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Benchmarking Internet Promotion of Renewable Energy Enterprises: Is Sustainability Present?

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Abstract: Sustainability constitutes a broad discipline that focuses on the social, economic and environmental impact of human activities. Many policies and strategies have been developed for the pursuit of environmental sustainability and the guidance to a green society. Many enterprises have taken meaningful steps to improve their own environmental performance through corporate sustainability and environmental management. Environmental management contributes to significant improvements to environmental performance of the enterprises. This paper aims to evaluate the Renewable Energy Enterprises performance in the Internet in Thessaloniki Prefecture regarding the characteristics of sustainability using Multi-criteria Decision Analysis. TOPSIS method was used to provide a ranking of the Renewable Energy Enterprises according to their sustainability and finally conclude to a benchmark. According to the results of the research, the Renewable Energy Enterprises achieve a good level of sustainability but not the optimum. However, the entrepreneurs should adopt modern environmental policy, sustainable marketing, green network framework and certified environmental management system in order to consider their enterprise sustainable.

Keywords: Renewable Energy Enterprises; sustainability; Internet; benchmark

1. Introduction

Sustainability-related issues address many significant topics such as environment, energy, ecology, management, marketing, economics, research and development, transportation [1]. Sustainability science is situated as a science in which the societal values form the scientific agenda and at the same time, it provides both theoretical and practical knowledge to the society [2]. The vital role of environmental sustainability excellences is recognized as the organizations that belong to the third sector (such as the business world, public administration and civil society) have already adopted technical solutions against this background and which are behavioural examples of guidance to the green society [3,4]. Sustainability science has received far and away the most attention worldwide, due to the growing environmental problems and socioeconomic inequity, concluding to the current Global Economy Model (GEM), which emphasized profits [5]. Studies regarding the transdisciplinary collaboration indicate that there is progress in linking and incorporating the knowledge with action to support the sustainable use of natural resources, the climate change adaptation, the research agenda, decision making and the governance [6–12].

The proliferation of environmental sustainability-related policies during the last decades introduced a great interest in their functioning as tools of governance and their role in influencing environmental outcomes [13]. Sustainability issues are characterized as wicked problems that require cooperation among different parties in order to be defined and addressed [14]. Corporate sustainability has gone mainstream as many enterprises have already taken meaningful and important steps to enhance their own environmental performance. But while Corporate Political Actions (APC) such as

lobbying can make a greater impact on environmental quality, they are frequently disregarded in most sustainability metrics and indices [15]. Whether forced by the concern for society and the environment, government regulation, stakeholder pressures, or economic profit, managers and strategists should continue to make important changes to achieve more efficient management of their socio-economic and environmental impacts—and to stay up to speed with the emerging market [16].

The ecologically sensitive corporate orientation sometimes referred to as the 'green' strategy, can originate with an enterprise's estimation of present-day production and marketing practices and adapting behaviour to indicate to a high level of environmental awareness [17]. A sustainable champion is defined as "the enterprise that has taken the lead in reducing the environmental impact of its activities, usually at levels beyond regulatory compliance and has achieved recognition as being 'green' compared with its competitors" [18,19]. The modern economic growth introduces new methods of organization and management, not only on national level but also on the levels of different economic entities, as well as on the replacement of the cumbersome technologies with the eco-friendly ones [20,21]. Sustainability innovations—new services or goods serving environmental and socio-economic goals [22–24]—constitute a critical attribute for many sectors (such as solar cell technology, electric cars, biofuels, biotechnology, bio-based plastics, wind-farms) but also provoke great uncertainty and ambiguity to the entrepreneurs and the intrapreneurs [25].

Many programs and initiatives have been established to help Small and Medium Enterprises (SMEs) to enhance their environmental performance, such as the Environmental Compliance Assistance Program for SMEs (ECAP) and the Green Action Plan (GAP), because SMEs seem to face more difficulties to conceive and implement environmental regulation [26,27]. Renewable energy support policies include research grants, development and demonstration projects, tax incentives for investment, fiscal and financial incentives and price-based and quantity-based policies such as feed-in tariffs, feed-in premiums, net metering, Renewable Energy Certificates (RECs), Renewable Portfolio Standards (RPSs) and competitive procurement for goods and services [28]. European Energy Industry is in the process of great revolution, which brings green power closer and can define its profiles for years to come [29]. Increasing the energy efficiency of large enterprises and SMEs plays a vital role in mitigating climate change [30], which is reflected in the EU energy efficiency target of 30% 2030 (Directive 2012/27/EU).

Energy enterprises ought to assume responsibility for improving the environment, beginning with the most fundamental practices such as minimizing, restoring and repairing the damaged environment in a timely fashion [31]. According to Bloomberg [32], investments in the sector of renewable energy declined by 8% in developed economies, while increased by 19% in developing economies [33].

There is a need to build a greener future, where technology, Internet of Things (IoT) and the economy will be replaced with green technology, green IoT and the green economy, respectively, which follows from a whole world of possible remarkable improvements of human welfare and therefore, supports the development of a smarter world [34]. ICT (Information and Communication Technology) integration and eco-innovation contribute not only to the main body of knowledge on sustainable marketing but also to the application of sustainable marketing amongst enterprises in developing economies [35]. Green ICT gains significant interest and it is considered as an important issue for the forthcoming years, while the enterprises are trying to compete with each other in how much "green" they are [36,37]. These modern green technologies provide significant opportunities for the people to advance in all areas [38]. Enterprises have been adapting their goods and services be more environmentally friendly [39,40]. Internet enables the collaboration with a variety of different enterprises, helping them to get sustainable competitive advantages in the global economic environment [41]. In particular, Internet is an effective channel for promoting an enterprise's green initiatives directly to consumers [42].

Nowadays, scientists, policymakers, managers and entrepreneurs are trying to find out how to turn IoT into reality and touch every aspect of our lives, since many technological constraints (such as standardization, interoperability, privacy and security issues, heterogeneity and data

deluge) complicate the development of an IoT network and the transition to a smarter future [43]. The performance of a renewable energy enterprise through the Internet is totally affected by the sustainability awareness of the enterprise. According to a recent study [44], organizational agility affects positively the green performance of the enterprise, which positively affects customer satisfaction and organizational innovation. Furthermore, it is pointed out that the strong market orientation of an enterprise is an essential factor for high environmental performance of the enterprise [45]. The application of collaborative governance contributes to the achievement of sustainable benefits for the enterprise (e.g., creating technology legitimacy for sustainability, preventing food waste and enhancing environmental performance and compliance) [46]. The incorporation of sustainability into business practices through the implementation of sustainability programs lead to higher economic profit through eco-friendly innovative products [47].

For the purpose of this benchmarking study, we assess the Internet performance of the Renewable Energy SMEs in the Internet located in Thessaloniki Prefecture regarding their characteristics of sustainability Multi-criteria Decision Analysis. TOPSIS method was applied for the ranking of the Renewable Energy SMEs according to their sustainability and finally conclude to a benchmark.

2. Materials and Methods

The Internet presences of the Renewable Energy SMEs in Thessaloniki Prefecture are retrieved from the Internet through large-scale hyper textual search engines (such as "Google" "Yahoo" and "Bing") and thematic search engines from June to August 2018.

As for the characteristics of sustainability that were examined, they are suggested by Kernel [48] and Andreopoulou et al. [4] to evaluate the sustainability of an enterprise. However, only 8 of these characteristics of sustainability were selected to study in order to describe the current situation in Thessaloniki Prefecture (Table 1). Each characteristic is represented by a variable X_i. The first step was to implement quantitative analysis through a 2-dimentional table in order to examine the presence or absence of these criteria. The value of 0 and the value 1 were attributed to the variables X_1, X_2, X_3, X_4, X_5, X_6, X_7 and X_8 for the non-existence and the existence of each characteristic respectively.

Table 1. Characteristics of sustainability.

Characteristic	Variable
Make environmental policy	X_1
Eco-friendly tips	X_2
Develop green shopping policy	X_3
Information on green services and activities	X_4
Involvement in local green networks	X_5
Green success stories	X_6
Implement certified environmental management system compatible with ISO or EMAS	X_7
Make a review of important environmental impacts	X_8

Variable X_1 refers to the environmental policy of the enterprise as it is an important channel to market the environmental advances of the enterprises, while environmental advances constitute a concrete manifestation for enterprises including the integration of environmental regulation and social responsibility principles [49]. Variable X_2 is associated with the provision of eco-friendly guidelines and tips for sustainable living to online visitors (such as investment in eco-friendly technology, 3R policy—reduce reuse and recycle, building insulation), while variable X_3 represents the development of green shopping policy (e.g., provide online shopping, sell electrical appliances with Grade 1 Energy Efficiency Label and saving energy, sell products with minimal packaging, reuse the packaging materials). Variable X_4 refers to the provision of information on green services and activities and variable X_5 refers to the involvement of the enterprise in local green entrepreneurial networks aiming to increase the effectiveness of their business activities regarding the environmental protection. Variable X_6 represents the list of successful examples of sustainable applications in order to give inspiration

and ideas. Variable X_7 is associated with the adoption of the most robust environmental management tool EMAS and the compliance with the ISO requirements, while variable X_8 deals with the existence of reviews using indicators and important environmental impacts such as impacts on climate change, acidification, ozone depletion, air pollution, chemical pollution, freshwater use, forest resources and so forth.

Since the characteristics of sustainability are partially or completely incompatible and by nature very distinct and measures in different units, the evaluations of subjective probabilities, the multi-criteria decision analysis (MCDA) is the method that fits better in evaluating sustainability of management model [50]. TOPSIS method, which was developed by Hwang and Yoon [51], is a broadly used multi-criteria method for improving the decision-making process. By using TOPSIS method, the decision-maker solves selection/evaluation problem because it is based on a sound logic, which represents the rational of human choice [52].

The main idea of TOPSIS method comes from the concept that the selected alternative should be closer to the Positive Ideal Solution (PIS) and further from the Negative Ideal Solution (NIS) [53–55]. PIS is called the solution that maximizes the benefit criteria and minimizes the cost criteria, whereas NIS is the solution that minimizes the benefit criteria and maximizes the cost criteria [56]. Although, two "reference" points are introduced in that method, the relative importance of the distances from these two points is not taken into consideration [57]. To sum up, the alternative optimal solution is the alternative with the minimum distance from the PIS and the maximum distance from the NIS [56]. The weights of criteria weights in the TOPSIS method are defined a priori [58]. Even though TOPSIS uses crisp numerical values to present the performance rating of alternatives and the criteria weights, the preferences of the decision makers are often abstract and cannot be represented in this way in reality [59]. Alternatives are ranked according to the value of their Closeness Coefficient (CC) in decreasing order, which is calculated regarding the distance of the respective alternative from both PIS and NIS [55]. CC takes a value between 0 and 1.

The procedure of TOPSIS method includes the following steps [60]:

- construction of normalized decision matrix
- construction of weighted normalized decision matrix
- selection of the PIS and NIS
- computation of separation measures and CC
- ranking of the alternatives.

TOPSIS method uses all the attribute information, presents the total ranking of the alternatives, while the given attribute preferences may be either dependent or independent [61–64]. TOPSIS method was applied in this case because it is the best-developed method in this field of multicriteria decision-making problems with simple computation process and high flexibility [65]. Furthermore, there are the following four main reasons [66,67]: (a) TOPSIS logic is rational and understandable; (b) the computation processes are straightforward; (c) this approach presents the best alternatives for each criterion through a mathematical formula; (d) the weights of the criteria are integrated into the procedures for comparison. In this case study, the weight of the criteria is the same (0.125).

3. Results

3.1. Statistics

The research on the Internet about the Renewable Energy SMEs in Thessaloniki Prefecture resulted in the retrieve of 23 Internet presences. In particular the internet research results are presented in Table A1. The achievement of each one of the characteristics of sustainability is presented in Figure 1. Almost all the Renewable Energy SMEs (91%) fulfil the fourth characteristic of sustainability regarding the provision of information on their green services and activities (X_4). Many SMEs provide a thematic about eco-friendly tips (X_2) and their green success stories (X_6) (48% and 61% respectively) while the

65% of them develops green shopping policy (X_3). Only the 26% is involved in local green networks (X_5) and the 30% implements certified environmental management system (X_7).
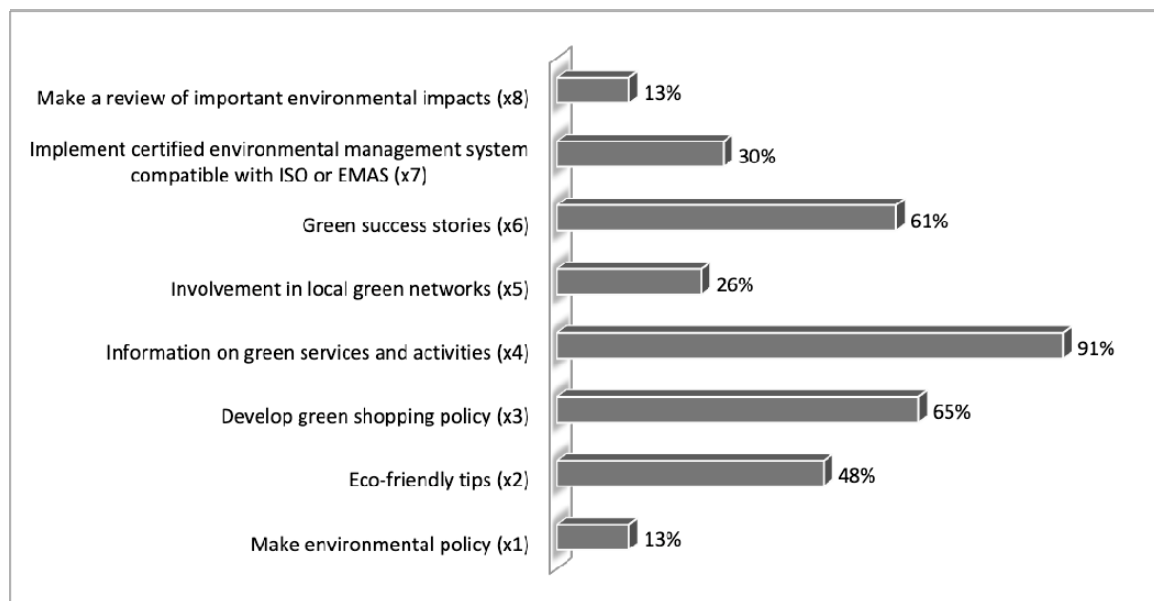

Figure 1. Achievement of the characteristics of sustainability.

Based on the application of the TOPSIS method, the total ranking of the Renewable Energy SMEs in Thessaloniki Prefecture according to their characteristics of sustainability retrieved from their Internet presence is presented in Table 2. The CC is estimated for each enterprise and it is used for the total ranking, as each enterprise with a higher CC is considered superior in ranking. According to these findings, the values estimated for CC present a spectrum of values between 0.19736 and 0.66281 and that indicates a great difference between the first and the last case in the ranking of the enterprises. The Renewable Energy SME with the best CC (REEnt_6) shows compliance with the legislation about environmental policy (X_1) (e.g., process control through standard operating procedures, environmental impact assessment of new projects, development and maintenance of constructive relationships with administration and local authorities, development of emergency response plan, environmental assessment policy and assessment of the environmental awareness of the suppliers), develops green shopping policy (X_3) through selling energy-efficient appliances, provides information on green services (X_4), describes some green success stories—case studies regarding the renewable energy development (X_6), implements certified environmental management system ISO 14001:2015 (X_7) and provides Environmental Impact Assessment Review (X_8). This enterprise can be used as a benchmark for the rest enterprises with lower CC. On the other side, the website of the Renewable Energy Enterprise with the worst CC (REEnt_14) provides only an overview of green success stories regarding the construction of solar parks.

The enterprises are further classified in two groups according to their ranking in order to present their level of sustainability. The average CC of the case is 0.3658. So, 12 enterprises belong to the group of "high sustainability" with average CC 0.4634 and the rest of the cases (11) belong to the group of "low sustainability" with average CC 0.2594. The averages of these two groups that were selected independently of each other was examined by using *t*-test for Independent Samples (with two options) in order to verify whether those group averages differ enough to believe that the enterprises from which they were selected have different averages. According to the results, there is clear differentiation between these two groups, as we reject the null hypothesis and accept the alternative one (Table 3).

Table 2. Total ranking of the Renewable Energy small medium enterprises (SMEs) according to their characteristics of sustainability.

	Renewable Energy Enterprises	Number of Achieved Characteristics	di+	di−	CC_i
1	REEnt_6	6/8	0.06344	0.1247	0.66281
2	REEnt_19	6/8	0.07906	0.11543	0.59352
3	REEnt_9	6/8	0.08626	0.11016	0.56084
4	REEnt_21	4/8	0.10529	0.09214	0.46668
5	REEnt_13	5/8	0.10704	0.09009	0.45701
6	REEnt_23	4/8	0.10708	0.09006	0.45683
7	REEnt_7	5/8	0.10739	0.08968	0.45507
8	REEnt_2	4/8	0.11732	0.07623	0.39383
8	REEnt_11	4/8	0.11732	0.07623	0.39383
9	REEnt_1	4/8	0.12017	0.07165	0.37353
9	REEnt_3	4/8	0.12017	0.07165	0.37353
9	REEnt_20	4/8	0.12017	0.07165	0.37353
10	REEnt_17	3/8	0.12765	0.05728	0.30972
10	REEnt_18	3/8	0.12765	0.05728	0.30972
11	REEnt_15	3/8	0.12913	0.05387	0.29437
12	REEnt_12	2/8	0.13082	0.04962	0.275
13	REEnt_16	2/8	0.13195	0.04652	0.26068
14	REEnt_8	2/8	0.1331	0.04313	0.24474
15	REEnt_4	2/8	0.13338	0.04226	0.2406
15	REEnt_5	2/8	0.13338	0.04226	0.2406
15	REEnt_10	2/8	0.13338	0.04226	0.2406
15	REEnt_22	2/8	0.13338	0.04226	0.2406
16	REEnt_14	1/8	0.13586	0.03341	0.19736

Table 3. *T*-test for the values of closeness coefficient (CC) in Renewable Energy small medium enterprises (SMEs) in Thessaloniki Prefecture.

	Levene's Test for Equality of Variances	*t*-Test for Equality of Means	
	Sig.	Sig. (2-Tailed)	Mean Difference
Equal variances assumed	0.642	0.028	−0.319
Equal variances not assumed	0.642	0.028	−0.319

3.2. Benchmarking the Sustainable Renewable Energy SMEs

According to the results of the research, the Renewable Energy SMEs achieve a good level of sustainability but not the optimum, as none of them achieve all the characteristics of sustainability. However, the entrepreneurs that are interested in integrating sustainable development at their enterprise level should integrate the main characteristics (Figure 2):

- modern environmental policy
- sustainable marketing
- green network framework
- certified environmental management system

While environmental management standards and frameworks provide a variety of effective tools for bringing significant improvements to the environmental performance of the enterprises, they are limited on developing environmental policies, strategies and procedures [68,69]. Hansmann and Claudia [70] highlighted that the fact that an entrepreneur can successfully address the environmental challenges, it indicates that he can successfully create competitive advantages to add massive value to his products or services [71]. For example, Arnold and Hockerts [72] studied the corporate sustainability innovation strategy of Royal Philips and present some of the sustainability-oriented approaches in the enterprise such as the provision of information regarding sustainability issues, the

adoption of sustainability and integrating reporting, the stake-holder integration in environmental issues and the ISO 14001 certification of all parties [73].

Figure 2. Benchmarking the sustainable Renewable Energy SMEs.

4. Discussion

Environmental sustainability constitutes an important goal in public policies as natural resources are continually eliminated and for this reason governments implement strategic management in order to keep their use within sustainable limits [74,75]. Within this framework, the objectives of corporate sustainability are both socio-economic and environmental and although they may appear to be independent by their nature, they are "inextricably connected and internally interdependent" [76,77]. Recognizing the need to achieve sustainable development, various favourable policies and strategies for the renewable energy industry have been developed, funding has increased and therefore, the enterprises that promote renewable energy, which are continually mushrooming [78]. In order to address the challenges of sustainability, renewable energy resources and environmental strategy, entrepreneurs should evaluate their technological needs and develop a creative strategy in their marketing plan in order to remain competitive and keep a steady pace with the growing sophistication of eco-friendly products and services [79].

The Renewable Energy SMEs performance in the Internet in Thessaloniki Prefecture were studied and analysed regarding their characteristics of sustainability using TOPSIS method. As for the fulfilment of the characteristics of sustainability, most of the Renewable Energy SMEs provide information on their green services and activities and thematic tabs about eco-friendly tips and their green success stories. Also, most of them develop green shopping policy. CC presents values between 0.19736 and 0.66281 and that indicates a great difference between the first and the last enterprise in the ranking. The Renewable Energy SMEs that present "high sustainability" can be used as benchmarks for the enterprises that have been characterized by "low sustainability." The Renewable Energy SME with the best CC makes environmental policy, develops green shopping policy, provides information on green services, describes some green success stories, implements certified environmental management system and makes a review of important environmental impacts.

According to the results of the research, the Renewable Energy SMEs achieve a good level of sustainability through their Internet performance but not the optimum. Chang and Cheng [80] confirm that unlike large enterprises, small and medium-sized enterprises have considerable difficulty in achieving sustainable enterprises. It has to be mentioned that in some cases, the choice of market may constitute the main explanation for differences in sustainable development rate at enterprise rate [81].

However, the entrepreneurs should adopt modern environmental policy, sustainable marketing, green network framework and certified environmental management system in order to consider their enterprise sustainable. Caldera et al. [82] also include risk profiling and ongoing education and awareness in the sustainable business characteristics that enable the enterprises to identify performance improvement opportunities for sustainability transformation. Hao et al. [83] highlight that high-level managerial skills are essential for the entrepreneurs to developing path and practices towards sustainable entrepreneurship internally and also high-level technical skills are essential to integrating new emerging technologies and sustainable characteristics externally.

This research provides the entrepreneurs with an overview on the level of sustainability of the Renewable Energy SMEs. The results can be an efficient tool for entrepreneurs while enhancing the profile of their sustainable enterprise. Undoubtedly, the level of sustainability of an enterprise constitutes a significant characteristic for the awakened customers. Although the paper does not study in detail any particular characteristic, it constitutes a good starting point for entrepreneurs in this sector to get familiarized with the most frequently implemented sustainability management tools. However, the findings provide an overview of the current situation in the second-largest city in Greece, which makes the results less generalizable. So, a future extend in this process would be to search the Renewable Energy Enterprises in the Internet located in the rest of Greece, proceed with a comparison study and conclude to a sustainable benchmark as a tool for continuous sustainable improvement. Finally, some other characteristics could be studied such as life cycle assessment, environmental accounting, organic labels, ecomapping and so forth. that influence the sustainable performance of an enterprise, too.

Appendix A

Table A1. Internet research results.

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
REEnt_1	0	0	1	1	0	1	1	0
REEnt_2	0	1	1	1	1	0	0	0
REEnt_3	0	0	1	1	0	1	1	0
REEnt_4	0	0	1	1	0	0	0	0
REEnt_5	0	0	1	1	0	0	0	0
REEnt_6	1	0	1	1	0	1	1	1
REEnt_7	0	1	1	1	1	0	1	0
REEnt_8	0	0	0	1	0	1	0	0
REEnt_9	0	1	1	1	1	1	0	1
REEnt_10	0	0	1	1	0	0	0	0
REEnt_11	0	1	1	1	1	0	0	0
REEnt_12	0	1	1	0	0	0	0	0
REEnt_13	0	1	0	1	1	1	1	0
REEnt_14	0	0	0	0	0	1	0	0
REEnt_15	0	0	1	1	0	1	0	0
REEnt_16	0	1	0	1	0	0	0	0
REEnt_17	0	1	0	1	0	1	0	0
REEnt_18	0	1	0	1	0	1	0	0
REEnt_19	0	1	0	1	1	1	1	1
REEnt_20	0	0	1	1	0	1	1	0
REEnt_21	1	1	0	1	0	1	0	0
REEnt_22	0	0	1	1	0	0	0	0
REEnt_23	1	0	1	1	0	1	0	0

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