

Renewable Energy in Ecotourism: A Case Study of Trinidad and Tobago's Implementation Challenges

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ABSTRACT

Small Island Developing States (SIDS) like Trinidad and Tobago (TT) are highly vulnerable to climate change effects, resulting in the urgent need to mitigate Greenhouse Gas (GHG) emissions. Globally, countries that have diversified their energy sector, and incorporated Renewable Energy Technologies (RETs) have simultaneously reduced their GHG emissions. As such, it is critical for TT to integrate RETs into their energy mix. One key sector where this is important is ecotourism, where historically, there is a slow uptake of RETs. This paper aims to identify the deterrents and critical success factors (CSFs) for renewable energy (RE) implementation in the ecotourism sector of TT. A thorough literature search was conducted to identify the gaps and unique factors for TT and these were utilised to develop and validate a survey. The survey was administered to key stakeholders in the ecotourism sector of TT. The collected data was analysed to determine the deterrents to RETs implementation in the ecotourism sector of TT and to identify the CSFs. The deterrents identified include the high cost of installing RE systems, lack of awareness, absence of infrastructure to facilitate the RE systems installation, lack of policies and regulations, inadequate technical know-how and training to implement RE systems, and the heavily subsidised electricity rate. Further analysis indicated that the respondents are willing to implement RETs in their companies if there are better financial incentives and options, opportunities for capacity building and collaboration with academia for innovation, research and development

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of RETs. The most popular RET of choice for implementation in this sector was identified as solar energy. Therefore, CSFs for RE implementation in TT include capacity building, infrastructure development, financial programs and opportunities, and policy development. These findings are crucial and play a vital role in policy development for RET implementation in the ecotourism sector in TT.

1 INTRODUCTION

Trinidad and Tobago (TT) are small island developing states (SIDS) with historically thriving oil and gas-based economies. As the largest oil and natural gas producer in the Caribbean¹, TT has relied heavily on hydrocarbons as its energy source, with oil and gas accounting for 93% of its energy supply in 2019². Anthropogenic climate change has been driven by increased emissions of greenhouse gases (GHG), particularly carbon dioxide (CO₂) and methane (CH₄), through the burning of fossil fuels³⁻⁶. Climate change has far-reaching consequences that include, ecological issues such as loss of biodiversity, water scarcity, and increasing temperatures, as well as health and social issues such as food insecurity and disease emergence^{7,8}.

TT is faced with the issue of a steadily decreasing supply of petroleum hydrocarbons⁹, with its oil production reducing from 243,000 barrels per day in 1980 to 60,000 barrels per day in 2021¹⁰. The availability of natural gas allows for heavily subsidised rates, which resulted in the current rate of electricity in TT to be between five and ten times lower than other countries in the Caribbean Community and Common Market (CARICOM) region at US\$ 0.05 per kWh¹¹⁻¹³. However, this may no longer be sustainable¹⁴ due to the depleting reserves and low rates that lead to waste, which inhibits the implementation of RETs.

Travel and tourism account for 10.3% of total global GDP contributions and 7.8% of TT's economy, with a -2.9% growth in 2019¹⁵. Being a large diffuse global industry, tourism impacts many areas, both positively and negatively, from climate change to local and regional effects on endangered phenomenon¹⁶.

TT is a signatory to the Paris Agreement and the Country's Nationally Determined Contributions (NDC), which is set to reduce overall CO₂ emissions by 15% (equivalent to 103,000,000 tonnes of CO₂ emissions) by 2030 from a Business as Usual (BAU) 2013 baseline¹⁷. TT, as documented in its National Development Policy Vision 2030 document, aims to develop and implement appropriate policy instruments to create the environment required for the development of RE technologies at the national level¹⁸.

A renewable resource can be replenished naturally over time. The term RET can be broadly described as technology that enables the harnessing of energy from renewable resources such as biomass, geothermal, solar, wind and hydropower, all considered free and readily available¹⁹. TT's location near the equator makes it favourable for solar energy generation. Wind power is also a viable option for TT.

Since 2017, Tourism in TT has been led by the Tobago Tourism Agency (TTA) and the Tourism Trinidad Destination Management Company Limited (TTL). In line with the demand for economic diversity in Vision 2030, the Standing Committee for the Strategic and Sustainable Development of Tourism in Trinidad identified Ecotourism as one of three main areas for future emission reduction opportunities²⁰. However, no information was found in the literature on direct plans to incorporate RE into the Ecotourism sector. Fig. 1 depicts areas of direct, indirect and induced contributions of travel and tourism.

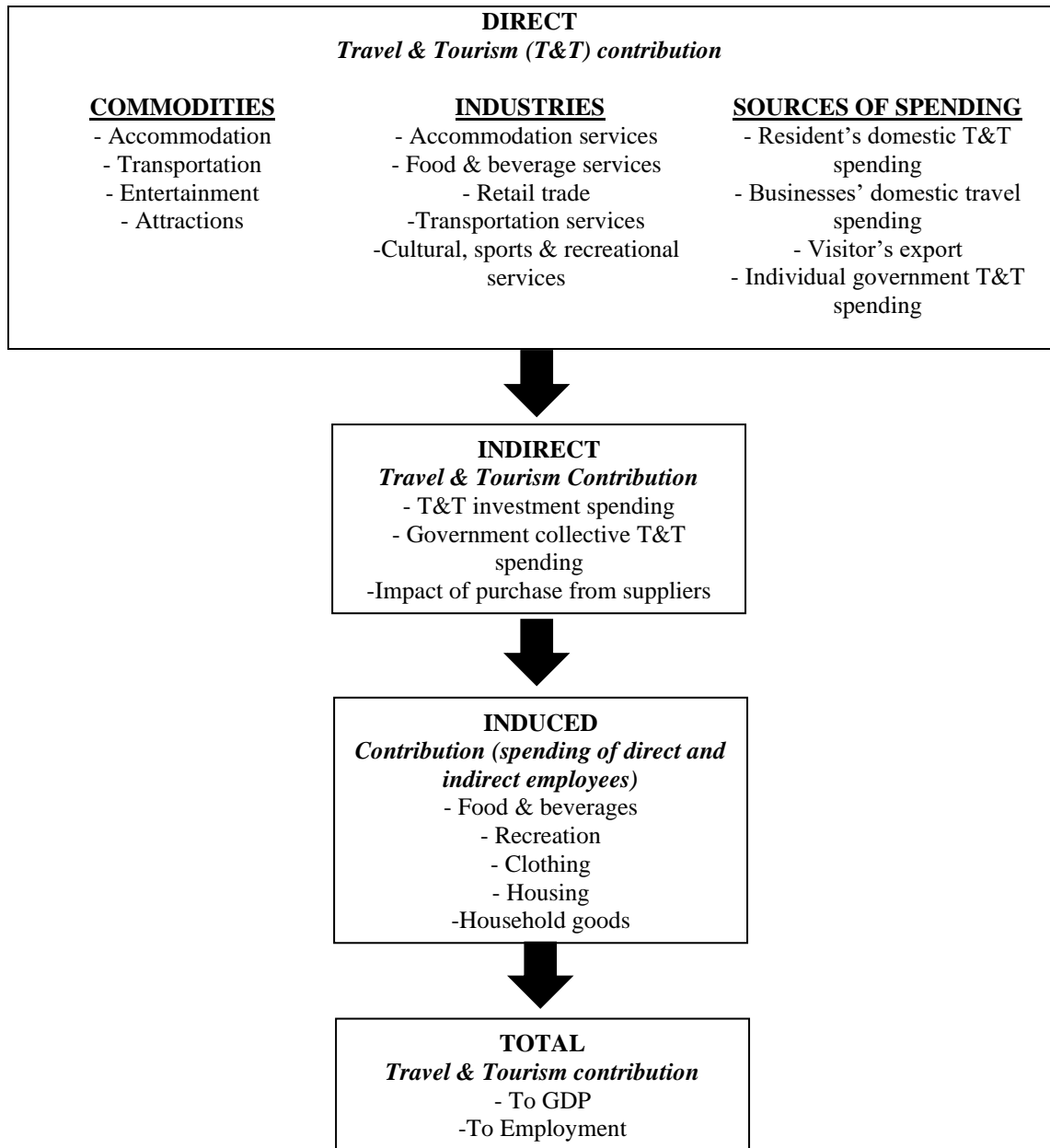


Fig. 1. Flowchart depicting the direct contributions of travel and tourism¹⁵.

Environmental sustainability and economic growth can both be driven in part by tourism²⁰. In the study of 'The impact of tourism arrivals, tourism receipts and RE consumption on quality of life: A panel study of Southern African region,' it is recorded that a boost in economic advancement is linked to the population's high literacy in science and technology and proper logistics structure²¹. In the case of the Ecotourism in German Alps, some hindrances to successful implementation recognised were, a disconnect between public negotiations, policy and implementation, lack of awareness of climate and demographic change and its relation to and effects on tourism and lack of resources²². Long term economic activity viability, capital and commercial space, respect and tolerance for interculturality, environmental

preservation and educational awareness were identified as critical CSFs for sustainable tourism in La Florida, Peru²³. Furthermore, buildings, infrastructure, transportation, and accommodation are areas identified for RET implementation opportunities to promote GHG emissions reduction in the tourism industry²³.

However, the lack of policy and legislation in TT restricts to the profitability of RE independent power generation²⁴. Specifically, for photovoltaic (PV) power generation, and solar thermal energy, most projects are on the micro scale, with macro projects still in the developmental stages. On the other hand, fiscal incentives extended to solar water heaters have encouraged a slow industry uptake²⁵. Moreover, the energy transition is creating an increase in demand for clean energy generation²⁶, which is expected to drive further the implementation of RETs across various sectors in TT, including ecotourism.

Sustainable entrepreneurship is defined as an entrepreneurial act that aims to recognise the profit opportunities while simultaneously introducing innovations for addressing environmental issues and social challenges²⁷. Inefficient firms, existing externalities, flawed pricing mechanisms, and imperfectly distributed information are four market imperfections that are catalysts of sustainable opportunities²⁸. Gabriel²⁹ identified six key challenges of RE entrepreneurs in the ecotourism sector in developing countries RET cost, inaccessible institutional funding, insufficient government or policy support, inadequate physical infrastructure and logistics, limited technical and skilled labour, and power/ dominance of incumbents. Additionally, government regulation, incentive programs, entrepreneurial culture and respect, and education or information on business start-up, or both, are other factors that can promote or inhibit entrepreneurship³⁰. Sources show that perceptual and socio-economic factors, whether positive or negative, impact one's propensity to and purpose for becoming an entrepreneur³¹. Whilst Gabriel²⁹ specifically noted that challenges faced are also influential to an entrepreneur's ability to identify and exploit opportunities.

Table 1 summarises the CSFs for RET implementation in the ecotourism sector, obtained from previous studies.

Table 1. Summary of critical success factors for RE implementation in the ecotourism sector

Category	Critical success factors
Economic	Market imperfections ^{27,28} High investment risk (uncertainty of the long-term economic activity viability) ^{23,32} Inaccessible institutional funding & lack of incentive programs ^{30,33} Prohibitive price point of RET ³⁴ High and volatile oil prices affecting electricity cost ^{35,36}
Governmental and institutional	Lack of policy and regulation ^{22,32,33,37} A disconnect between public negotiations, policy and regulation ²² Insufficient government or policy support ³² Insufficient capacity for exclusive dedication to RE issues, and ineffectual institutions ³²
Knowledge / education	Lack of trained human resources in RET ^{30,32,38} Lack of educational awareness of RET and/ or vision for the relevance and importance ^{21,22,37}
Technology	Limited availability of service and technology providers ^{35,36} Lack of local renewable energy sources ^{37,38}
Infrastructure	Inadequate physical infrastructure and logistics ³⁰

To date, no local studies have been done to identify the deterrents and CSFs for implementing RETs in the TT ecotourism sector. Since these CSFs are critical for appropriate policy development, this paper will attempt to close this gap in knowledge, from the entrepreneurial perspective, and to identify the deterrents and CSFs for RE implementation in the ecotourism sector in TT.

To identify these deterrents and CSFs, a survey instrument was utilised to collect data, consistent with previous studies³⁹⁻⁴³. The objectives of these previous studies were quite similar to the current study, with the use of a survey instrument proving to be quite effective in achieving the stated objectives. The survey was validated by peer reviewers, subject matter experts and industry stakeholders and administered to key participants in the ecotourism sector. The results obtained were analysed and reported.

2 METHODOLOGY

The methodology adopted in this paper is consistent with other similar research^{24,39-42}. Based on literature review, the CSFs for sustainable ecotourism in other jurisdictions were identified and shown in Table 1. This provided the basis for developing a survey instrument (see Appendix 1) to identify the deterrents and CSFs for RET implementation in ecotourism in TT.

The survey instrument was validated by peers, subject matter experts and industry stakeholders and then disseminated to 150 key participants in the ecotourism sector of TT including food and beverage, lodging, and tour operators. The survey was administered over a 4-month period, during which 20 responses were received, representing a response rate of approximately 13%. It is important to note that the responses (85%) were predominantly received from micro to small businesses. This low response rate may be attributed to the lengthy approval protocols implemented in most organisations for responses to surveys requiring official responses from medium to large entities such as chain-hotels, restaurants, etc. Most of these organisations require several levels of approval before official participation can be approved, which is a significant deterrent to participation. Despite the low response rate, the data collected showed a clear trend in the responses and can be utilised to draw preliminary conclusions, thus making the results valid to influence decisions and inform policies.

The questionnaire was designed to gather data as follows: questions 1 to 9: demographic data; questions 10 to 17: knowledge and awareness of RE and RETs; question 18: challenges to RE implementation related to installation, cost and energy yield; question 19: challenges related to infrastructure, policies and regulations; question 20: challenges related to capacity, training and awareness; question 21: incentives that will positively affect company's decision to implement RE; question 22: sustainable practices in the ecotourism sector; question 23: need for collaboration among government entities, public institutions, industry stakeholders, and educational institutions on sustainable innovation, research and development in RE for the ecotourism sector.

The data collected was analysed to identify the deterrents and CSFs for the sustainable ecotourism sector of TT via the implementation of RETs and the results were discussed and reported in tables and graphs.

3 RESULTS AND DISCUSSION

The literature review was utilised to identify CSFs for RET implementation in the eco-tourism sector in several other countries. The data was then utilised to develop the survey instrument (see Appendix 1) that was used as a data collection tool to gather information that identifies the CSFs that are applicable to the eco-tourism sector of TT. The CSFs included in the survey tool were in alignment with those found in the literature that were seen as most applicable to the unique situation in TT. The questionnaire was validated and administered to participants in the ecotourism sector of TT, such as food and beverage,

lodging, and tour operators, in accordance with previous studies^{24,39-42} that were administered in corresponding sectors in other countries.

Questions 1 to 9 captured demographic data on age, gender, and educational attainment. Results showed that 40% of participants were men and 60% of participants were women. Approximately 85% of respondents were between the ages of 24 to 54. Within this age group, 30% had completed post-Secondary education, 45% had earned a Bachelor's Degree, and 15% had earned a Master's Degree and above, whereas nearly 10% of respondents fell in the 55 to 64 age category and earned a Master's Degree and above. The remaining 5% were above 65 years old and had a secondary level education. Fig. 2 provides a demographic summary of respondents. Research suggests that in comparison to the older age groups, younger age groups had a greater level of knowledge regarding RE. In contrast to earlier generations, younger individuals are increasingly cognisant of climate change and its daily implications, which is why RE is gaining popularity. Furthermore, from the survey, it is noted that people aged 65 and older completed secondary school education only, inferring that their knowledge of RE may be less than those who completed higher education. As such, it is evident that there lies an opportunity for the inclusion of capacity building activities targeted at the older population.

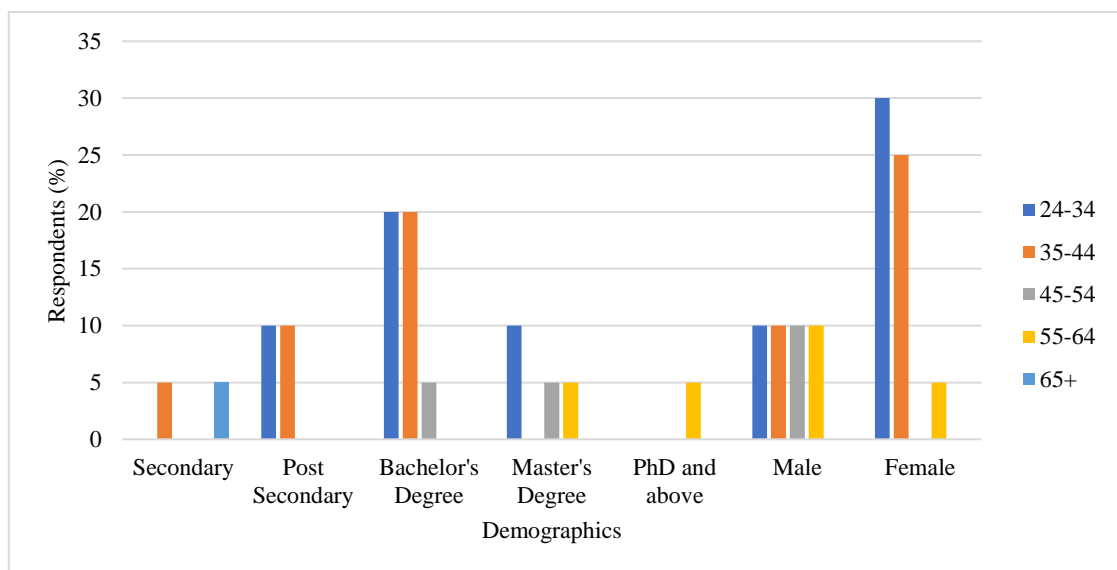


Fig. 2. Summary of respondents' demographic information.

Table 2 shows data obtained on the size, role, and services offered by organisations (questions 7 to 9). Small businesses (10-99 employees) made up the largest share (45%), followed by microbusinesses (40%), large businesses (> 500 employees) being 10%, and 5% medium-sized businesses (100-499). 32% of the respondents were managers, advisers, or supervisors, 58% were executive managers, and 5% were staff members (senior, intermediate, associate, or entry-level workers). 37% of responses were from the food and beverage industry, 27% from the travel and tourism, tour guide, and entertainment sectors as well as hotels and lodging. The remaining 9% included marketing, handcrafted goods, and performances. The data obtained was spread across different sizes and types of eco-tourism businesses, providing a good opportunity to gather a consensus on the opportunities for RET implementation in this sector. It must be noted that the responses received were mostly from upper management personnel with the decision-making power to allow RET integration within their businesses. Moreover, since no similar studies have been previously executed, the data collected was of vital importance.

Table 2. Summary of company's size, function, and services provided

Data	Details	Percentage (%)
Size	Micro (1 to 9 employees)	40
	Small (10 to 99 employees)	45
	Medium (100 to 499 employees)	5
	Large (over 500 employees)	10
Position	Executive manager (senior executive, executive, owner)	58
	Middle manager (senior director, director)	5
	Manager, advisor, or supervisor	32
	Staff (senior, intermediate, associate, entry-level)	5
Services	Hotel or accommodation	27
	Food & beverage	37
	Tourism, tour guide or entertainment	27
	Other	9

With regards to respondents' knowledge and awareness of RET, questions 10 to 17, 100% indicated that they are aware. Age, education, and degree of RE knowledge all had a significant relationship. Individuals aged 55 and above were only somewhat educated on RE. In contrast, individuals holding master's degrees and those between the ages of 25 to 34 and 35 to 44, were very knowledgeable. The pattern of relationships between age groups and RE knowledge is displayed in Fig. 3. The pattern is not unexpected as in recent years, RET education has been introduced into the curriculum at tertiary level institutions. It has been promoted at public forums and other events, with the target audience of latter age categories.

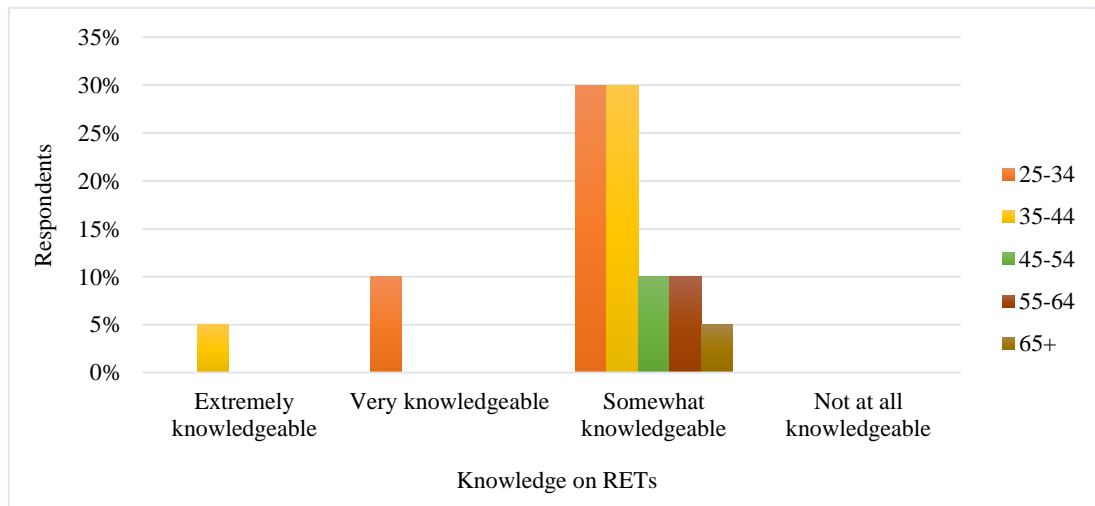


Fig. 3. Relationship distribution between age groups and RE knowledge levels.

In the area of RET training (questions 12 to 14), it was found that 10% of participants completed training in RE, while 90% never did. Of the personnel in their individual organisations, 25% completed RET training activities for employees, while the remaining 75% did not. This information proves to be quite useful as it identifies a clear opportunity within the ecotourism sector for capacity building. The data collected can be utilised to engage decision-makers and inform policies targeted at this particular sector.

In their response to question 15, 44%, 41%, 9%, 3%, and 3% were knowledgeable about solar thermal energy, solar electricity, wind turbines, green hydrogen for ammonia production and waste-to-energy technology respectively. Fig 4. shows the percentage of respondents who were aware that RET was either being used or considered for deployment in TT. The data collected highlights the leading percentage of 44% of respondents know what solar thermal energy is. Once more, the data shows a clear need for capacity building in RET in the eco-tourism sector. In TT, electricity is the main source of hot water generation²⁵ despite the abundance of solar energy available year-round. 95% of respondents indicated that they were likely to form partnerships in order to attain sustainability (question 17), showing the willingness of the respondents to commit to the NDCs goals outlined by TT.

Regarding financial incentives for the use of RETs (question 16), 85% of respondents were aware of the zero-rated value added tax (VAT) that is applied to solar water heaters, solar PV panels, and wind turbines, while only 15% were aware of the 25% tax credit for solar water heaters, valued up to TT\$ 10,000²⁵. Tourism companies in TT, such as hotels along with food and beverage institutions, all rely on hot water for hygienic reasons and to ensure guests' comfort. However, despite solar water heaters having the capacity to reduce electricity bills and decrease GHG emissions, they remain unpopular due to the higher initial investment required and lack of knowledge of the incentives available. This shows the need for more public awareness campaigns that promote the RET incentives that are accessible by all TT citizens.

Fig. 4 shows the respondents' knowledge on the type of RETs that are being considered for TT with a mere 3% of the respondents indicating that they are knowledgeable about technologies that convert waste to energy. Similar to the majority of countries worldwide, TT is experiencing growing issues with disposing of solid waste²⁵. This coupled with the need for TT to reduce its environmental impact by diversifying its energy mix, sets the stage for the possibility of utilising waste in the ecotourism industry for the waste-to-energy production. Waste-to-energy plants are commonly found in numerous countries across the world such as the United States of America (USA), China, Japan, and the European Union²⁵. They can be implemented in TT to alleviate the high accumulation of waste at the local landfills.

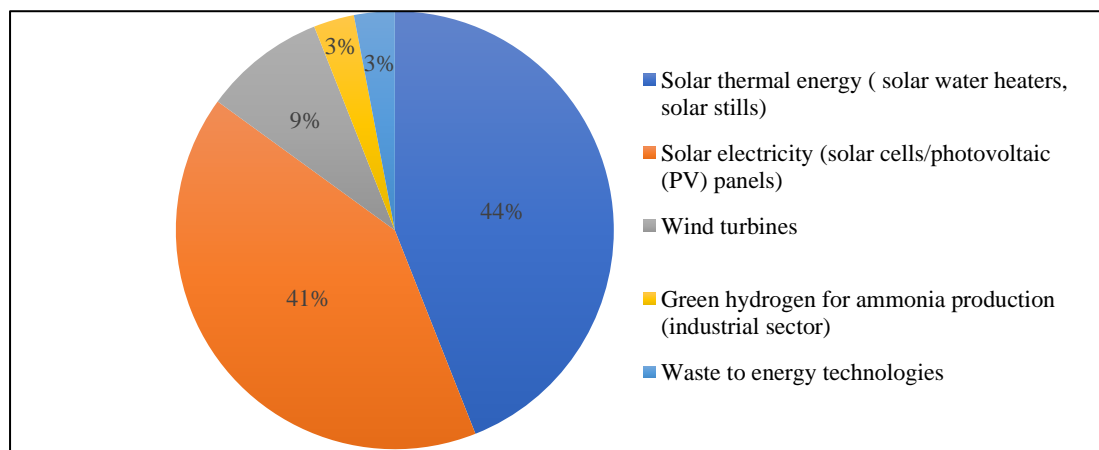


Fig. 4. Percentage of respondents' knowledge about RET that is either in use or being considered for TT deployment.

Questions 18 to 21 addressed the obstacles to RE implementation. 27% of respondents indicated that the installation cost is excessive, and they believe that this is the main obstacle preventing RE deployment in the ecotourism sector. Another 19% of respondents suggested that the high cost of RE systems is due to the lack of assurance surrounding their long-term viability. 19% of respondents indicated that there is little or no funding organisations available to assist in financing RE projects; 10% believe that the energy yield from RE systems is insufficient for the company's current energy needs; 7% believe that the cost of

electricity in TT is reasonable and that RE systems will be more expensive; 5% believe that the installation process is too challenging; and 2% believe that RE systems are not efficient enough to supply their company's energy needs. Fig. 5 shows the obstacles pertaining to the installation, pricing, and energy yield of RE systems that hinder their adoption.

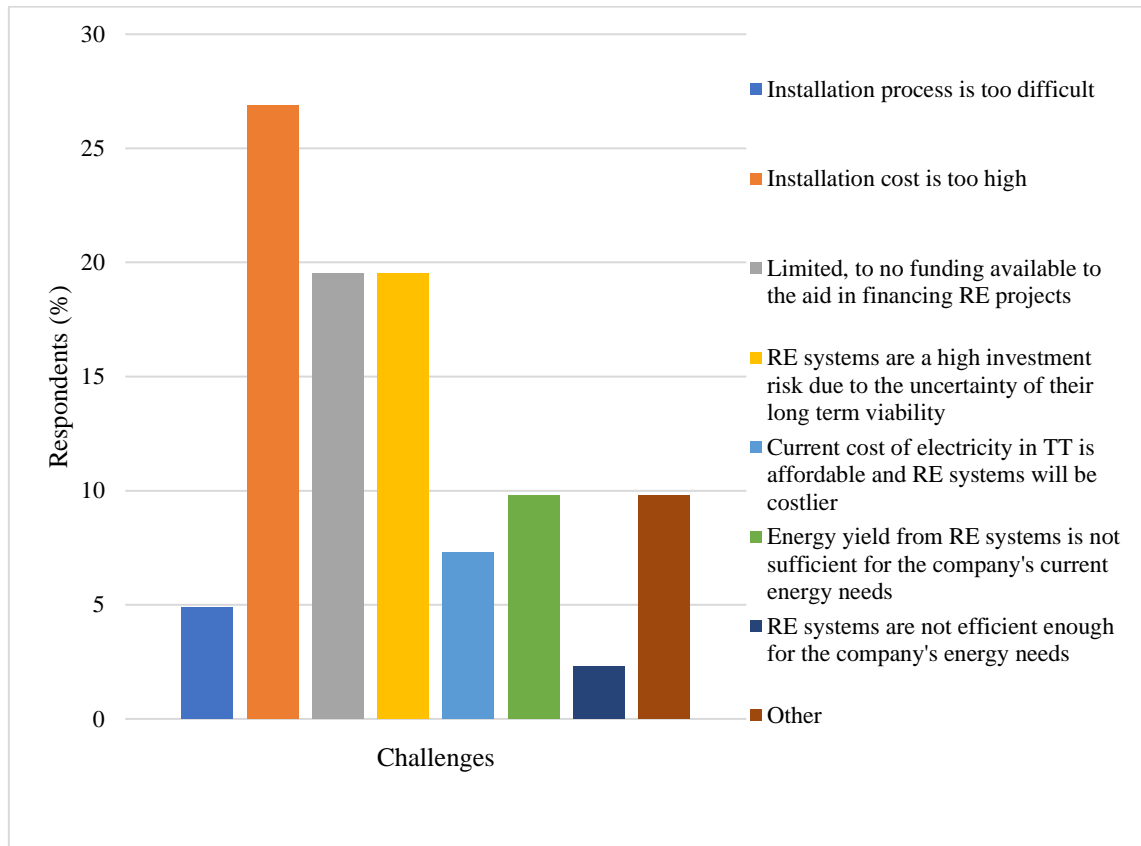


Fig. 5. Challenges that prevent RE implementation as it relates to installation, cost, and energy yield of RE systems.

With regards to the infrastructure, policy, and regulatory hurdles (question 19) that businesses must overcome, as shown in Table 3, 29% of respondents indicated that the absence of infrastructure to facilitate the RE systems installation; 12% indicated that there are not enough local RE service and technology suppliers; and 19% indicated that RE is not very high on their priority list, at this time. A total of 16% of respondents indicated that either none or insufficient policies and regulations concerning RETs exist in TT, while 12% feel that there is a discrepancy between public negotiations and the policies and regulations that are put into place, and that the current RE incentives do not satisfy the company's financial criteria.

Table 3. Respondents' responses on the challenges companies faced as it relates to infrastructure, policies and regulations

Infrastructure, policies and regulations	Percentage (%)
The company does not currently have the infrastructure to easily implement RE systems	29
The company does not have the capacity to focus on RE currently	19
There are insufficient local RE service and technology providers	12
There are no or insufficient policies and regulations as related to RET in TT	16
The current RE incentives do not meet the needs of my company's fiscal guidelines	12
There is a disconnect between public negotiations and the policies and regulations implemented	12

The responses to question 20 questioned regarding capability, education, and awareness needed for RE systems, revealed that the majority of businesses lack the RET background knowledge that is required. The majority of respondents (24%) think that the company's biggest challenge is that it does not have the requisite RET background knowledge. As such, it is evident that priority should be given to building capacity in RET for the ecotourism industry and the public at large. Moreover, collaboration between the ecotourism sector and academia for education in RETs and GHG reduction efforts, is deemed highly important due to the critical need for ongoing research and development in the past to ensure the business's competitiveness. In addition, 11% believe there are not enough campaigns highlighting the relevance and significance of RE and 19% of businesses believe they lack the appropriately trained personnel to operate and maintain RE systems. Fig. 6. shows the difficulties companies faces in obtaining the knowledge, expertise, and resources needed for RE systems.

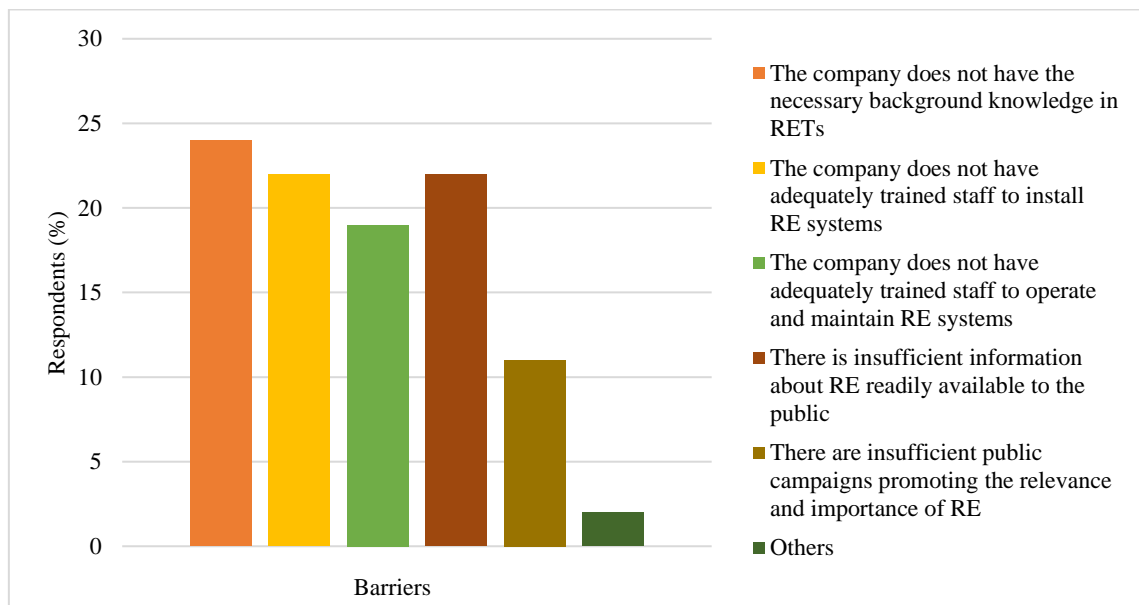


Fig. 6. RE implementation barriers encountered by companies.

Question 21 asked about incentives that favourably impact the companies' choice to integrate RE systems into their operations. The majority of respondents (19%) think that the best way to encourage the adoption of RE is if the price of energy produced from RE is less than the utility's cost (TTEC). Low electricity costs discourage consumers from investing in RE sources like solar energy. To encourage the adoption of RE, TT must first lessen the substantial subsidies given to its citizens thereby making the electricity prices aligned with other Caribbean islands, such as Barbados (\$ 0.28), Jamaica (\$ 0.32), Grenada (\$ 0.43), St. Lucia (\$ 0.34), Bahamas (\$ 0.32), Antigua (\$ 0.37), and Dominica (\$ 0.38), where the prices are not as heavily subsidised⁴³. The cost for electricity in these nations is among the highest worldwide, which drives their need for adaptation of RETs. In contrast, the government of TT subsidises the price for electricity and vehicle gasoline, at a cost of US\$ 187.3 million in 2016⁴⁴, which is becoming increasingly burdensome to the local economy.

The subsidised domestic electricity cost in TT ranges between TT\$ 0.047 and TT\$ 0.062 per kWh, which means that around 61% of the cost is subsidised⁴³. The projected unsubsidised cost of electricity in the country will range between \$ 0.046 to \$ 0.113 per kWh. In order to reach a 10% renewable energy production rate, the price of electricity would need to be raised by 9.1 cents per kWh to 13.8 cents per kWh. This would require eliminating the electricity subsidy entirely over the course of three years and raising the

price to 1.8 cents per kWh above the estimated cost of production, assuming no changes in production costs⁴³. The data gathered showed that the respondents are generally more willing to implement RETs if they are more affordable which shows the gap in awareness of the unsubsidised cost of electricity in TT.

As depicted in Fig. 7, when asked about the incentives that would encourage their company's implementation of RETs, 16% indicated that low interest rates would be an incentive; 13% stated that the cost of the solar water heater should be lower than electric water heaters; 11% would be inclined if there is an option to sell excess power generated by the system to the grid and 11% indicated that there is a need for national education campaigns that highlight the relevance and significance of RE, as well as national recognition for businesses that install RE systems at their locations. The final 8% indicated that funding from third parties for RE initiatives will be an incentive.

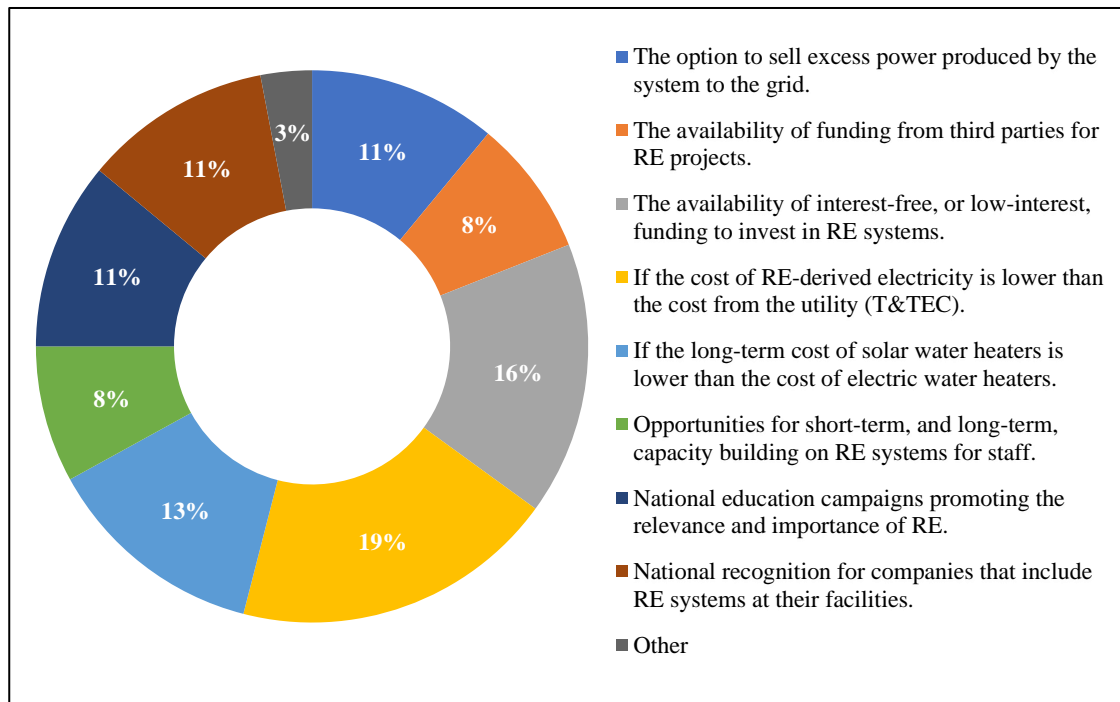


Fig. 7. Shows incentives that promote RE implementation.

Responses to question 22 indicated that most companies already engage in sustainable ecotourism practices such as limiting single-use plastics such as straws and water bottles and using biodegradable bags and containers for food and drink items. Moreover, in TT, sustainable tourism standards and educational efforts are implemented by Green TT, a non-profit environmental civil society organisation located in TT, and they have given their approval for hotels and boat operators in Tobago. Additionally, 17% of businesses use locally produced goods and services, while 16% incorporate initiatives to raise public awareness of environmental issues and encourage water and energy conservation. 10% of respondents indicated that they engage in composting or recycling. All these in Fig. 8 show the sustainable ecotourism methods that the organisations surveyed, currently employ.

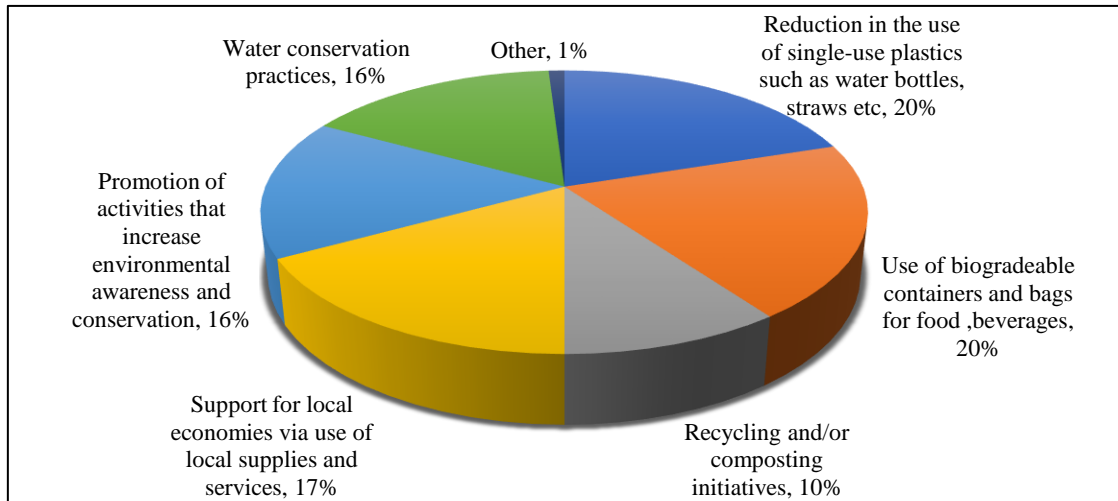


Fig. 8. Sustainable ecotourism methods that businesses presently employ.

In their response to question 23, 100% of respondents indicated that cooperation between public institutions, businesses, government agencies, and educational establishments is necessary for sustainable innovation, research, and development in RE for the ecotourism sector in TT.

In conclusion, the data analysis revealed that age and educational background were significant determinants of RE knowledge level in TT. Results indicated that solar thermal energy was the most often implemented RET in TT, and coincidentally, is the most promoted RET. The primary deterrents to the adaptation of RETs in TT were identified as the lack of awareness of RETs, the high cost of installation, the lack of infrastructure, the lack of policies and regulations, the lack of technical know-how and training to implement RE systems and the highly subsidised electricity rate in TT. The information gained is quite important since it identified the CSFs for RET implementation in the eco-tourism sector in TT. Identification of these deterrents was vital since it identified the areas of primary importance and presented the opportunity to execute informed decisions and inform necessary policies. These issues can be resolved by building capacity in RETs by raising awareness and providing free RE education and training, and providing incentives and recognition that will inspire and attract more RE users.

4 CONCLUSION

The main objective of this study was to identify the unique CSFs for RE implementation in the ecotourism sector in TT. Out of 150 targeted respondents, 20 completed responses were received, representing a response rate of approximately 13%. Analysis of the demographic data revealed that nearly 85% of respondents were between the ages of 24 to 54 years, and most respondents were from small and micro-organisations where they mostly held managerial or higher positions. Nearly 80% of the respondents completed tertiary level education and higher, and further analysis showed that age and educational background were contributing factors in the RET awareness. Respondents from the age categories of 24 to 44 combined with an educational background of tertiary level or higher demonstrated the highest level of awareness in RETs. The primary obstacles and CSFs for RE adoption in TT were found to include the high cost of installing RE systems, lack of awareness of RETs, absence of infrastructure to facilitate the RE systems installation, lack of policies and regulations, unavailability of technical know-how and training to implement RE systems, and the heavily subsidised electricity rate in TT. By identifying these obstacles, decision-makers now have access to the data that will inform decisions regarding legislation and policies as it relates to RET integration in the eco-tourism sector specific to TT. It is evident that there lies significant room for opportunities for implementation of RETs in the ecotourism sector in TT. 100% of respondents

agreed that cooperation between public institutions, businesses, government agencies, and educational establishments is necessary for sustainable innovation, research, and development in RE for the ecotourism sector in TT. 95% of the participants indicated that they were willing to form partnerships in order to attain sustainability and encouraged academic partnerships for innovation, research and development of RET.

Fiscal incentives were also perceived as beneficial. Implementation of incentives⁴⁵ that include 25% tax credits on Solar Water Heaters (SWH), 0% value added tax on SWH and solar PV systems, 150% wear and tear allowances for SWH, SWH plants, machinery and conditional duty exemptions for SWH manufacturers will go a long way in promoting RE implementation in the ecotourism sector of TT. There was also a general agreement on the importance of vocational training centres in RET and ecotourism. The offer of technical training programs with RE labs with state-of-the-art equipment and technology, industry-based software and international standards and best practices to aid in formal training will encourage and promote interest in RE adoption in this sector. Solar energy was identified as the most popular energy choice for effective implementation in this sector. The issues identified can be further resolved by raising awareness, providing free RE education and training, and providing incentives and recognition that will motivate and encourage more RE implementation. The data collected was of substantial importance as it identified the preliminary needs of the sector. As such, it is recommended that future work include the expansion of the survey and engagement of the state to capture a broader response rate, particularly for medium to large organisations in the ecotourism sector. The authors strongly recommend that the findings from this study be utilised to inform policy development for the future RET implementation in the ecotourism sector in TT.

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CONFLICT OF INTEREST

The author declares that there was no conflict of interest.

AUTHORS' CONTRIBUTIONS

Conceptualisation: S. Maharaj

Data curation: M. Dedier & A. Clark

Methodology: M. Dedier, S. Maharaj, M. Boodhan & R. Maharaj

Formal analysis: A. Clark, M. Dedier, S. Maharaj, M. Boodhan & R. Maharaj

Visualisation: Not applicable

Software: Not applicable

Writing (original draft): A. Clark & S. Maharaj

Writing (review and editing): M. Boodhan & R. Maharaj

Validation: Not applicable

Supervision: S. Maharaj, M. Boodhan, D. Boodlal & R. Maharaj

Funding acquisition: Not applicable

Project administration: Not applicable

APPENDICES OR SUPPLEMENTARY MATERIAL

A. Sustainable entrepreneurship in ecotourism in T&T

Survey: Sustainable Entrepreneurship in Ecotourism in T&T: Conceptual Analysis of Opportunities and Challenges Survey

Introduction

Good day, my name is Amy Clark, and I represent a team of researchers from the University of Trinidad and Tobago.

As continuation of the M.Sc. project entitled “*Sustainable Entrepreneurship in Ecotourism in Trinidad & Tobago: Conceptual Analysis of Opportunities and Challenges*” completed by Ms. Malaika Dedier, we are expanding the survey with the intention of collecting data that aids in identifying the opportunities, and challenges, for the integration of renewable energy technologies (RETs) in the Ecotourism sector of Trinidad and Tobago, with special emphasis on Sustainable Entrepreneurship practices.

The perspective of key stakeholders in the ecotourism sector is extremely important in this study, as your responses will help to fill current data gaps and contribute to the existing body of research on renewable energy technology integration in Trinidad and Tobago.

This survey consists of 23 questions and should take approximately 6 minutes to complete. All responses will be kept strictly confidential.

Should you have any further questions, please email me at: amy.clark@utt.edu.tt

Thank you once more for taking part in this survey and assisting the team with completion of this research. Your feedback is very important.

* Required

1. Consent

I verify that I am 18 years of age, or older, and I agree to participate in this voluntary, important, survey. I understand that the data collected will be treated with the strictest confidentiality, and the results will be published.

- I agree
 I do not agree

2. Demographics

Please select your age group. *

- 18-24
 25-34
 35-44
 45-54
 55-64
 65+

3. Gender *

- Male
 Female

1. What is your highest education level? *

- Ph.D. and above (Ph.D., Post Doc., etc.)
- Master's Degree (M.Sc., M.Phil., etc.)
- Bachelor's Degree
- Post-Secondary Education (Certificate/Diploma/Associate's Degree, etc.)
- Secondary - Advanced Level (CAPE, GCE A-Level, etc.)
- Secondary - Ordinary Level (CSEC, GCE O-Level, etc.)
- Other

2. Company Background

What is the name of your company?

3. On which island is your company located?

- Trinidad
- Tobago
- Other

4. Which category best describes your company, based on the number of employees?

- Micro (1 to 9 employees)
- Small (10 to 99 employees)
- Medium (100 to 499 employees)
- Large (over 500 employees)

8. Which of the following best describes your position/role in the company? *

- Executive management (senior executive, executive, owner)
- Middle management (senior director, director)
- Manager, Advisor, or Supervisor
- Staff (senior, intermediate, associate, entry-level)

9. Which of the following services are offered by your company?

Please select all that apply. *

- Hotel/Accommodation
- Food and Beverage
- Tourism/Tour Guide/Entertainment

10. Do you know what renewable energy (RE) is? *

- Yes
- No

11. How would you describe your knowledge on RETs?

- Extremely knowledgeable
- Very knowledgeable
- Somewhat knowledgeable
- Not at all knowledgeable

12. Have you participated in formal training in the area of RETs? *

- Yes
- No

13. Has your company completed any RE training activities for employees?

- Yes
- No

14. Does your company currently use any RETs? *

- Yes
 No

15. Which of the following RETs do you know exists currently, or is being evaluated, for implementation in T&T?

Select all that apply. *

- Solar thermal energy (solar water heaters, solar stills, etc.)
 Solar electricity (Solar cells/photovoltaic (PV) panels)
 Wind turbines
 Green hydrogen for ammonia production (industrial sector)
 Waste to energy technologies

16. Which of the following fiscal incentives for the use of RETs, are you aware of?

(Select all that apply) *

- Zero-rated value added tax (VAT) applied to solar water heaters, solar PV panels, and wind turbines.
 25% tax credit for solar water heaters

17. Is your company likely to engage in partnerships to achieve sustainability?

- Likely
 Unlikely

18. Challenges that prevent Renewable Energy (RE) implementation.

This section addresses the challenges that may prevent the easy implementation of RE systems in your company. The section is further sub-divided into specific areas.

*The following relates to installation, cost, and energy yield of RE systems. Please select all challenges that apply to your company. **

- The installation process is too difficult.
 The installation cost is too high.
 There are limited, to no, funding agencies (banks etc.) available to aid in financing RE projects.
 RE systems are a high investment risk due to the uncertainty of their long-term viability.
 The current cost of electricity in T&T is affordable, and RE systems will be costlier.
 The energy yield from RE systems is not sufficient for the company's current energy needs.
 RE systems are not efficient enough for the company's current energy needs.
 Other

19. The following relates to the infrastructure, policies, and regulations required for RE systems.

Please select all challenges that apply to your company. *

- The company does not currently have the infrastructure to easily implement RE systems.
 The company does not have the capacity to focus on RE currently.
 There are insufficient local RE service and technology providers.
 There are no/insufficient policies and regulations as related to RETs in T&T.
 The current RE incentives do not meet the needs of my company's fiscal guidelines
 There is a disconnect between public negotiations, and the policies and regulations implemented.
 Other

20. The following relates to the capacity, training, and awareness required for RE systems.

Please select all challenges that apply to your company. *

- The company does not have the necessary background knowledge in RETs.
 The company does not have adequately trained staff to install RE systems.
 The company does not have adequately trained staff to operate and maintain RE systems.
 There is insufficient information about RE readily available to the public.

- There are insufficient public campaigns promoting the relevance and importance of RE.
- Other

21. Incentives that promote Renewable Energy (RE) implementation.

This section addresses the incentives that will positively influence your company's decision to implement Renewable Energy (RE) systems in your company.

Please select all incentives that apply to your company. *

- The option to sell excess power produced by the system to the grid.
- The availability of funding from third parties for RE projects.
- The availability of interest-free, or low-interest, funding to invest in RE systems.
- If the cost of RE-derived electricity is lower than the cost from the utility (T&TEC).
- If the long-term cost of solar water heaters is lower than the cost of electric water heaters.
- Opportunities for short-term, and long-term, capacity building on RE systems for staff.
- National education campaigns promoting the relevance and importance of RE.
- National recognition for companies that include RE systems at their facilities.
- Other

22. Sustainable Ecotourism Practices

This section addresses sustainable practices in the ecotourism sector.

Please select all sustainable ecotourism practices that your company currently exercises. *

- Reduction in the use of single-use plastics such as water bottles, straws, etc.
- Use of biodegradable containers, and bags, for food, beverages, etc.
- Recycling and/or composting initiatives.
- Support for local economies via the use of local supplies and services.
- Promotion of activities that increase environmental awareness and conservation.
- Water conservation practices.
- Other

23. Lastly, do you think there is need for collaboration among government entities, public institutions, industry stakeholders, and educational institutions, on sustainable innovation, research, and development in renewable energy for the ecotourism sector?

- Yes
- No

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