainable development?
- What is the effect of ERCE on pollution reduction?
- What is the impact of pollution reduction on sustainable development?
- Does pollution reduction play a mediating role in the association between ERCE and sustainable development?

The current study is helpful for managers/professionals to assimilate environmental resource-conservation efforts strategies for reducing pollution to achieve sustainable development in the context of energy firms.

## 2. Literature Review

### 2.1. Environmental Resources conservation Efforts and Sustainable Development

At large-scale, ERCE give vital information about resources and tendencies for their utilization and also identifies problems in their importance to the society sector that has real influence on the use of the resources, and guide objectives that could help in sustainable development actions [18]. ERCE are the process of preserving natural resources from collapsing as a result of harmful human actions, for instance, burning fossil-fuel, deforestation and unsustainable agriculture [2]. ERCE are turning into the actions of particular planning and tactical processes to deal with broad strategies and elements of them; often it is engaged in the preparation of action plans related to the specific community and sector, e.g., regional land and national parks' tree growing and management plans, etc., which are directly concerned with sustainable development [19]. At a human level, ERCE have to be seen as critical parts of the sustainable development process, sustainable development must be dependent on sustainable utilization of water, forests and also wildlife, etc.; all these resources will also restore themselves if properly managed [20]. Sustainable development is an idea/approach that humans employ to fulfill their basic needs with no compromise in a way that permits future generations to meet their needs [10]. It has been demonstrated that ERCE and sustainable development are inexorably connected but not separate challenges [21]. Dividing responsibilities before planning of ERCE strategies leads to conflicting directives, for instance waste of money/time, poor coordination and fragmentation of the efforts [22]. These problems can only be overcome through determining how one sector's decisions influence the ability of other sectors which rely on similar resources, and how sustainable resources use is beneficial in covering sustainable resource development [23].

**H1.** *ERCE is positively linked with sustainable development.*

### 2.2. ERCE and Pollution Reduction

Environmental resource-conservation efforts give support to huge numbers of agencies that are concerned about environmental pollution control, such as solid waste, noise, contaminated land, air and water, etc. [24]. Environmental resource-conservation efforts can have well-formulated opinions about over development, every firm has diverse procedures and compliance regulations regarding pollution reduction which is applied in their operational and manufacturing methods [25]. Environmental resource-conservation efforts help in developing better environmental quality by reducing and preventing waste with innovative strategies and techniques that help in the reduction of pollution and meeting the requirements and objectives of people and agencies [26]. Pollution reduction is any strategy or practice that decreases, prevents and eliminates pollution sources before it is generated [14]. Pollution managing agencies used powerful resources conservation efforts for controlling critical factors involved in development proposals for land use which reduces pollution in the environment [27]. ERCE focused on increasing suitability and reducing harmful impacts of major projects, and also emphasize environmental planning for reduction of pollution [28]. The conservation efforts of pollution control agencies acting as representatives for high-level sectoral and government agencies who are involved in quality

control of the environment, also presents critical implications for planning coordination for the planners at the highest level which diminishes pollution reduction [29].

**H2.** *Environmental-resources-conservation efforts are linked with pollution reduction.*

### 2.3. Pollution Reduction and Sustainable Development

Every firm is able to reduce pollution in a number of different ways. They may overcome their emissions through transferring of waste onsite, a third party and preventing waste pollution at the source [30]. Sustainable development should come about through diverse means of pollution reduction; if each factor of pollution reduction is expensive to attain, several factors might be underused, whereas other factors could be overexploited [31]. Firm sustainable development expectations determine new information search locations and concentrations for cost-effective pollution-reduction opportunities [32]. If firms' managers want small profits, they may not seek profitable pollution reduction strategies and accordingly they cannot find such profitable opportunities, which increases operational sustainable development in firms [33]. Different pollution reduction strategies help in the prevention of waste that enhances employee incentives and supports the development of workers' skills, which increase sustainable development and performance in firms [34]. Profitable pollution reduction strategies lead to the unanticipated synergies between the latest innovative production techniques and waste prevention [35]. Implementation of the increased innovation processes leads to sustainable development [33]. Cost-effective pollution-reduction opportunities decrease incentives to obtain better innovative production processes and sloppy practices performance. Innovative ways of production help in easier waste prevention that deliver benefit to firms and also add to their sustainable development in the long-run [36].

**H3.** *Pollution reduction is directly linked with sustainable development.*

### 2.4. Pollution Reduction as Mediator

The importance of pollution reduction has become a vital consideration among researchers from different fields. This study suggested that pollution reduction acts as a bridge/mediator between ERCE and sustainable development links. Pollution reduction is a basic element for enhancing sustainable development [37]. Firms' specific activities linked to pollution reduction are essential for achieving better sustainable development for organizations. Besides, ERCE are critical approaches and also enable SMEs to augment their sustainable development [38]. The impact of environmental resource-conservation-efforts on the sustainable development of energy firms are positively and significantly mediated through pollution reduction strategies of the firms. To acquire better results, sustainable development must capitalize on adequate techniques and strategies of the top management [39]. The ERCE, pollution reduction and sustainable development relationship come to pass when top management demonstrate commitment to prevent environmental worsening and expend valuable time with environment-friendly resources that increase sustainable development through the knowledgeable abilities of their employees [40]. Current research fills the gap on this issue through evaluating the association between efforts to conserve environmental resources and sustainable development of the energy firms which are mediated through pollution-reduction strategies. Our research shows that pollution reduction is the key mediator between ERCE and sustainable development in different sectors. Pollution reduction acts as the basis for a firm's ERCE, which encourages positive insight for stakeholders regarding the energy firm's pollution-reduction strategies, which alternatively improved sustainable development of the energy firm [41]. Pollution reduction acts as mediator between ERCE and sustainable development because ERCE force energy firms to take part in pollution reduction activities/actions, which facilitates energy firms to promote sustainable development [42]. Accordingly, we emphasized ERCE impacts to protect natural environmental resources and also pollution-reduction practices of energy firms, which consequently increase sustainable development.

**H4.** *Pollution reduction mediates the association between environmental resources-conservation efforts and sustainable development.*

### 3. Methodology

Current research uses a deductive approach and also a cross-sectional method for investigation. The element that is investigated in our study is energy firm's that implement ERCE in their various activities to achieve sustainable development. For the collection of data, questionnaires were used to accumulate information through both hard form and online via email. Energy firms' middle level and top management were selected as appropriate respondents for the completion of questionnaires as they are present in significant positions and contain pertinent information. Simultaneously, they participate positively in designing environmental resources conservation efforts practices for various divisions. The questionnaire contains the attached cover letter which explains the main objective of the study and also guarantees the confidentiality of facts. In total, 750 questionnaires were distributed among respondents, such as managers, CEOs, supervisors, managing directors and executives, through different resources, both in hard form and online, and within 2 months, 543 responses were received. Of these responses, only 382 questionnaires were selected for further analysis because some questionnaires were not filled completely and desired information could not be obtained from them, and were thus discarded. The total return rate was 50.93%. The questionnaire was divided into two sections. Section 1 included the demographic information of respondents, for instance, field position, education and experience, etc. Section 2 contained the information regarding variables. Detailed contents about the variables of the study are presented in a questionnaire, i.e., added in Appendix A. Questionnaires were checked by professors and specialists before their distribution to ensure their validity and reliability.

The questionnaire's contents were explained in detail through an attached cover letter. We used all those questions which were duly testified by previous researchers (already used items). Besides, all validity checks and reliability checks were confirmed before sending the final questionnaire. The first draft of the questionnaire was checked by 2 academia experts and 3 industry specialists. They made normal modifications and added some details which were incorporated in a cover letter attached to the questionnaire. We also conducted a pilot research on 50 respondents and results ensured the content of questionnaire were satisfactory.

#### 3.1. Measurement

In this study we used the 7-point Likert-scale for measurement of latent variables where 1 = strongly agree and 7 = strongly disagree. The authors adapted measured items and the measurement scale from previous studies which were standardized and tested previously and customized them according to the study context. These variables were also checked by two experts to ensure their contextual consistency.

##### 3.1.1. EREC

For the measurement of environmental resource-conservation efforts (ERCE), 14 scale items were adapted from [43]. The questions asked of the respondents focused on the extent of their firms' initiatives to save, protect and restore the natural resources. The scale has been used and validated by many previous researchers and is one of the major components of environmental management systems [43]. The contents under these sections asked the respondents how their firms participate in utilizing natural resources in the most effective ways; the firms' preferences for effective use of energy and proper recycling systems.

##### 3.1.2. Pollution Reduction

For the measurement of pollution reduction, we adapted 6 items from [44]. This scale focused on the firm's ability to prevent pollution. The contents of this scale also show the firm's commitment towards the efforts for supporting government for taking actions

to stop pollution in the environment. The questions regarding pollution reduction also highlight how organizations develop strategies for reducing pollution.

### 3.1.3. Sustainable Development

Sustainable development is calculated through 5-items-scale which is adapted from [45]. This is a widely used variable and most researchers indicate various dimensions of sustainable development. However, in the current study we focused on asking about the firm's contribution to sustainable developmental activities to promote social, economic and environmental concerns. The major aim of this scale was to explore how firms function in societies and protect the environment through green infrastructure.

## 4. Analysis

Table 1 shows the results of factor-loading average variance extracted AVE, Cronbach alpha ( $\alpha$ ), convergent validity and composite reliability (CR). All the results were reliable and valid. Discriminant validity was accepted with the Fornell–Larcker test (1981), factor loading is greater than 0.70 while average variance extract is higher than 0.50. Composite reliability was greater than 0.60 and Cronbach alpha ( $\alpha$ ) was greater than 0.70.

**Table 1.** F-L, CR and AVE.

| Details                                     | F-L  | Alpha | CR   | AVE  |
|---------------------------------------------|------|-------|------|------|
| Environmental Resource-Conservation Efforts |      | 0.86  | 0.94 | 0.76 |
| ERCE-1                                      | 0.82 |       |      |      |
| ERCE-2                                      | 0.83 |       |      |      |
| ERCE-3                                      | 0.84 |       |      |      |
| ERCE-4                                      | 0.76 |       |      |      |
| ERCE-5                                      | 0.78 |       |      |      |
| ERCE-6                                      | 0.74 |       |      |      |
| ERCE-7                                      | 0.88 |       |      |      |
| ERCE-8                                      | 0.82 |       |      |      |
| ERCE-9                                      | 0.80 |       |      |      |
| ERCE-10                                     | 0.81 |       |      |      |
| ERCE-11                                     | 0.83 |       |      |      |
| ERCE-12                                     | 0.85 |       |      |      |
| ERCE-13                                     | 0.87 |       |      |      |
| ERCE-14                                     | 0.77 |       |      |      |
| Pollution Reduction                         |      | 0.84  | 0.92 | 0.74 |
| PoR-1                                       | 0.87 |       |      |      |
| PoR-2                                       | 0.83 |       |      |      |
| PoR-3                                       | 0.78 |       |      |      |
| PoR-4                                       | 0.84 |       |      |      |
| PoR-5                                       | 0.85 |       |      |      |
| PoR-6                                       | 0.78 |       |      |      |
| Sustainable Development                     |      | 0.82  | 0.96 | 0.72 |
| SD-1                                        | 0.82 |       |      |      |
| SD-2                                        | 0.86 |       |      |      |
| SD-3                                        | 0.81 |       |      |      |
| SD-4                                        | 0.78 |       |      |      |
| SD-5                                        | 0.75 |       |      |      |

Note: PoR = pollution reduction; SD = sustainable development.

Table 2 presents CFA and model fitness. Results proved that our final model fourth model is appropriate to data ( $\chi^2 = 1036.32$ ,  $df = 460$ ;  $\chi^2/df = 2.253$ ; RMSEA = 0.05; CFI = 0.93; GFI = 0.92).

**Table 2.** CFA results.

| Model Detail                 | $\chi^2$ | Df  | $\chi^2/\text{df}$ | RMSEA | GFI  | CFI  |
|------------------------------|----------|-----|--------------------|-------|------|------|
| Hypothesized. 4-factor model | 1036.32  | 460 | 2.253              | 0.05  | 0.92 | 0.93 |
| 3-factor model               | 1155.57  | 315 | 3.668              | 0.12  | 0.87 | 0.88 |
| 2-factor model               | 1242.26  | 345 | 3.601              | 0.14  | 0.73 | 0.74 |
| Single-factor model          | 1285.42  | 375 | 3.428              | 0.22  | 0.62 | 0.63 |

Table 3 indicates the results of the correlation between environmental resource conservation effort, pollution reduction and sustainable development. ERCE are positively associated and significant with SD ( $r = 0.20^{**}$ ,  $p$  value = significant). Pollution reduction is positively associated with SD ( $r = 0.38^{**}$ ,  $p$  value = significant). ERCE and PR have significant effect ( $r = 0.39^{**}$ ,  $p$  value = significant). The VIF scores also confirm that multi-collinearity is not an issue in this research as its value was less than 10.0.

**Table 3.** Correlation results.

| Variable                                    | 1        | 2     | 3     | 4       | 5        | 6        | 7    |
|---------------------------------------------|----------|-------|-------|---------|----------|----------|------|
| 1 B.Age                                     | 1.00     |       |       |         |          |          |      |
| 2 B.Size                                    | 0.142 ** | 1.00  |       |         |          |          |      |
| 3 R.Experience                              | 0.07     | 0.04  | 1.00  |         |          |          |      |
| 4 R.Education                               | −0.02    | 0.03  | −0.18 | 1.00    |          |          |      |
| 5 Environment Resource Conservation Efforts | 0.074 *  | −0.02 | −0.15 | −0.01   | 1.00     |          |      |
| 6 Pollution Reduction                       | −0.07    | 0.07  | −0.15 | 0.083 * | 0.391 ** | 1.00     |      |
| 7 Sustainable Development                   | −0.01    | −0.02 | −0.05 | −0.07   | 0.201 ** | 0.391 ** | 1.00 |

Note: \* =  $p > 0.001$ ; \*\* =  $p > 0.05$ .

Table 4 shows that the direct hypothesis testing, i.e., H1, H2 and H3, is accepted. H1 is proved ( $\beta$  value =  $0.20^{**}$ ,  $p \leq 0.000$ ) and H1 proposed that ERCE positively affect sustainable development. ERCE is positively affected with pollution reduction ( $\beta$  value =  $0.39^{**}$ ,  $p \leq 0.000$ ) and H2 is proved. Pollution reduction is significantly impacted by sustainable development ( $\beta$  value =  $0.39^{**}$ , sig = 0.000) and H3 is accepted.

**Table 4.** Results of hypotheses.

| Model | Details                                        | Beta-Value | F      | T-Value | Sig   | Remarks  |
|-------|------------------------------------------------|------------|--------|---------|-------|----------|
| 1     | ERCE to Sustainable Development                | 0.20       | 34.88  | 11.82   | 0.000 | Accepted |
| 2     | ERCE to Pollution Reduction                    | 0.39       | 149.26 | 12.21   | 0.000 | Accepted |
| 3     | Pollution Reduction to Sustainable Development | 0.38       | 140.64 | 16.54   | 0.000 | Accepted |

Table 5 shows the mediating effect of pollution reduction between environmental resource conservation effort and sustainable development. Preacher and Hayes (2004; 2008) test analysis was used with a 5000-bootstrap method at 95% confidence level. Table 5 also indicates the results of the indirect role of EREC on SD through pollution reduction (EREC  $\rightarrow$  PR  $\rightarrow$  SD). Table 5 presents all path descriptions, i.e., total, direct and indirect path effects (a, b, c, c' and ab). Path 'a' proved that EREC affects pollution reduction ( $B = 0.562$ ,  $t = 11.824$ ,  $p = \text{sig}$ ). Path 'b' proved that pollution reduction directly affects sustainable development ( $B = 0.472$ ,  $t = 10.742$ ,  $p = \text{sig}$ ). Path 'c' proved that the total effect of EREC on sustainable development ( $B = 0.325$ ,  $t = 8.425$ ,  $p = \text{sig}$ ). Path 'c' explains that when pollution reduction was measured, the direct effect of ERCE on SD was compact and non-significant, proving a mediating effect ( $B = 0.195$ ,  $t = 2.145$ ,  $p = 0.667$ ). Path 'ab' shows the results of the indirect effect in the last portion of Table 5. The results of indirect effect proved that pollution reduction performed as a mediator ( $B = 0.185$ , lower = 0.1516

to upper = 0.2852. Thus, H4 was proved and it is proved that the ERCE and SD link is mediated through pollution reduction.

**Table 5.** Mediation effects showing different paths a, b, c, and c'.

| Paths Detail                                                         |       | Model     | Beta  | SE    | T      | Sig    |        |
|----------------------------------------------------------------------|-------|-----------|-------|-------|--------|--------|--------|
| ERCE to Pollution Reduction (path a)                                 |       | ERCE → PR | 0.562 | 0.445 | 11.824 | 0.000  |        |
| Pollution Reduction to SD (path b)                                   |       | PR → SD   | 0.472 | 0.334 | 10.742 | 0.000  |        |
| ERCE to Sustainable Development (path c)                             |       | ERCE → SD | 0.325 | 0.523 | 8.425  | 0.000  |        |
| ERCE to Sustainable Development (path c')                            |       | ERCE → SD | 0.195 | 0.633 | 2.145  | 0.667  |        |
| Bootstrap for indirect effect of IV on DV through mediator “ab path” |       |           |       |       |        |        |        |
| Model Detail                                                         | Data  | Boot      | Bias  | SE    | Lower  | Upper  | Sig    |
| ERCE → PR → SD                                                       | 0.185 | 0.2174    | 0.002 | 0.03  | 0.1516 | 0.2852 | 0.0000 |
| R <sup>2</sup> = 0.1422; F = 34.7321; p = 0.000                      |       |           |       |       |        |        |        |

## 5. Discussion

The current study highlighted the involvement of organizations in issues linked to environmental resource-conservation efforts and pollution reduction strategies to achieve high-level sustainable development. This study also shows the mediating role of pollution reduction in the linkage between environmental resource-conservation efforts and sustainable development of energy firms. In this research, for testing the association between environmental resource-conservation efforts, pollution reduction and sustainable development, four hypotheses was suggested. Regarding H1, findings confirmed the positive relationship between ERCE and sustainable development. These outcomes are consistent with previous studies that ERCE are turning into actions with particular planning and tactical processes to deal with broad strategies and elements of them; often it is engaged in the preparation of action plans related to the specific community and sector, e.g., regional land and national park tree growing and management plans, etc., which is directly concerned with sustainable development [19]. At a human level, ERCE have to be seen as critical parts of the sustainable development process; sustainable development must be dependent on sustainable utilization of water, forests and also wildlife, etc.; these resources will also restore themselves if properly managed [20]. Hence, H1 is proved, thus we suggested that ERCE are the key fundamental factor that helps energy firms in the achievement of sustainable development. Concerning H2, the results support that the environmental resource-conservation efforts of the energy firms affect pollution reduction. These findings are in agreement with previous studies that environmental resource-conservation efforts give support to huge numbers of agencies that are concerned with environmental pollution control, such as solid waste, noise, contaminated land, air and water, etc. [24]. Environmental resource-conservation efforts can have an important say about over development. Every firm has diverse procedures and compliance regulations about pollution reduction which are applied in their operational and manufacturing methods [25]. Environmental resource-conservation efforts help in developing better environmental quality by reducing and preventing waste with innovative strategies and techniques that help in the reduction of pollution and meeting the requirements and objectives of people and agencies [26]. Pollution managing agencies use powerful resources conservation efforts for controlling critical factors involved in developing proposals for land-use which reduces environment pollution [27]. ERCE focused on increasing suitability and reducing harmful impacts of major projects, and also emphasizes environmental planning for reduction of pollution [28]. Therefore, we recommend that ERCE of energy firms play a critical role in pollution reduction. Regarding H3, outcomes was proposed that pollution reduction can be directly and positively linked with sustainable development. This research finding supports H3 and also previous scholars' works that every firm is able to reduce pollution in a number of different ways. They may overcome their emissions through transferring of waste onsite, third party and preventing waste pollution at the source [30]. Sustainable development

should come through diverse means of pollution reduction; if each factor of pollution reduction is expensive to attain, several factors might be under used whereas other factors could be overexploited [31]. Firm sustainable development expectations determine new information search locations and concentrations for cost-effective pollution-reduction opportunities [32]. If firm managers want small profits, they may not seek profitable pollution-reduction strategies and accordingly they cannot find profitable opportunities which increase operational sustainable development in the firm [33]. Different pollution reduction strategies help in the prevention of waste that enhances employee incentives and supports the development of workers' skills, which increases sustainable development and performance in firms [34]. Profitable pollution reduction strategies lead to unanticipated synergies between the latest innovative production techniques and waste prevention [35]. Implementation of increased innovation processes leads to sustainable development [33]. Still, a marginal level of relationship between ERCE and sustainable development demonstrates that ERCE are not a primary direct factor for achieving sustainable development. Therefore, our research provides an opportunity to determine internal mechanisms to fulfill the gap through testing and mediating variable pollution reduction. Concerning H4, the current study shows that ERCE forecast sustainable development through the mediation effect of pollution reduction. Environmental resource-conservation efforts are the preconditions for pollution reduction which improve the sustainable development of energy firms. Our research results support previous studies' work that the impact of environmental resource-conservation efforts on sustainable development of energy firms are positively and significantly mediated through pollution reduction strategies of firms. To acquire better results, sustainable development must capitalize on adequate techniques and strategies of the top management [39]. The ERCE, pollution reduction and sustainable development relationship come to pass when top management demonstrate commitment to prevent environmental worsening and expend valuable time with environment-friendly resources that increase sustainable development through knowledgeable abilities of their employees [40]. Current research fills the gap in this issue through evaluating association between efforts of environmental resources conservation and sustainable development of the energy firms which are mediated through pollution reduction strategies [41]. Pollution reduction acts as a mediator between ERCE and sustainable development because ERCE force energy firms to take part in pollution reduction activities/actions, which facilitates energy firms to promote sustainable development [42].

### 5.1. Theoretical Implications

Our research adds to this theory by providing the most up-to-date deliberations about the relationship between ERCE, pollution reduction and sustainable development. Environmental resource-conservation efforts of the energy firms belonged to technical operational efforts in the direction of sustainable use of the water, preventing waste and reduction of energy. By conservation efforts, energy firms can make use of the latest pollution prevention techniques which reduce their emissions/waste and also minimize the negative impacts of the production methods on natural resources and the environment. ERCE are initiatives that enable energy firms to be accountable for both a clean society and environment. This research showed that ERCE and pollution reduction are the key antecedents of sustainable development.

This study corroborates that ERCE direct energy firms in taking various actions for the enhancement of sustainable development. While environmental resource-conservation efforts perform key roles for the protection of natural environmental resources and solving environmental issues, they also make it easier for energy firms to achieve environmental goals. When energy firms demonstrate different concerns and actions about the environment and society development, it is anticipated that these energy firms will formulate conservation efforts for protecting them; and these ERCE may collectively achieve different acts, that are directed towards improved sustainable development.

## 5.2. Practical Implications

Our research proposed that ERCE give a basis for sustainable development in a circular economy. A circular economy acts as a solution framework that helps in tackling global changes such as loss of biodiversity, pollution, climate challenges and recycling of waste. This system helps in managing existing resources, making and usage of products and recycling of waste materials. Accordingly, energy firms are now paying attention toward hygienic issues and are focused on green structures, processes and environmental consciousness. The current study highlighted the forthcoming concern through suggesting an essential antecedent of sustainable development, i.e., ERCE. Furthermore, this study offers that energy firms' management must focus on the missing linkage of pollution reduction between ERCE and sustainable development. Correct and timely decisions taken by the managers and appropriate response of the stakeholders can eventually strengthen sustainable development. In practice, management place emphasis on the environmental resource-conservation efforts and pollution reduction strategies for acquiring overall sustainable development. This study explains that energy firms' environmental resource-conservation efforts give operational vitality to perform pollution-reduction activities for obtaining targeted sustainable development.

## 6. Conclusions

This study provides several critical practical policies and suggestions for management of energy firms for raising their sustainable development. Our research provides major implications through focusing on the role of ERCE and pollution reduction strategies and activities to enhance sustainable development of energy firms. This study expands the prior literature knowledge through providing an empirical model for energy firms. This model analyzes the effect of ERCE and pollution reduction strategies on sustainable development of the energy sector.

Current research examines the pollution-reduction mediating role between ERCE and the sustainable development link; however, other variables, such as environmental performance, green innovation, stakeholder attraction, etc., can be considered as mediators for improving this association. Another future research direction could be to investigate this model in other sectors, with diverse features, e.g., the manufacturing industry, tourism and hospitality industries, that embody the main part of the economy.

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**Informed Consent Statement:** Written informed consent has been obtained from the respondents.

**Data Availability Statement:** Data is available on request.

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

## Appendix A

| Variables | Items          | Constructs                                                                                                                    |
|-----------|----------------|-------------------------------------------------------------------------------------------------------------------------------|
| ERCE      | ERCE1<br>ERCE2 | Our firms prefer to:<br>use automatic daylighting timer and sensors.<br>reset temperature of offices and other working rooms. |

| Variables               | Items  | Constructs                                                                                                                                 |
|-------------------------|--------|--------------------------------------------------------------------------------------------------------------------------------------------|
| ERCE                    | ERCE3  | use energy efficient products and equipment.                                                                                               |
|                         | ERCE4  | switch to lighting systems which is energy efficient.                                                                                      |
|                         | ERCE5  | use monitoring systems for effective consumption of energy.                                                                                |
|                         | ERCE6  | use water-efficient equipment and low-flow shower heads.                                                                                   |
|                         | ERCE7  | use alternative sources of water/energy saving applications                                                                                |
|                         | ERCE8  | well water for metering equipment.                                                                                                         |
|                         | ERCE9  | compost unrefined food waste.                                                                                                              |
|                         | ERCE10 | use refillable amenity dispensers.                                                                                                         |
|                         | ERCE11 | suitably treat storage/disposal of the waste.                                                                                              |
|                         | ERCE12 | frequently buy recycled-content products.                                                                                                  |
|                         | ERCE13 | provide recycling dustbins in the offices and guest-rooms.                                                                                 |
|                         | ERCE14 | avoid usage of disposable tableware.                                                                                                       |
| Pollution reduction     | PR1    | We perform more effort to assist in prevention of pollution.                                                                               |
|                         | PR2    | We prefer to pay additional taxes for harming the environment and increasing pollution.                                                    |
|                         | PR3    | We use and learn about pollution-reduction techniques.                                                                                     |
|                         | PR4    | We support government laws and regulations for the reduction of pollution.                                                                 |
|                         | PR5    | We adopt the latest techniques of production for pollution reduction.                                                                      |
|                         | PR6    | We design strategies that focus on pollution reduction.                                                                                    |
| Sustainable development | SD1    | We reduce the harm to the environment from people which can frequently have disastrous consequences and encourage sustainable development. |
|                         | SD2    | We protect the environment to enhance sustainable development.                                                                             |
|                         | SD3    | We save natural resources, such as water and forests from our firm's activities and save it from harm.                                     |
|                         | SD4    | We improved sustainable development through a green infrastructure.                                                                        |
|                         | SD5    | Our major focus is to protect the environment and establish sustainable development, social, economic and environmental efforts.           |

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