SELINUS UNIVERSITY
BUSINESS SCHOOL

TITLE THESIS

A strategy to transition Trinidad and Tobago to a green economy

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A DISSERTATION

Presented to the Department of
Management (major)
program at Selinus University Business School

Faculty of Business & Media
in fulfillment of the requirements
for the degree of Doctor of Business Administration
in Business Administration (Major)

2023

Abstract

The imperative to address global environmental challenges and mitigate climate change has necessitated a paradigm shift towards sustainable economic models. This paper outlines a comprehensive strategy for transitioning Trinidad and Tobago to a green economy, a critical endeavor in resource diversification for a nation currently highly dependent on fossil fuels. The three pillars that support the approach are sustainable agriculture, eco-tourism, and clean renewable energy facilities. Trinidad and Tobago will significantly lessen its reliance on its traditional energy sources, reduce greenhouse gas emissions and its carbon footprint, and improving energy security, by utilizing the region's significant solar, wind, geothermal, hydroelectric and, to a smaller extent, biomass potential. To maintain this priceless resource, investments in conservation initiatives such as protected areas and sustainable land use planning are suggested.

Trinidad and Tobago can establish a sustainable eco-tourism business that not only promotes cross-border environmental stewardship, but also stimulates sustainable economic growth. Renewable energy development will promote local community development by up-skilling of the workforce, improvement in recycling, engineering of better infrastructure for utilities, roads and buildings that are more resilient to hurricanes, rising sea levels and other fallout from global warming. The creation of a strong, long-term national policy framework, that is immune to the vagaries of politics, is essential to the achievement of this goal. Clear regulatory guidelines, fiscal incentives, subsidies, and affordable pricing of renewable energy are proposed to stimulate green investments and practices. Public awareness programs and campaigns will also be crucial in gaining support and promoting behavioral changes toward sustainability. Collaboration with independent power producers and flexibility in the implementation process will auger well for success.

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Declaration

This work is being submitted in partial fulfillment of the requirements for the Doctorate of Philosophy in Business Management at the Selinus University.

I, Lloyd Straker, solemnly declare that:

1. This work is entirely my own, except where otherwise stated.
2. Any external sources used in the production of this work have been duly acknowledged and referenced.
3. This work has not been previously submitted for any academic requirements or examination, neither in whole nor in part.

I understand the gravity of making a false declaration and I am aware of the potential consequences outlined by the University's policies on academic integrity.

Lloyd Straker

Date: September 2023

Dedication

This dissertation is dedicated to my wife Bridgit, my two sons Atiba and Philip and my professor Dr. Salvatore Fava whose unwavering support, encouragement, and love have been my pillars of strength throughout this academic journey. Your belief in me has been the driving force behind the completion of this endeavor.

Reaching this goal has been made possible by your faith in me and your unwavering patience when things became tough. I sincerely appreciate your support, tolerance, and unwavering confidence in my capabilities. This accomplishment is as much yours as it is mine.

Thank you for being my constant source of inspiration and motivation.

Acknowledgements

I would like to express my deepest gratitude to my professors, for their invaluable guidance, unwavering support, and continuous encouragement throughout the entire research process. Their expertise, insightful feedback, and dedication to my academic growth have been instrumental in shaping this dissertation.

I am also indebted to my wife, for her valuable input, constructive critiques, and scholarly insights. Her expertise has significantly enriched the quality and depth of this research.

Lastly, I want to express my gratitude to the responders, who provided invaluable assistance, whether in data collection, technical support, or moral encouragement.

This dissertation would not have been possible without the collective contributions and support of these individuals and institutions. Their efforts have left an indelible mark on this work. Thank you and God bless you.

Lloyd Straker

Date: September 2023

Acronyms

CCCCC	Caribbean Community Climate Change Centre
CO2	Carbon Dioxide
EE	Energy Efficiency
FTC	Federal Trade Commission
GHG	Greenhouse Gas
IDB	Inter-American Development Bank's
IPPs	Independent Power Producers
JPSCo	Jamaica Public Service Company
NSEP	National Sustainable Energy Policy
NIMBY	Not in My Backyard
NSEP	National Sustainable Energy Policy
PCJ	Petroleum Corporation of Jamaica
PPAs	Power Purchase Agreements
PV	Photovoltaic
RE	Renewable Energy
SEF	Sustainable Energy Framework

SIDS	Small island developing states
T&T	Trinidad and Tobago
UNFCCC	United Nations Framework Convention on Climate Change

Chapter 1: Introduction

1.1 Background and Executive Summary

When the United Nations Framework Convention on Climate Change (UNFCCC) went into effect in 1994, the international community made a big step toward securing the future of our planet. The main goal of this convention was to achieve a stable equilibrium in the concentrations of greenhouse gases in our atmosphere. The main objective was to avoid any risky human activity that would disturb the delicate balance of the climate system. In 1997, the Kyoto Protocol was introduced, further solidifying this historic accord. This protocol involves all nations in a shared commitment by including a comprehensive approach. To reduce their greenhouse gas (GHG) emissions, member nations banded together, aiming for a substantial average decrease of 5% by the year 2012 compared to the emission benchmarks of 1990.

The Caribbean nation of Trinidad and Tobago (T&T), has long been praised for the abundance of fossil resources, particularly oil and natural gas. These resources have long been the backbone of the country's economy, providing a vital source of tax revenue and foreign exchange gains. The rhythmic beat of this economic engine, powered by hydrocarbons, resonated across the islands, shaping livelihoods and aspirations. However, a booming appeal for a paradigm shift towards sustainability is resonating internationally as the globe confronts a crucial turning point in the fight against climate change and struggles with the knowledge that fossil fuel reserves are limited. In light of the current situation, Trinidad and Tobago is prepared to set off on a revolutionary path that will require it to navigate its economic sail into the frontiers of a green economy. This paper explores the significant historical backdrop and contextual elements that highlight the necessity and urgency of such a change.

This nation's history is filled with references to Trinidad and Tobago's symbiotic relationship with its fossil fuel resources. A major turning point was the discovery of enormous oil and natural gas deposits in the middle of the 20th century, which sparked an economic boom that reverberated throughout the islands (Moses-Wothke et al, 2021). The principal engine of economic growth swiftly transitioned to the energy industry, which provided lucrative prospects for both domestic and foreign investment (Shah & Niles, 2016). The national treasury had consistent revenue streams from hydrocarbon exports, which fueled huge expansion of public services, infrastructure, and social initiatives.

Since the reality of climate change and environmental degradation solidified into an existential issue requiring collective action, the global worldview has undergone a significant transformation. Nations have been inspired by international agreements like the Paris Agreement to combat climate change and shift toward sustainability (Heffron & Heffron, 2021). The need to reevaluate economic models is more urgent than ever as the repercussions of climate change, such as rising sea levels and more intense hurricanes, begin to cast an extended veil over small island developing states (SIDS) like Trinidad and Tobago (Cooper, 2014). A new narrative that advocates for a change from the fossil fuel-driven status quo has emerged in response to the worldwide consensus on the importance of lowering greenhouse gas emissions and switching to renewable energy sources.

1.2 Problem Statement

The Caribbean is at the forefront of the fight against environmental vulnerabilities due to its fragile ecosystems and sensitivity to climate-related calamities. Despite its economic growth,

Trinidad & Tobago is not exempt from these difficulties. The negative effects of climate change are placing more and more strain on the islands' biological balance. Infrastructure and those who rely on the sea for their livelihood are both at risk from coastal erosion. The specter of coral bleaching looms, endangering marine biodiversity and the fishing industry. These vulnerabilities underline the pressing need to transition to a green economy, characterized by sustainable practices that mitigate environmental risks and enhance resilience.

Fossil fuel extraction and export have accelerated economic expansion while generating large carbon emissions that have exacerbated global climate change and increased environmental dangers for the islands (Centobelli et al., 2021). In addition, the nation's economy is vulnerable to the instability of global energy markets due to its over-reliance on oil and gas exports, endangering its long-term fiscal stability and diversification attempts. There are significant obstacles to the integration of renewable energy sources into the national grid because of inadequate energy infrastructure and regulatory frameworks that are designed for the use of fossil fuels.

While the imperative for transitioning to renewable energy in Trinidad and Tobago is evident, a lack of a well-defined, actionable strategy hinders progress towards this transformation. The absence of a comprehensive policy framework, ambiguous regulatory guidelines, and limited investment incentives have contributed to a slow uptake of renewable energy projects (Shah et al., 2018). Public awareness about the benefits of renewables remains relatively low, and the engagement of key stakeholders, including local communities and industries, is pivotal for the successful implementation of any transition plan.

The overall issue of switching from fossil fuels to renewable energy in Trinidad and Tobago is the focus of this dissertation, which seeks to resolve it by creating a solid and contextually appropriate plan (Eicke & De Blasio, 2022). The research will delve into the complex web of

issues involving economic, environmental, technological and policy aspects. The study aims to suggest an all-encompassing plan that navigates the intricacies of this shift by looking at global best practices, regional restrictions, and stakeholder views.

1.3 Research Objectives

The switch from fossil fuels to renewable energy sources has received increased attention globally due to the urgent need to combat climate change and cut carbon emissions. This crucial shift is essential for guaranteeing energy security, economic stability, and sustainable growth in addition to reducing the environmental effect of existing energy sources (Andres et al., 2023). In light of this, the goal of this dissertation is to provide a thorough plan specifically adapted to Trinidad and Tobago's particular situation in order to facilitate a smooth transition from fossil fuels to renewable energy.

Similar to many other countries that rely largely on fossil fuels, Trinidad and Tobago faces a twofold challenge: the urgent need to reduce greenhouse gas emissions and the desire to diversify its energy sources to increase resilience and self-sufficiency (Mentis & Moonsammy, 2022). The nation's vast oil and natural gas reserves have historically had a considerable impact on its economy. However, the erratic character of the world's energy markets and the growing worries about environmental deterioration have forced a proactive review of its energy strategy. It is essential to take a diverse approach in order to start a successful transformation (Gehring, 2016). The government must take the lead by establishing a distinct policy framework that encourages the use of renewable energy. This entails establishing challenging yet realistic goals for renewable

energy production, offering financial incentives for private sector investment, and fostering an atmosphere that encourages the development of innovative clean energy technology.

To achieve this overarching goal, several specific research objectives have been formulated:

i. Assessing the Current Energy Landscape:
   - Conduct a detailed analysis of Trinidad and Tobago's current energy mix, including the proportion of fossil fuels in the energy generation, consumption, and export sectors.
   - Evaluate the environmental impacts of fossil fuel usage, such as carbon emissions, air pollution, and their contribution to global climate change.

ii. Identifying Technological and Infrastructure Gaps:
   - Identify the existing energy infrastructure that supports fossil fuel operations and assess its compatibility with renewable energy integration.
   - Evaluate the technological advancements required for transitioning to renewable energy sources, including grid integration, storage solutions, and distribution networks.

iii. Analyzing Policy and Regulatory Frameworks:
   - Examine the existing policies and regulations related to energy generation, consumption, and renewable energy integration in Trinidad and Tobago.
   - Identify gaps, inconsistencies, and barriers within the current regulatory environment that hinder the adoption of renewable energy technologies.

iv. Evaluating Socioeconomic Impacts:

- Assess the potential socioeconomic benefits and challenges associated with transitioning to renewable energy, including job creation, community engagement, and income distribution.
- Examine the implications of the transition on energy affordability and access for different segments of society, particularly vulnerable communities.

v. Examining Stakeholder Engagement and Public Awareness:

- Investigate the perceptions, attitudes, and knowledge levels of various stakeholders, including government agencies, industries, local communities, and environmental organizations, regarding renewable energy.
- Assess the effectiveness of existing public awareness campaigns and educational initiatives aimed at promoting renewable energy adoption.

1.4 Significance of the Study

The proposed thesis will focus on the creation of a plan for Trinidad and Tobago to switch from utilizing fossil fuels to renewable energy. The process is very important on many levels since it addresses important issues and provides useful information to many stakeholders. The results of this research and suggested course of action present a potential approach for dealing with climate change, one of the most important global problems of our day (Cooper, 2014). Given the negative effects of greenhouse gas emissions on the environment, public health, and the economy, there has never been a more pressing need to switch from fossil fuels to renewable energy sources. This shift could have an influence that extends beyond local advantages and has the potential to make a substantial contribution to international efforts aimed at reducing climate change.

The indigenous ecosystems and biodiversity of Trinidad and Tobago have been negatively impacted by the environmental deterioration brought on by the mining and use of fossil fuels. The rich natural legacy of the country is in danger due to oil spills, habitat degradation, and other detrimental effects of fossil fuel operations (Heffron & Heffron, 2021). The move to renewable energy sources can be crucial to protecting the local environment and its distinctive ecosystems. The country can safeguard its fragile ecosystems, promote biodiversity, and make sure that future generations may take advantage of the country's abundant natural resources by reducing the ecological footprint associated with energy production.

The key significances of the proposed study on transitioning from fossil fuels to renewable energy in Trinidad and Tobago include:

i. Environmental Stewardship and Climate Mitigation: The study's focus on developing a strategy for transitioning to renewable energy sources aligns with global efforts to mitigate climate change and reduce carbon emissions.

ii. National Energy Security and Diversification: Due to its strong reliance on the export of fossil fuels, the country's economy is vulnerable to fluctuations in the world energy markets (Shah et al, 2018). By decreasing dependency on imported fossil fuels, a successful transition to renewable energy sources can improve the country's energy security.

iii. Economic Growth and Job Creation: The study's proposed strategy for renewable energy transition can stimulate new economic opportunities and industries within Trinidad and Tobago.

iv. Policy and Regulatory Improvements: The knowledge gathered from examining current energy laws and regulations can result in policy changes that encourage the use of renewable energy sources (Yakubu, 2023).

v. Local and Global Leadership: The findings of the study could establish Trinidad & Tobago as a leader in the region for environmentally friendly energy options. This leadership position supports the global initiative to hasten the transition to cleaner energy sources.

1.5 Scope and Limitations

The scope of this report includes a thorough examination of the country's switch from fossil fuels to renewable energy sources. This transition's numerous aspects, including its environmental, economic, technological and social implications, will be studied. It will entail a thorough analysis of Trinidad and Tobago's existing energy situation, including an examination of the share of fossil fuels used in energy production and consumption as well as the effects these fuels have on the environment.

This study has some restrictions that need to be acknowledged despite its wide-ranging breadth. The energy transition process is complicated and has many facets, thus it might not be able to address every nuance and complexity within the study's constrained timescale (Eicke & De Blasio, 2022). Prioritizing some aspects of the research above others could be necessary, which might leave some topics lacking in exhaustive depth.

Additionally, it could be difficult to find data that is accurate and readily available about energy production, consumption, and environmental effects. The reliability and accuracy of the results

and inferences made from the study could be impacted by inaccurate or incomplete data. While the report seeks to offer a complete plan for the switch to renewable energy, its actual execution may face unforeseen challenges or necessitate modifications owing to shifting political, economic, or technological circumstances (Moses-Wothke et al., 2021). The study's assessment of these perspectives at a certain point may not capture dynamic changes that occur in the long term. Stakeholder perspectives and attitudes may vary over time.

The suggested plan strives to address Trinidad and Tobago's particular setting, although it might not be directly applicable to other nations with different socioeconomic and geopolitical circumstances. The generalizability of the study's suggestions outside of the country may be constrained by contextual variables (Iwama et al., 2021). While the study aims to provide a thorough analysis of the switch to renewable energy in Trinidad and Tobago, it is crucial to note such limitations may affect the study's findings, conclusions, and its wider applicability.

Chapter 2: Literature Review

2.1 Global Energy Transition and Climate Change

The transition away from energy systems based on fossil fuels toward cleaner, more sustainable sources, especially renewable energy, is referred to as the **global energy transition**. Due to the pressing need to combat climate change, cut greenhouse gas emissions, and guarantee long-term energy security, this transition has gained prominence (Gahman & Thongs, 2020). **Climate change**, a complex and multifaceted phenomenon, has emerged as one of the most pressing global challenges of our time. Its far-reaching impacts are driven primarily by the emission of carbon dioxide (CO2) and other greenhouse gases resulting from the burning of fossil fuels, such as coal, oil, and natural gas (Heffron & Heffron, 2021). This anthropogenic influence on the Earth's climate system has catalyzed a cascade of interconnected environmental changes that are profoundly altering the planet's dynamics.

The primary cause of climate change is the release of greenhouse gases, which surround the Earth like an insulating layer, trapping solar heat and raising average temperatures. When fossil fuels are burned for transportation, energy, and industrial operations, large amounts of CO2 are released into the atmosphere. The **greenhouse effect** is a phenomenon that results from the buildup and thickening of the allegorically heat-trapping blanket caused by this extra carbon dioxide. The effects of this phenomenon are numerous and becoming more apparent. The interconnectedness of Earth's systems means that disruptions in one area can trigger cascading effects throughout the environment (Gahman & Thongs, 2020). For instance, as ice sheets melt and oceans warm, the delicate balance of ocean currents could be disrupted, potentially leading to shifts in weather patterns with global ramifications. Similarly, changes in ecosystems could impact biodiversity, alter food chains, and affect human societies that depend on these natural resources.

Efforts to combat climate change have taken the form of international agreements, such as the **Paris Agreement** of 2015 where 196 countries committed to reducing their greenhouse gas emissions and limiting global warming (Centobelli et al., 2021). Transitioning to renewable energy sources, improving energy efficiency, reforestation, and sustainable land use practices are some of the strategies being employed to mitigate climate change's impacts. However, the urgency of the situation demands more concerted and accelerated action.

Key Drivers of the Energy Transition include:

i. Climate Change Mitigation: The need to lessen climate change is the most compelling force behind the energy shift. The burning of fossil fuels releases great volumes of CO2, which contribute to the greenhouse effect and global warming. Reducing carbon emissions and preventing the rise in global temperatures can be accomplished by switching to renewable energy sources including solar, wind, hydro, and geothermal.

ii. Energy Security: Relying heavily on finite fossil fuel resources poses energy security risks due to geopolitical tensions, supply disruptions, and price volatility. Diversifying energy sources to include renewables enhances energy security by tapping into local, abundant, and sustainable resources.

iii. Economic Opportunities: The switch to renewable energy has significant economic advantages. The market for renewable energy has expanded quickly, generating jobs, encouraging innovation, and luring investments. This change can drive economic growth while lessening reliance on the markets for fossil fuels.

2.1.1 Successful Renewable Energy Projects in the Caribbean

2.1.1.1 CASE STUDY 1: JAMAICA'S WIGTON WIND FARM

In an era marked by escalating concerns about climate change and the urgent need to transition away from fossil fuels, the Wigton Wind Farm in Jamaica emerges as a beacon of hope and a testament to the potential of renewable energy projects in the Caribbean region. Situated on the southern coast of Jamaica, the farm stands as a pioneering example of successful integration of renewable sources, particularly wind power, into a nation's energy mix to achieve sustainable development goals (Cooper, 2014). A number of legislative initiatives were implemented in Jamaica to encourage the growth of renewable energy sources. Aiming to increase the capacity of renewable energy sources, the National Energy Policy (NEP), which was formed in 2009, supported private sector investment.

The cooperation between public and private institutions is at the core of the Wigton Wind Farm's success. The Petroleum Corporation of Jamaica (PCJ) launched the project as a public-sector enterprise in 2000, laying the framework for further phases. The project was, nevertheless, really advanced by the private finance and expertise input. The PCJ formed alliances with foreign investors and technological specialists after realizing the need for professional knowledge and financial support (Centobelli et al, 2021). This strategic partnership made sure that the project benefited from the synergy of public sector commitment and private sector efficiency in addition to risk mitigation.

The Wigton Wind Farm's success story resonates beyond the borders of Jamaica, serving as an example to other Caribbean countries and regions dealing with comparable energy issues. The Caribbean region has a wealth of renewable energy sources, including geothermal, wind, and solar

energy, which can be used to develop sustainable energy systems. Countries in the region can follow Jamaica's lead in reducing their carbon emissions and diversifying their energy sources by implementing a multifaceted strategy that includes advantageous policies, public-private partnerships, and technical innovation. The proliferation of renewable energy projects in Jamaica and the success of the Wigton Wind Farm can potentially be linked to a clear, ambitious policy framework. The government's goals for renewable energy, as detailed by the Green Growth Knowledge Platform (2013), reflect the nation's dedication to making the switch to a more sustainable energy future. A road map for directing the expansion of renewable energy sources as a percentage of total energy production was provided by the incremental targets of 11% by 2012, 12.5% by 2015, and 20% by 2030 (Shah et al, 2018). These goals communicated the government's commitment to reducing reliance on fossil fuels and embracing cleaner alternatives, giving stakeholders a sense of direction and purpose.

Funding the building of the Wigton Wind Farm presented a substantial challenge, notably during the development of the first phase Wigton 1. Due to the high upfront expenditures of installing infrastructure and equipment, this challenge is frequently encountered by renewable energy projects around the world (Gehring, 2016). The requirement for capital investment to set up the wind farm's initial phase emphasizes the significance of financial support, which frequently calls for collaborations with private investors, development banks, or international organizations.

The negotiations between PCJ and the government representatives and the interaction with the Jamaica Public Service Company (JPSCo) serve as additional evidence of the complexity of the regulatory environment. The disparity between the desired tariff rate and the ultimately reached rate serves as a reminder of the delicate balance that must be struck between providing fair pricing for energy users and generating enough cash to support and expand renewable energy initiatives

(Gahman & Thongs, 2020). As stakeholders negotiated the unfamiliar waters of incorporating wind power into the country's energy mix, the necessity for cooperation and compromise became clear.

The Wigton Wind Farm's early development was hampered by the lack of a complete regulatory framework, which serves as an example of the difficulties that might occur with cutting-edge renewable energy projects. According to (Centobelli et al, 2021), after legislation was introduced to take externalities into account and provide incentives for alternative energy companies, the situation changed. This legal change recognized that there are more advantages to renewable energy than just financial ones. The idea of externalities includes social and environmental advantages like decreased greenhouse gas emissions and job growth (Shah & Niles, 2016). The ensuing creation of rules that provided further advantages to renewable energy projects was in line with the broad policy goals of the government. By guaranteeing that renewable energy companies received fair compensation for their contributions to the national grid, these policies attempted to promote investment in greener energy sources.

Around 2010, the legal environment added a requirement for any project with an output more than 15 MW to go through an open bidding process. This regulation was put into place at the same time that the creators of Wigton 2 were getting ready to start working on it. However, Wigton Wind Farm Inc.'s studies revealed that a maximum economically viable capacity was close to 18 MW. The fact that the owner of Wigton Wind Farm Inc, the Petroleum Corporation of Jamaica (PCJ), had a special permit from the Jamaican government to build renewable energy projects derailed them from their core business- petroleum.

Lessons Learned

1. Policy Development

The Wigton Wind Farm's development throughout various governments in Jamaica emphasizes the significance of constant policy creation and implementation. Every administration that was in charge of the project made changes as soon as it came into political power. This circumstance created difficulty in preserving consistency in legislation in the face of political transitions, with resultant impediment of the development of renewable energy (RE) in Caribbean countries (Yakubu, 2023). In sharp contrast is Barbados, where the RE sector has grown consistently despite political power changes, due to policy consistency from the 1970s regarding solar-powered water heaters.

Action for Trinidad and Tobago: This lesson emphasizes the necessity of ongoing support for RE projects in Trinidad and Tobago, regardless of political shifts, to guarantee steady growth and prevent setbacks. Binding, long-term, stable bipartisan policies that endure political upheavals and change of government should be the top priority for the Trinidad and Tobago administration.

2. Planning and Policy Implementation

The Jamaican government's desire to improve planning capacities in regard to renewable energy initiatives highlights the need of having a close link between policy and implementation. Although developing planning capacity takes time, it is an essential step on the path to successful delivery (Middelbeek et al, 2014). By learning that effective planning and policy alignment are necessary for successful energy initiatives, Trinidad and Tobago can be motivated.

Action for Trinidad and Tobago: The nation of Trinidad and Tobago needs to ensure seamless development and logical execution of RE via creating specialized units or departments that bridge the gap between policy formation and on-the-ground implementation.

3. Tariffs and Consumer Perception

Due to the high cost of power in Jamaica, customers have accepted wind energy favorably, even at somewhat higher pricing. This underlines the significance of effectively explaining the cost-saving advantages of RE integration. This lesson emphasizes the value of resolving customer concerns and demonstrating the long-term financial benefits of including renewable sources in the energy mix of the island country.

Action for Trinidad and Tobago: Trinidad and Tobago should prioritize transparent and comprehensive communication campaigns aimed at educating consumers about the positive impacts of RE integration on their electricity bills. By highlighting potential future cost savings, consumers are more likely to embrace RE initiatives.

Recommendations for Overcoming RE Obstacles

i. Flexibility in Implementation

Trinidad & Tobago needs to be flexible when putting renewable energy initiatives into action. Regulations and policies must be flexible enough for the government to adapt to changing conditions and technological developments. This can be achieved via being responsive to changing needs by setting up a process for routine policy review and modification.

This adaptability can improve project outcomes overall, speed up project execution, and decrease delays (Cooper, 2014).

ii. Discussion and Collaboration Regarding Independent Power Producers (IPPs):

Trinidad and Tobago can gain from improved stakeholder collaboration, notably between regulatory bodies and Independent Power Producers (IPPs). It is vital to make sure that IPPs and grid operators have a thorough understanding of the grid effect and operational problems connected with the integration of renewable energy (Mentis & Moonsammy, 2022). As a result of this, it is advised that conversations and decisions about Renewable energy efforts be based on a thorough analysis of potential grid impacts. The smoother project execution made possible by joint efforts will cause fewer disruptions.

iii. Suitable Pricing Policy

The country has to implement a pricing scheme that guarantees the financial viability of renewable energy initiatives while paying developers fairly. It is important to avoid undervaluing renewable energy tariffs after learning from the Wigton Wind Farm experience because doing so can have a detrimental effect on project sustainability. It will stimulate investment and project success to make sure that pricing reflects market realities and the long-term advantages of renewable energy integration.

iv. Public involvement and skill development

Trinidad and Tobago should give priority to local skills development and participation in renewable energy projects, much like the Wigton Wind Farm. A skilled labor pool can expand as a result of the creation of possibilities for local workforce involvement, employment, and training (Gahman & Thongs, 2020). This strategy strengthens the local renewable energy ecosystem while improving the project's long-term viability.

2.1.1.2 CASE STUDY 2: WILLIAMS COMPANIES – BARBADOS

Williams Industries Inc is a diversified Caribbean conglomerate, headquartered in Cane Garden, St. Thomas, Barbados, employing over 800 employees, of which 300 are shareholders. Its portfolio includes clean, sustainable, renewable energy, manufacturing, electrical engineering, procurement, construction, waste recycling, sewage treatment, water desalination, well drilling, real estate development, cellular communication and tourism.

The National Sustainable Energy Policy (NSEP) of Barbados was approved by the country's legislative assembly. This strategy was built on the Sustainable Energy Framework (SEF), which was developed as part of an Inter-American Development Bank's (IADB) program. The NSEP and SEF aimed to reduce the country's reliance on foreign oil and gas, to enhance its energy security and stability, and to improve environmental sustainability. Additionally, the SEF also created specific programs to support and boost the RE business (Centobelli et al, 2021). Financial assistance from the IADB required Barbados to clearly define its plans, programs and activities for proper utilization of the funds provided in shaping its national energy policy. Barbados has a target of producing 29% renewable energy by 2029. Barbados' dedication to the development of

renewable energy is supported by a strong regulatory system under the direction of the Federal Trade Commission (FTC). This framework is essential for preserving quality standards, promoting the integration of renewable energy sources, and assuring utility tariff oversight. The path Barbados has taken to reaching its goals for sustainable energy is a clear illustration of the interrelationship between the legal framework, the formulation of energy policies, and international aid.

With the introduction of a first draft energy plan in 2007, Barbados' journey towards a future powered by renewable energy sources got underway. This draft was in line with the NSDP, demonstrating how committed the country was to incorporating sustainable practices into all areas of life. This strategy established the framework for thorough energy planning, aiming to lessen reliance on fossil fuels and to boost the proportion of renewable energy sources in the energy mix. The result of these efforts was the creation of the SMART Energy Fund and the Renewable Energy Component. The Federal Trade Commission authorized the program, which proposed promoting the use of renewables by rewarding consumers for energy they supply to the grid (Moses-Wothke et al, 2021). The $10 million SMART Energy Fund promotes local corporate involvement in grid-connected renewable energy initiatives. These programs have helped increase the capacity for renewable energy.

Barriers and Considerations:

Barbados' pursuit towards a sustainable energy future has been characterized by remarkable accomplishments as well as difficulties. The country has made tremendous progress in increasing

its renewable energy capacity by overcoming obstacles connected to bureaucracy, obtaining funds, and rectifying early setbacks.

Challenges Faced

i. ***Lengthy Bureaucratic Processes****:* One of the challenges Barbados faced was navigating lengthy bureaucratic processes for duty exemptions. These processes had the potential to slow down the importation of necessary equipment and materials for renewable energy projects, potentially delaying implementation and increasing costs.

ii. ***Funding for Energy Efficiency (EE) Upgrades***: The need for funding to upgrade energy efficiency in public institutions posed another challenge. While energy efficiency upgrades would lead to long-term cost savings, the initial investment required was a barrier. Seeking funding, especially from international sources like the IADB, was essential to overcoming this challenge.

Lessons Learned

One significant aspect highlighted in the study was the implementation of energy policies. While Barbados had an established energy plan, it appeared to be less integrated into energy-related operations compared to neighboring Jamaica. This emphasized the need for strong alignment between policy frameworks and practical energy-related activities to ensure effective outcomes. Additionally, the challenge of revising online regulations in Barbados (and also in its neighbouring island St. Lucia) underscored the importance of clear and accessible regulations to

engage and win over stakeholders (Iwama et al., 2021). Addressing this barrier contributed to smoother implementation processes.

There were several conclusions drawn from this case study and local patterns that merited consideration. At its core, success depended on the ability to oversee initiatives, manage finance applications, and respond quickly to project demands. Establishing frameworks for information transmission on a regional and global scale encouraged knowledge sharing, and allowed acknowledgement of, and rendering of assistance, to current projects and RE champions within a collaborative environment (Heffron & Heffron, 2021). Risk analysis and pilot programs were adequately funded (Cooper, 2014). To prove a project's feasibility, secure outside funding and innovate, it was essential to collect thorough data on the projects' economic, social, and environmental implications by increased collaboration between research groups and universities.

Recommendations for Overcoming Such Obstacles

The importance of communication and cooperation was emphasized, as a lack of collaboration among organizations had the ability to impede progress despite the availability of internal resources. Effective communication, supported by solid facts, was paramount to ensuring the success of programs (Gehring, 2016). An understanding of local and global renewable energy industries and what contributed to RE successes was necessary for informed decision-making. To achieve this, allocating resources and financing for research was vital, with an emphasis on making investigation findings readily accessible to stakeholders.

2.2 Renewable Energy Potential in Trinidad and Tobago

The physical location of Trinidad and Tobago in the Caribbean, near the Earth's equator, with its ample sunshine and advantageous wind patterns, provides a great field for exploring renewable energy. Its tropical climate provides abundant sunlight, making solar energy a plentiful resource just ready to be exploited. Additionally, its coastal regions encounter consistent wind currents from the Tradewinds, making it a favorable setting for the production of wind energy. This tremendous wind energy potential and enormous solar resource has the ability to transform the country's energy industry and pave the path for a more sustainable future (Mentis & Moonsammy, 2022).

2.2.1 Solar Power: A Radiant Opportunity

The deployment of solar photovoltaic (PV) systems is gaining momentum, evident in the growing number of residential installations and the emergence of utility-scale solar farms. This transition towards solar power is not only environmentally responsible but also strategically prudent, given the country's reliance on imported fossil fuels. The use of solar energy is completely in line with the country's goal to lessen its reliance on fossil resources (Centobelli et al., 2021). Due to its historical reliance on oil and gas imports, Trinidad and Tobago's economy is put under strain and is vulnerable to changes in the world energy market. Solar energy provides a remedy by utilizing a domestic resource that is sustainable and protects the country from the turbulence of foreign markets.

Trinidad and Tobago's solar energy capacity relative to other Caribbean countries

When compared to some of its Caribbean neighbors like the Dominican Republic and Jamaica, Trinidad and Tobago's solar energy sector is still in a developing phase. For instance, Barbados has established itself as a leader in renewable energy adoption in the Caribbean, with a high percentage of households utilizing solar power. These nations have more extensive policy frameworks in place to promote the use of solar energy, including beneficial rules, feed-in tariffs, and public-private partnerships.

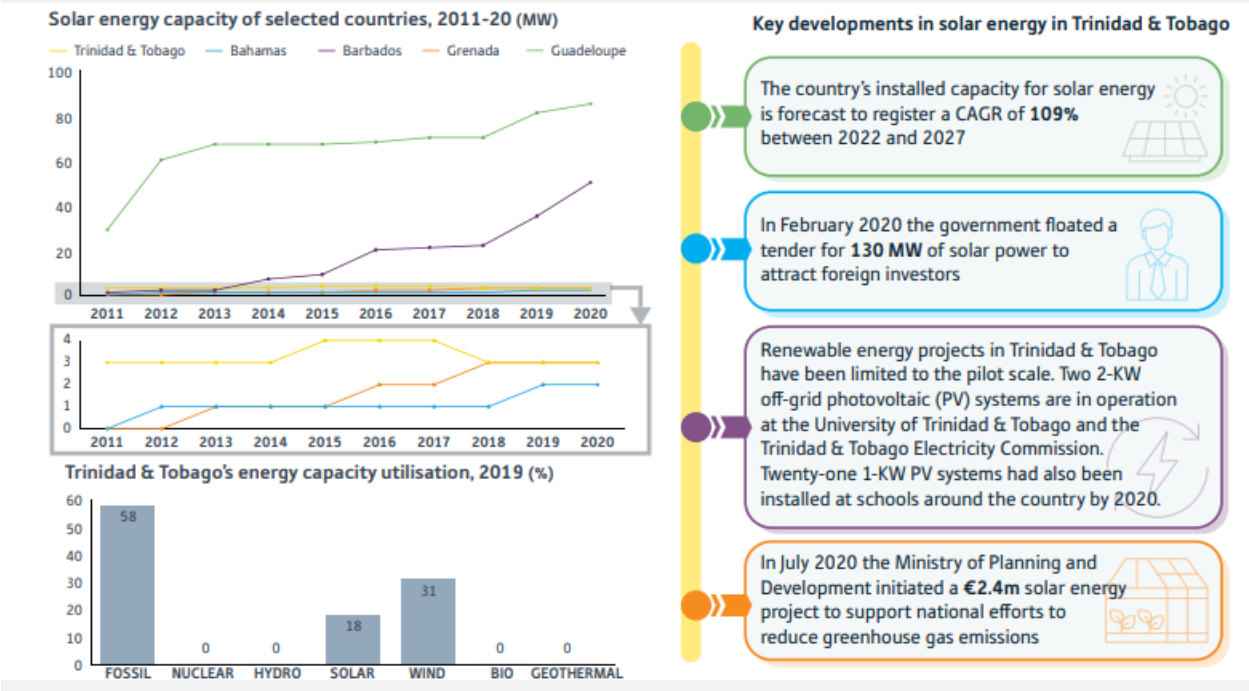

Figure 1: Solar Energy in the Caribbean

Source: UNDP; Mordor Intelligence; Government of Trinidad & Tobago

2.2.2 Wind Energy Potential

2.2.2.1 Wind Energy: Capitalizing on Coastal Winds

The coastal topography of Trinidad and Tobago offers another renewable energy avenue in the form of wind power. Coastal winds, propelled by the cooling effects of the nearby sea, can be efficiently harnessed through the deployment of wind turbines. The blustery conditions prevalent along the coastlines make wind energy a feasible and enticing option. With proper planning and infrastructure, wind farms could contribute significantly to the energy mix, diversifying the nation's energy portfolio and reducing its carbon footprint.

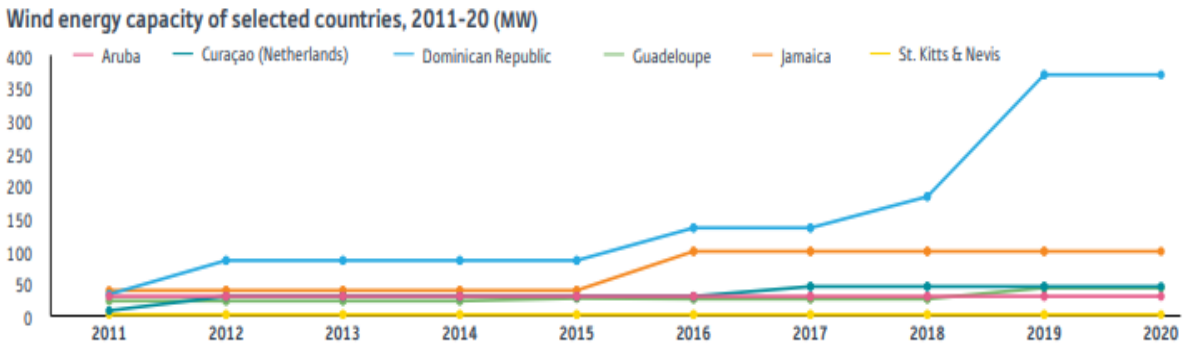

Figure 2: Wind Energy Capacity in the Caribbean

Source: UN; UNESCO; Partnership on Transparency

2.2.3 Bioenergy: Nurturing Natural Resources

Trinidad and Tobago's lush landscapes and rich biodiversity provide ample opportunities for bioenergy development. The country's agricultural sector generates organic waste, which can be converted into biofuels through processes like anaerobic digestion and biomass gasification.

Additionally, the cultivation of dedicated energy crops, such as sugarcane and algae, can yield feedstock for biofuel production. By tapping into these resources, Trinidad and Tobago can not only mitigate waste-related issues but also produce cleaner alternatives to conventional fossil fuels.

Climate change, deforestation and excessive nutrient loading has been associated since 2011 with seasonal “golden tides”. These are massive brown mats of Sargassum algae, floating on the Atlantic Ocean surface and borne by ocean currents, that wash ashore the eastern beaches of many Caribbean countries and Mexico in the Inter-Tropical Convergence Zone (ITCZ). These then decay, removing oxygen from surrounding water and releasing toxic gases like hydrogen sulphide and ammonia. The results are mortality of fish and other marine species, despoiling previously picture-perfect beaches and coral reefs in small island states with fragile economies dependent on the tourism, marine sport and fishing industries.

Currently, the cost of cleaning beaches of Sargassum are high and the algae are disposed of in landfills. A viable alternative being researched is to wash with rain water, autohydrolyse and use as biomass to produce biogas, bioethanol, biodiesel, or as fertilizer (Orozco- Gonzalez, 2022).

2.2.4 Geothermal Potential: Tapping into Earth's Heat

The eastern Caribbean is a chain of “geologically young volcanic islands where the thermal gradient is higher than average” according to Koon Koon et al (2020). Geothermal power involves harnessing the heat from within the Earth's crust to generate electricity. Although geothermal exploration is still in its early stages, preliminary studies indicate the existence of geothermal reservoirs beneath the islands. Developing geothermal energy can provide a reliable and constant source of power, reducing the nation's dependence on imported fossil fuels.

Figure 3: Tectonic Plates across the Caribbean islands (Source-Goggle Earth 2018)

Guadeloupe is the only Caribbean territory with a 15 megawatt geothermal energy plant that currently produces 5% of the island's electricity (Joseph, 2022). Dominica, Montserrat, St. Kitts and Nevis, St. Vincent and the Grenadines, Grenada all show huge untapped potential. Kenya generates 630 megawatts of geothermal power, some of which provides 24-hour heating of greenhouses of the country's largest flower exporter Oserian. The map below shows the exploitable potential of geothermal energy of Eastern Caribbean islands of 6280 megawatts.

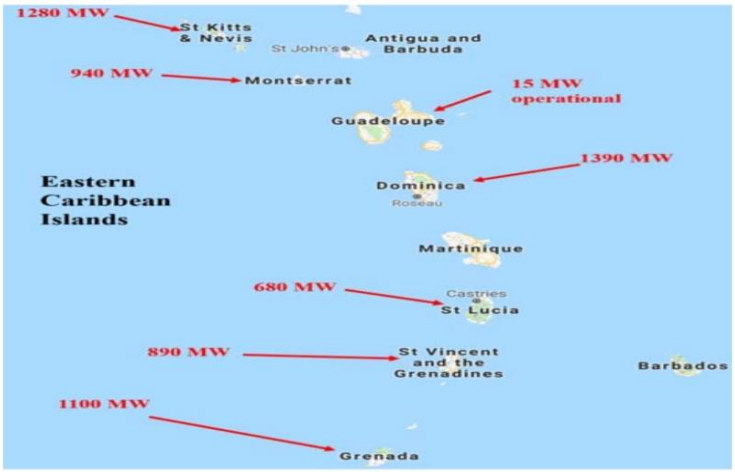

Figure 4: Exploitable potential geothermal energy for Eastern Caribbean Islands
Source- R. Koon Koon Jan 2020

Trinidad and Tobago, by contrast can harness this energy from its 18 mud volcanos in Princess Town, Tabaquite, Piparo, Nariva Swamp and other southern towns, and by retrofitting its 5000 abandoned oil and natural gas wells (J. Patihk et al, 2021).

2.3 Economic and Environmental Benefits of Renewable Energy

Renewable energy sources have emerged as a beacon of hope in the global pursuit of sustainable development. Beyond their role in curbing greenhouse gas emissions and mitigating climate change, these sources offer a plethora of economic and environmental benefits that resonate across industries and societies.

2.3.1 Economic Advantages of Green Economy

i. Job Creation and Local Economies

The adoption of renewable energy sources triggers a surge in job opportunities across various sectors. From manufacturing and installation to maintenance and research, the renewable energy industry fosters a diverse range of employment avenues (Shah & Niles, 2016). This job growth invigorates local economies, injecting capital and reducing unemployment rates.

ii. Diversification of Energy Sources

Relying on a mix of renewable energy sources diversifies a nation's energy portfolio, reducing vulnerability to the price volatility of fossil fuels. This diversification fosters energy independence,

shielding economies from the geopolitical and economic uncertainties that often accompany fossil fuel markets.

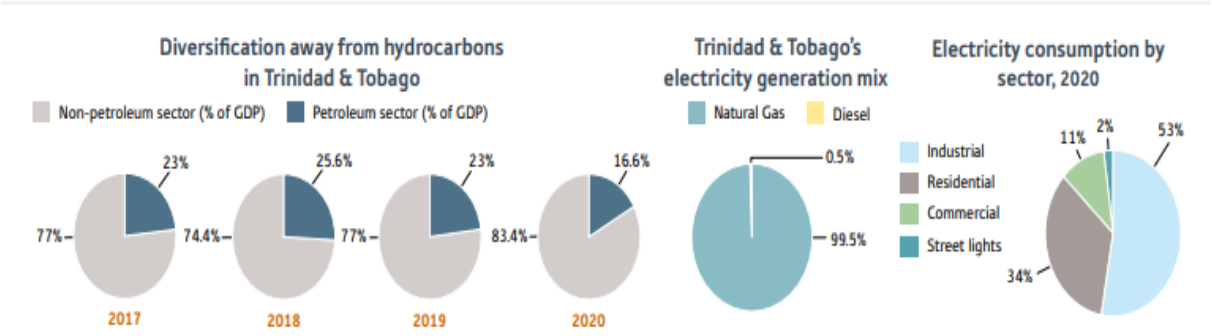

Figure 5: Diversity of Energy Sources in Trinidad and Tobago

Source: CBTT; IRENA; US DoE

iii. Technological Innovation and Competitiveness

The transition to renewable energy propels technological advancements. Research and development efforts in solar, wind, and bioenergy result in breakthroughs that not only bolster the renewable energy sector but also stimulate innovation in related fields. Nations investing in renewable technologies cultivate a competitive edge in the global arena of clean energy innovation.

iv. Reduced Energy Costs

Renewable energy systems, once established, often lead to decreased energy costs in the long run. Unlike fossil fuels, which are subject to price fluctuations and geopolitical tensions, renewable energy sources like solar and wind have minimal operational costs once the infrastructure is in

place (Gahman & Thongs, 2020). This predictability in costs benefits consumers and industries alike.

2.3.2 Environmental Benefits

i. Mitigation of Greenhouse Gas Emissions

The most pivotal environmental advantage of renewable energy is its potential to drastically reduce greenhouse gas emissions. By displacing fossil fuel-based energy sources, renewables significantly curtail carbon dioxide and other pollutants, addressing the primary driver of global climate change.

ii. Air and Water Quality Improvement

Renewable energy generation emits little to no air pollutants or greenhouse gases during operation. This contributes to cleaner air quality, which in turn reduces respiratory illnesses and related healthcare costs (Lewis & Su, 2021). Moreover, renewable energy processes do not generate harmful byproducts that can contaminate water bodies, preserving water quality and aquatic ecosystems.

iii. Biodiversity and Habitat Conservation

Unlike fossil fuel extraction, which often leads to habitat destruction and ecosystem degradation, renewable energy projects can be designed to have minimal ecological impact. Proper

site selection and responsible project development ensure that natural habitats and biodiversity are conserved, fostering a harmonious coexistence between energy generation and ecosystems.

iv. Reduced Water Consumption

Many renewable energy sources, such as wind and solar power, require minimal water for operation. This stands in stark contrast to fossil fuel-based power generation, which demands substantial water consumption for cooling and other processes. Shifting towards renewables alleviates the strain on water resources, especially in water-scarce regions.

2.4 Barriers to Renewable Energy Adoption

The adoption of renewable energy sources is undoubtedly a critical step towards a sustainable and low-carbon future. However, despite their numerous benefits, several barriers hinder their widespread integration into our energy systems. These barriers, often complex and interconnected, can impede the progress of renewable energy adoption at various levels – from policy implementation to technological deployment.

i. High Initial Costs and Investment Barriers

One of the most significant barriers to renewable energy adoption is the high upfront capital investment required for the development and installation of renewable energy infrastructure. While the operational costs of renewable energy systems are generally lower than those of fossil fuel-based systems, the initial costs can be prohibitive for governments, businesses, and individuals

(Middelbeek et al., 2014). This financial barrier can deter potential investors, especially in regions where access to financing is limited.

ii. Lack of Grid Integration and Infrastructure

Integrating renewable energy sources into existing energy grids can be challenging due to differences in energy generation patterns. For instance, solar and wind power are intermittent sources, dependent on weather conditions. This intermittency poses challenges for grid stability and reliability (Iwama et al., 2021). Retrofitting existing grids or building new infrastructure to accommodate these fluctuations requires substantial investment and technical expertise.

iii. Inadequate Energy Storage Solutions

Energy storage is crucial for mitigating the intermittency of renewable energy sources. However, despite advancements in battery technology, cost-effective and scalable energy storage solutions remain limited. The availability of reliable and affordable energy storage is essential for balancing supply and demand and ensuring a steady power supply, particularly during periods of low renewable energy generation.

iv. Policy and Regulatory Barriers

Inconsistent or inadequate policy frameworks and regulations can hinder renewable energy adoption. Lack of clear incentives, feed-in tariffs, tax benefits, and supportive legislation can discourage potential investors (Moses-Wothke et al., 2021). Regulatory uncertainties and lengthy

approval processes can lead to delays in project development, creating a challenging environment for renewable energy projects.

v. Lobbying and Fossil Fuel Interests

The fossil fuel industry often exerts considerable influence on energy policies and regulations. Lobbying efforts to protect vested interests in traditional energy sources can slow down the adoption of renewables. This influence can result in the maintenance of subsidies for fossil fuels or limited support for renewable energy projects, creating an uneven playing field for sustainable alternatives.

vi. Perceptions of Reliability and Technology Maturity

Skepticism regarding the reliability and maturity of renewable energy technologies can impede adoption. Some stakeholders perceive renewable sources as less dependable than traditional fossil fuels, despite advancements in technology. Overcoming these misconceptions requires public awareness campaigns and robust communication strategies.

vii. Technical and Skills Gaps

Implementing and maintaining renewable energy systems require specialized technical skills that might not be readily available in certain regions (Cooper, 2014). A lack of skilled workforce and training opportunities can slow down project development and result in suboptimal performance of renewable energy installations.

2.5 Policy and Regulatory Frameworks for Renewable Energy

Trinidad and Tobago has formulated renewable energy roadmaps that outline the country's strategic vision for transitioning to clean energy sources. These roadmaps provide a clear trajectory, setting renewable energy targets and pathways for achieving them. By establishing tangible goals and timelines, these roadmaps guide policy development and project implementation. The implementation of feed-in tariffs and power purchase agreements (PPAs) has been pivotal in incentivizing renewable energy development. Feed-in tariffs ensure fixed payments for renewable energy producers, guaranteeing a return- on- investment and fostering investor confidence (Centobelli et al., 2021). PPAs provide a framework for energy producers to sell excess energy to the grid at predetermined rates, promoting renewable energy generation and integration.

Policy measures to facilitate grid interconnection and integration are vital for accommodating intermittent renewable energy sources. Smart grid technologies, advanced monitoring, and interconnection regulations ensure that renewable energy can be efficiently integrated into the existing energy infrastructure, minimizing disruptions and ensuring grid stability. Policy frameworks emphasize the importance of environmental and social safeguards in renewable energy projects (Heffron & Heffron, 2021). Regulations ensure that projects adhere to environmentally responsible practices, minimizing negative impacts on ecosystems and local communities. These safeguards align with Trinidad and Tobago's commitment to sustainable development.

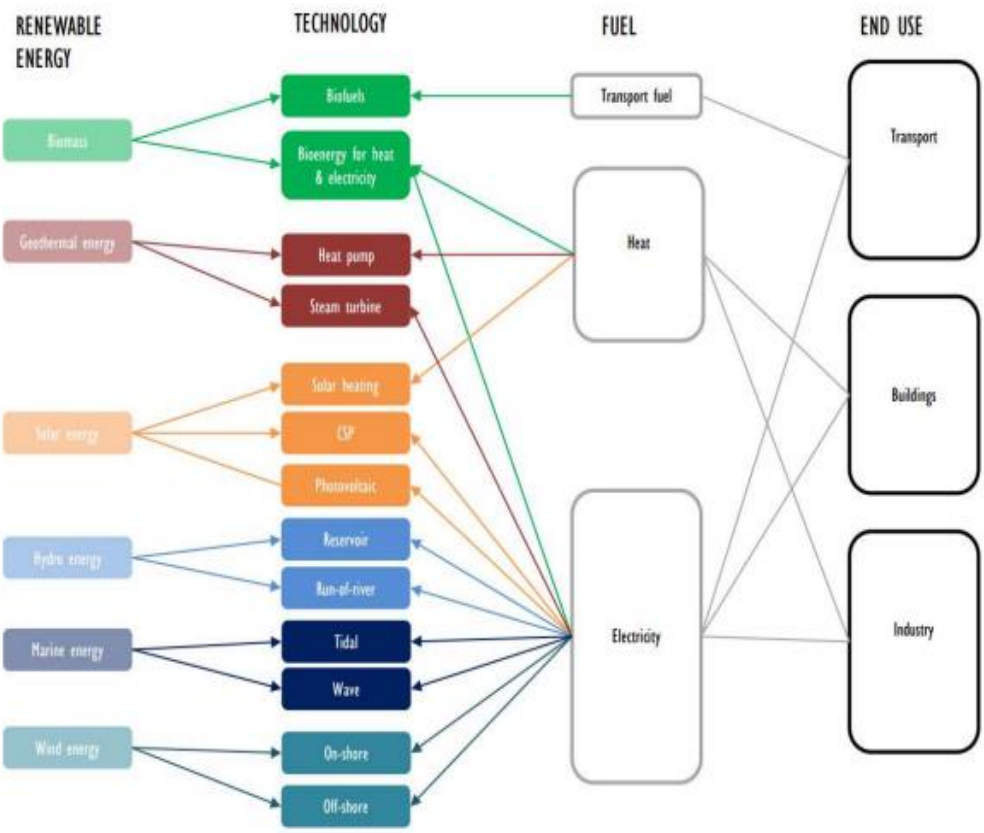

Figure 6: Renewable Energy Mapping *(Source: Brown et al. (2016).*

2.6 The Role of Public Perception and Awareness

In the journey towards renewable energy adoption, the role of public perception and awareness cannot be underestimated. The attitudes, beliefs, and knowledge of the general public play a pivotal role in shaping policies, driving investments, and determining the success of renewable energy initiatives. Public perception can directly impact the formulation and implementation of renewable energy policies. When citizens demonstrate strong support for clean energy sources, policymakers are more inclined to design and endorse policies that promote renewable energy development (Stevis, 2021). Conversely, skepticism or lack of awareness may

lead to less ambitious policy measures or delays in their implementation. Public demand for renewable energy can act as a catalyst for progressive policy changes, fostering an environment conducive to sustainable energy transition.

Effective communication and engagement with local communities are essential for successful renewable energy projects. When communities are well-informed about the benefits of clean energy, they are more likely to support the development of renewable energy installations in their vicinity. Public acceptance can mitigate opposition, conflicts, and NIMBY (Not in My Backyard) sentiments, streamlining project approvals and ensuring smoother project execution. Public awareness campaigns have the potential to drive individual behavioral changes that contribute to energy conservation and efficiency (Gehring, 2016). Educating the public about the impact of their energy consumption habits can encourage energy-saving practices, reducing overall energy demand. This shift in behavior complements renewable energy efforts by lessening the burden on energy resources and enhancing sustainability.

Chapter 3: Research Framework and Methodology

3.1 Research Paradigm

This study's research paradigm, which combines the constructivist and realist concepts, aims to examine the country of Trinidad and Tobago's move toward renewable energy. This strategy enables a thorough comprehension of the intricate socioeconomic and environmental elements that affect the adoption and application of renewable energy programs. The objective facts and the subjective experiences of stakeholders involved in the transition process are both intended to be captured by this research paradigm, which combines quantitative and qualitative methodologies. This pragmatic element of the research framework affirms the nature of the study as a means of solving practical problems. It acknowledges that tackling the switch to renewable energy calls for an interdisciplinary strategy that integrates knowledge from a range of disciplines, including economics, engineering, policy, and social sciences (Moses-Wothke et al., 2021). This study adopts a pragmatic viewpoint with the goal of delivering practical insights that can guide policy suggestions and workable transitional measures.

In addition, the constructivist aspect of the research paradigm recognizes the significance of comprehending the various viewpoints, motivations, and difficulties that people and communities encounter in the context of the adoption of renewable energy sources (Mentis & Moonsammy, 2022). This approach tries to elucidate the social, cultural, and behavioral elements that influence the transition process by utilizing qualitative techniques including interviews, focus groups, and content analysis.

3.1.1 Study Structure

The research framework for this study employs a mixed-methods approach that combines quantitative data analysis with qualitative insights. When a mixed-methodologies approach is used in research, quantitative and qualitative research methods are combined. This method seeks to enhance the benefits of each while minimizing the drawbacks of each separately. Researchers hope to provide a more complete and nuanced knowledge of the study problem or phenomenon under examination by integrating these two approaches. Quantitative data analysis involves the use of numerical data and statistical tools to analyze patterns, trends, and relationships within the data (Shah et al, 2018). This approach often generates objective and measurable results, making it useful for examining large-scale trends or establishing correlations between variables. In order to answer queries like "how much" or "how often," quantitative data can offer insights into the prevalence of specific events.

a. Purpose of the Study

The purpose of the study on renewable energy in Trinidad and Tobago is to comprehensively investigate and analyze the current state, challenges, and opportunities related to the adoption and integration of renewable energy sources within the country. The overarching goal of this research is to contribute valuable insights and recommendations that can inform policy-making, industry development, and sustainable energy planning in the region.

The purpose of this study includes:

i. Assessment of Current Energy Landscape

ii. Recognizing the Potential of Renewable Energy

iii. Impacts on the Economy and Society

iv. Energy Security and Diversification

v. Environmental Sustainability and Climate Mitigation

vi. Policy and Regulatory Framework Analysis

Energy security refers to the consistent and reliable availability of energy resources at affordable prices. It's a crucial aspect for any nation's economic, social, and political stability (Shah & Niles, 2016). Energy security is compromised when a country heavily depends on imported energy sources, especially when those sources are subject to price fluctuations, geopolitical tensions, or supply disruptions.

b. Research Questions

The purpose of the study question and the hypotheses for this topic is to investigate the potential barriers, difficulties, and elements that affect how successfully the economy of the nation may be transformed toward sustainability. The research question delves into the strategies that can guide Trinidad and Tobago's transition, while the hypotheses propose various assertions about the key elements driving this transition. The study intends to provide a thorough understanding of how the island nation might successfully adopt a green economy, promoting economic growth, environmental stewardship, and social well-being by examining these assumptions.

The research questions to be investigated include:

i. What are the key policy instruments and regulatory frameworks that need to be established or enhanced to facilitate a successful transition of Trinidad and Tobago's economy towards green practices and sustainability?

ii. How can technological innovation and the development of green infrastructure contribute to the effective integration of sustainable transportation and waste management systems in Trinidad and Tobago's shift to a green economy?

iii. What tactics and techniques may be used to increase public awareness, encourage community involvement, and guarantee broad public support for the country's move toward a green economy?

iv. Which industries and potential economic sectors are most likely to thrive as the nation transitions to a green economy, and how might these sectors promote both economic growth and environmental sustainability?

v. What international cooperation and partnership possibilities can Trinidad and Tobago take advantage of in order accelerate the adoption of green technologies, improve information exchange, and secure funds for the effective implementation of its green economy transition strategy?

3.2 Hypotheses:

3.2.1 Technological Innovation and Infrastructure:

Hypothesis 1: *Increased investment in green technology innovation and infrastructure development will drive the successful transition to a green economy in Trinidad and Tobago.*

Testing: *Gather information regarding the amount of funding allocated to infrastructure, research and development for green technologies. Examine the relationship between investment amounts and the execution of green initiatives. Analyze the link using regression to determine its strength and importance.*

3.2.2 Economic Diversification and Job Creation:

Hypothesis 2: *A green economy transition will result in economic diversification and the creation of new job opportunities in Trinidad and Tobago.*

Testing: *Gather information on the growth of the labor force and the diversification of the economy in the fields of ecotourism, sustainable agriculture, and renewable energy. Compare these sectors' growth rates and employment figures to those of established industries.*

3.3 Research Design

A multidisciplinary research methodology was suited in this evaluation for a thorough examination of the transition to a green economy in Trinidad and Tobago. This approach combined both quantitative and qualitative methods to provide a well-rounded understanding of the topic. This approach capitalized on the strengths of both methods, enabling the researcher to gain a more comprehensive and nuanced understanding of complex phenomena like the transition to a green economy. Structured surveys were used to gather quantitative data from key stakeholders such as policymakers, business, and the general public (Shah et al., 2018). The questions included related items that were aligned with the perceptions, awareness, attitudes and opinions regarding green economy strategies.

The researcher used secondary data analysis of existing data from other researchers, organizations or agencies for the purpose of developing a well-designed study. Secondary data analysis offered useful quantitative insights into economic patterns and the consequences of green

initiatives (Yakubu, 2023). Statistics on energy consumption and the adoption of renewable energy sources from neighbouring Caribbean countries were gathered.

The researcher utilized semi structured interviews with the country's citizens and viewed live interviews and symposia involving industry experts. The interviewees expressed their insights, experiences, and opinions on the subject at hand because these interviews are led by a free structure of the questions. Transcripts of conversations and interviews are included in the textual data that was subject to content analysis. The researcher was able to discern how policies were implemented, the challenges encountered, and the potential benefits.

Finding repeating themes, patterns, common threads of thought, key points of emphasis, and noteworthy perspectives and qualitative insights from the data was the aim (Centobelli et al, 2021).

3.4 Questionnaire Design and Development

Designing and developing a questionnaire is a pivotal phase in quantitative research. It involves crafting a set of carefully structured questions to gather specific information from respondents. For the topic of transitioning Trinidad and Tobago to a green economy, a well-designed questionnaire can provide valuable insights into public perceptions, attitudes, and behaviors related to green initiatives.

The following is a step-by-step guideline of how the questionnaire will be developed:

i. Define Objectives: Clearly outline the objectives of the research. Identify the key research questions and hypotheses that the questionnaire will address.

ii. Identify Target Respondents: Determine the characteristics of the target respondents, such as age, gender, occupation, and geographic location (Gahman & Thongs, 2020). This information will influence the wording and structure of the research questions.

iii. Choose Question Types: This research will utilize both closed-ended questions and open-ended question. Closed-Ended Predefined response alternatives will be provided for questions, making it simpler to quantify and evaluate data. For instance, "*How aware are you of Trinidad and Tobago's renewable energy programs on a scale of 1 to 5?*"

iv. Write questions that are unambiguous and clear: The questions will be easy to comprehend, straightforward, and clear. The researcher shall stay clear of technical language and jargon by using straightforward language.

v. Pilot Testing: Before finalizing on the questionnaire, a pilot testing will be conducted on a small group of individuals similar to the target audience. This will help to identify any ambiguities by ironing out technical issues.

vi. Ethical Considerations: Respecting respondents' privacy and confidentiality is paramount in any research endeavor. It not only helps build trust but also ensures ethical compliance.

3.4.1 Pilot Testing

Pilot testing is a critical step in the questionnaire development process, and it involves administering said questionnaire to a small, representative group of individuals before conducting the full-scale survey (Andres et al, 2023). This helps identify and address any issues with the

questionnaire, ensuring that it is clear, comprehensible, and effectively captures the intended information.

The following procedure will be used to test and engage pilot testing.

i. Select the pilot test sample

Choose a sample size that will represent the target respondent however it will be small scale. A pilot test typically has 10 to 20 participants. It is important to ensure diversity in the group by having different demographics. This diversity helps the researcher to assess how different groups of respondents might perceive and answer the questions.

ii. Administer the Questionnaire

Distribute the questionnaire in a controlled environment to the pilot group that was chosen. Depending on the technique for gathering data, this will be done via email and through an online survey platform.

iii. Collect Feedback

Encourage the pilot participants to share their feedback on the questionnaire. It is vital to ask them to be open and honest about any problems they run across. Feedback will include a range of topics, such as question clarity, response choices, question order, and overall questionnaire flow.

iv. Analyze the Feedback

Gather the participant input from the pilot test and analyze it for any recurring themes or problems. Pay attention to questions that participants found confusing or ambiguous, as well as any suggestions for improvement.

v. Summarize the Procedure

Keep accurate documentation of the suggestions given, changes made, and judgments made during the pilot testing phase. When defending the questionnaire's design decisions in the study report, this documentation can be helpful.

3.5 Ethical Considerations

The proper conduct of academic research and the preservation of the rights and well-being of people, communities, and the environment depend critically on ethical considerations in research. These guidelines act as the researchers' moral compass throughout their work, assisting in upholding honesty, openness, and accountability in the quest for knowledge. Protecting the rights of those who take part in research as subjects or participants requires strict adherence to ethical norms. In order to do this, participants must provide their agreement after being fully informed of the research's goals, methods, and possible dangers. By letting people make choice and informed judgments about participating in the study, researchers respect the autonomy of people (Cooper, 2014). In addition to being against ethical standards, failing to obtain informed permission might result in harm, exploitation, or mistrust, undermining the validity of research findings.

Securing research data, encompassing both quantitative and qualitative data, is a critical aspect of ethical and responsible research practice. Such measures are essential not only for safeguarding the integrity of research findings but also for protecting the privacy and confidentiality of participants and the overall credibility of the research process. Data security is a complex process that includes safeguards against illegal access, data breaches, and data loss

(Stevis, 2021). Researchers must acknowledge that dangers can affect both digital and physical data, and that these risks call for comprehensive approaches to be taken. The pursuit of robust, equitable, and inclusive scientific inquiry is supported by the fundamental ethical necessity of respecting and embracing variety in research participants (Moses-Wothke et al, 2021). This research will examine the deep significance of diversity in research and the value of making sure that a representative sample of the population is used to avoid prejudice and discriminatory practices.

An essential component of responsible and ethical research practice is taking the long-term effects of research on the environment and society into consideration. When it comes to sustainability and the shift to a green economy, researchers have a critical role to play in finding solutions to global problems. The researcher will delve into the significance of predicting and working towards a beneficial contribution to the environmental and societal well-being through research efforts in this academic exploration. By incorporating sustainability concepts into their work, researchers have a special potential to support this shift (Shah & Niles, 2016). This means actively looking for ways to enhance sustainability goals in addition to minimizing the detrimental environmental effects of research. The ecological impact of research activities is one of the most important factors to take into account in this regard. During their study, students should be aware of the materials they use, the trash they make, and the pollutants they release.

Chapter 4: Results and Findings

4.1 Overview of Data Collection

In order to investigate the complexities of the research questions and to contribute to a more comprehensive understanding of the transition to a green economy, the overview of data acted as a fundamental component. It was important to explain how the data was obtained. This part tells the story of the journey to get the necessary insights, not just a technical description of the data collection techniques. Research technique was the guiding framework that shaped how data was gathered in the setting of the study. Describing the reasoning behind choosing this specific methodology and how it fitted with your research goals was part of the objective. This part demonstrated the careful attention that went into technique selection, regardless of whether the data gathering strategy was quantitative, qualitative, or mixed-methods.

The data collected aligned with the research strategies which were developed with specific objectives in mind. The stakeholders who invested in the renewable energy of the country including the government had direct interests that affected the transition period positively (Centobelli et al, 2021). The study utilized purposive sampling technique that entailed selecting participants based on their specific characteristics such as expertise, knowledge in a particular field and how they were affected by this developing phenomenon. To achieve these objectives effectively, it was imperative to engage with individuals who had a profound understanding of the subject matter and were actively involved in shaping policies and strategies in this domain (Shah et al., 2018). By deliberately targeting these experts and key decision makers, the research benefitted from their wealth of knowledge and experience. These participants were likely to possess not only a deep understanding of the intricacies of renewable energy but also the ability to influence and implement policies that would drive the green energy transition forward.

4.2 Quantitative Results

The quantitative analysis used in this study produced crucial results on Trinidad and Tobago's switch from fossil fuels to renewable energy. A thorough dataset was first gathered from a targeted sample of important stakeholders, such as legislators, energy specialists, and environmental organizations. To give a comprehensive summary of the findings, the results were visually depicted using bar charts and tables (Heffron & Heffron, 2021). The essential measurements and trends associated with the research objectives were effectively examined with the help of this presentation structure.

The following are the analyzed responses based on quantitative analysis of the study:

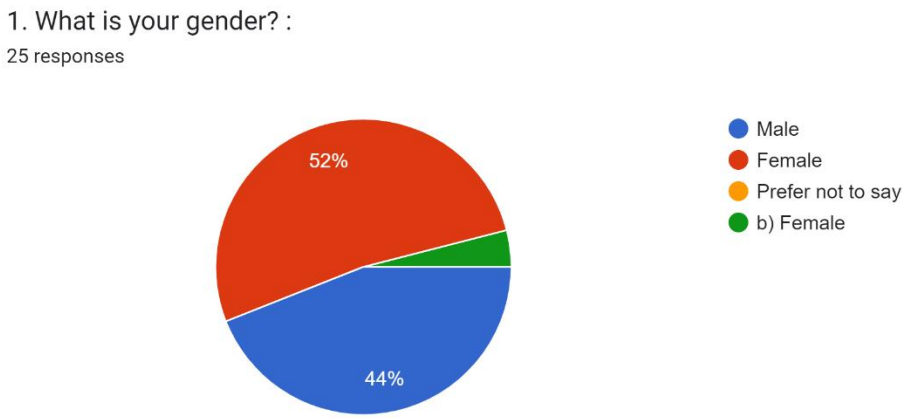

Figure 7: Gender of the Responders

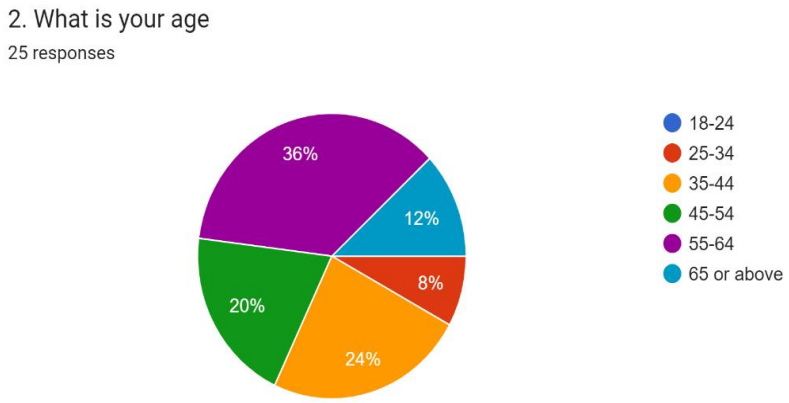

Figure 8: Age of the Responders

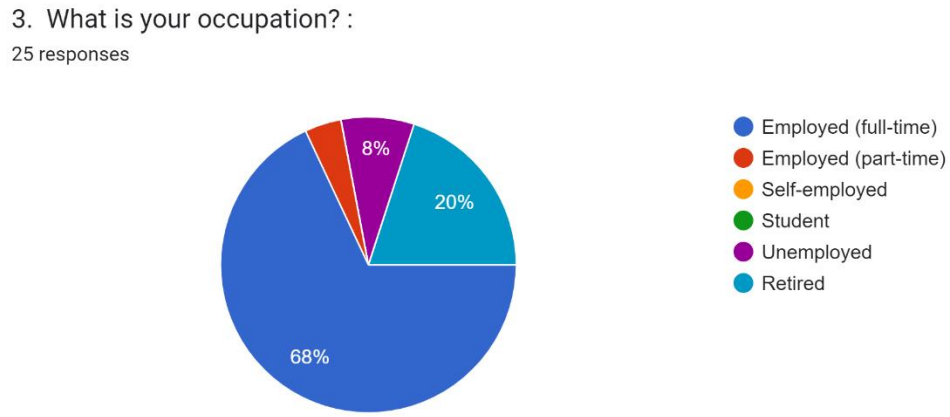

Figure 9: Occupation of the Responders

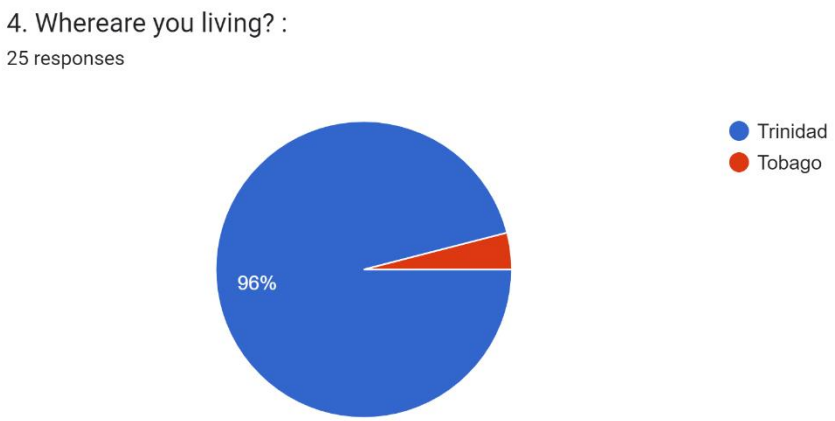

Figure 10: Where the Responders Live

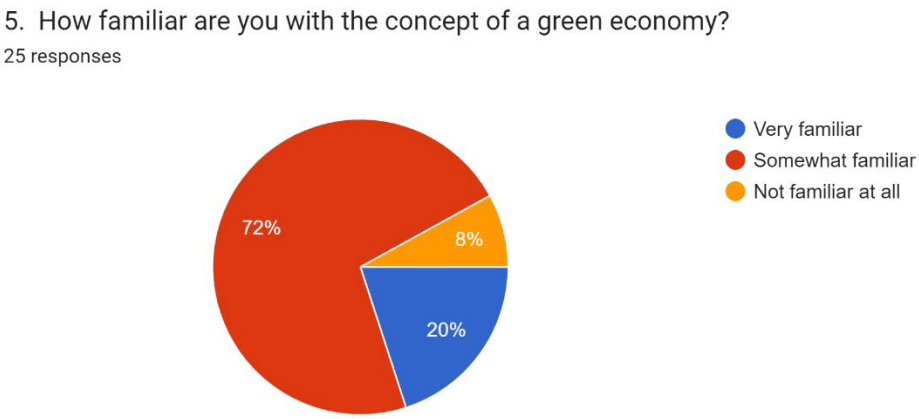

Figure 11: Responders' Familiarity with Green Economy concept

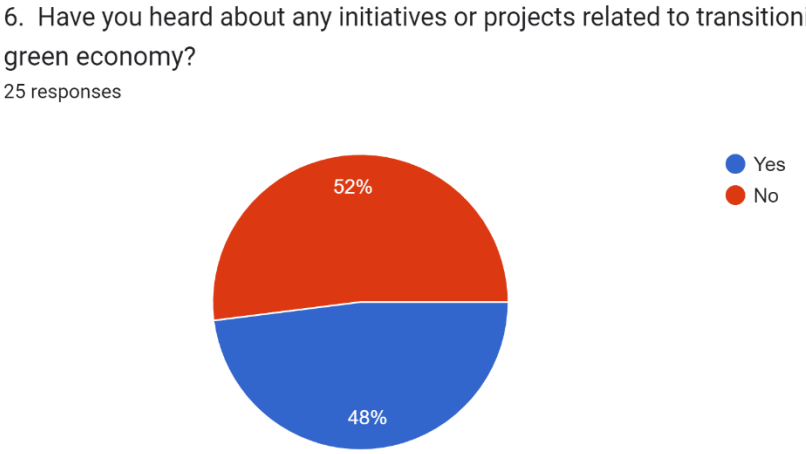

Figure 12: Knowledge of Initiatives Relating to Green Economy

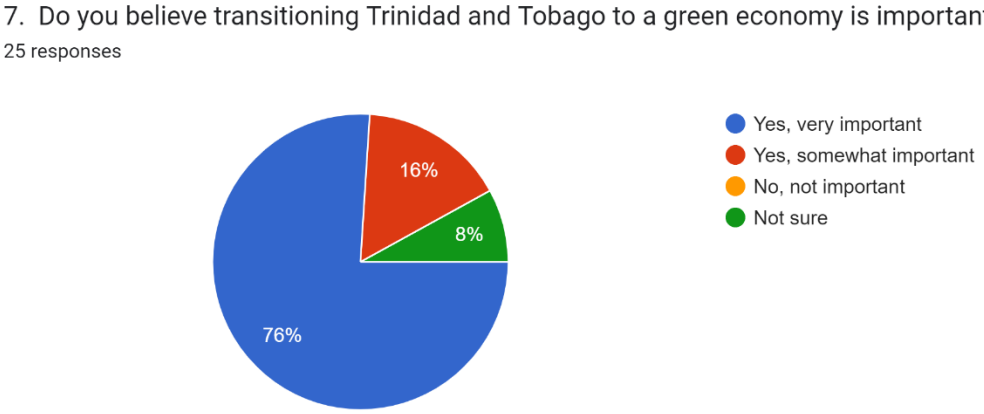

Figure 13: Opinion of Importance of Transitioning to a Green Economy

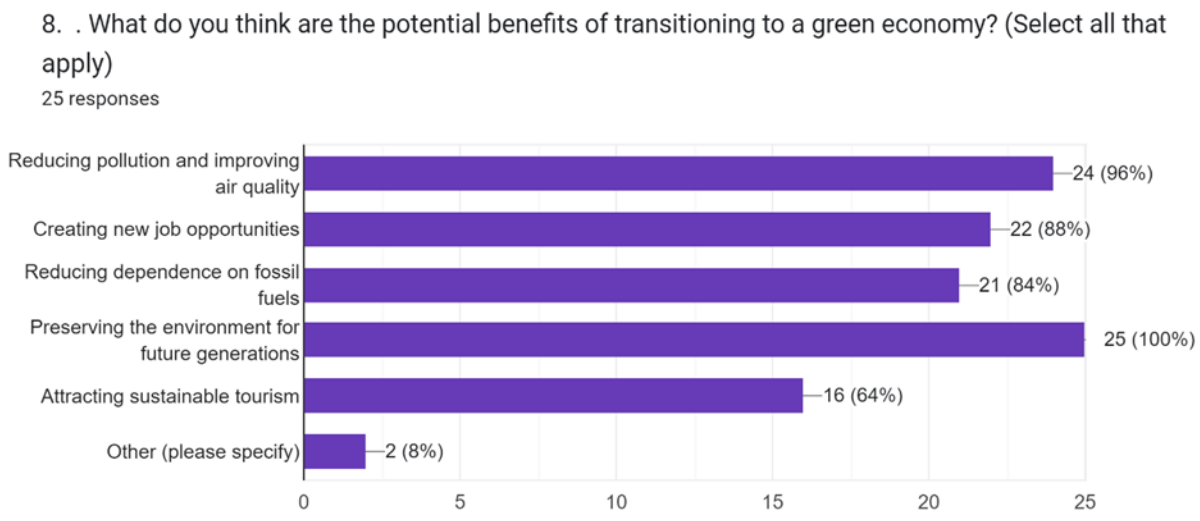

Figure 14: Potential benefits of Transitioning to a Green Economy

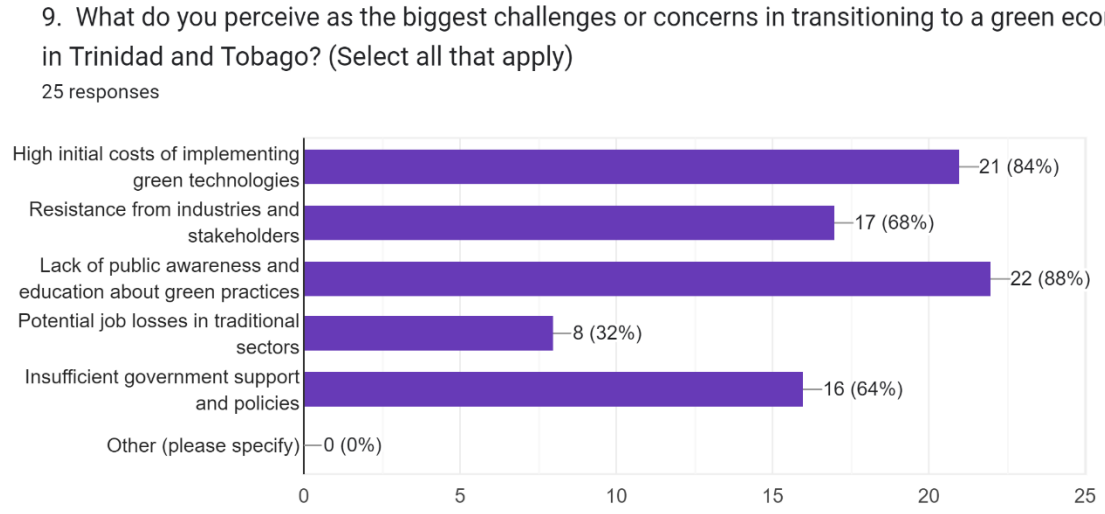

Figure 15: Biggest Challenges & Concerns in Transitioning to a Green Economy

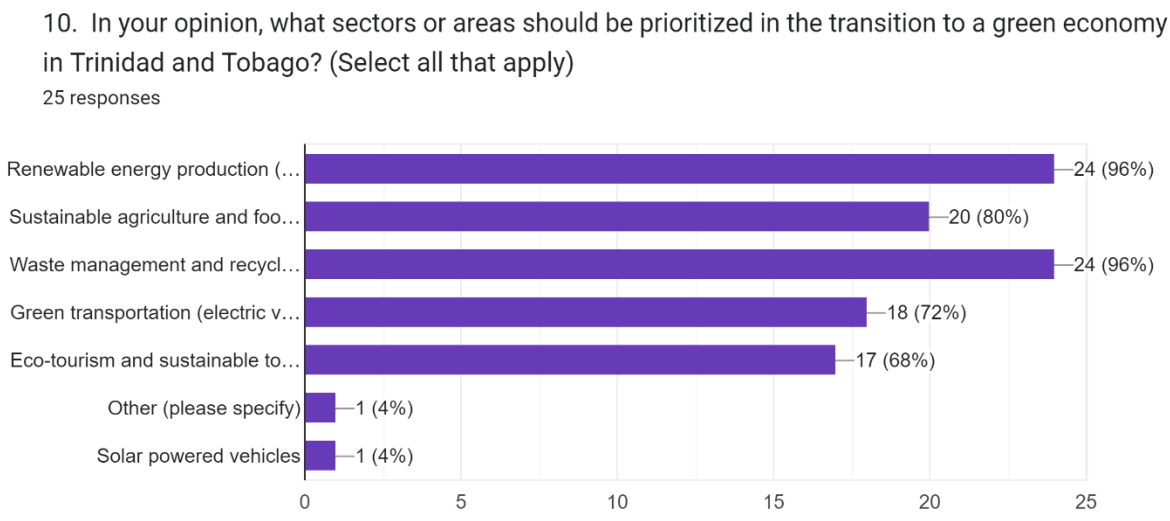

Figure 16: Areas That should be Prioritized in Transitioning to a Green Economy

11. How do you think the government can encourage and support the transition to a green economy? (Open-ended)

25 responses

- Educating the public and showing the benefits of going green
- Create renewable energy incentives.
- Tax break incentives for compliance
- The government has to ban items such as styrotex.
- There needs to be implementation of recycling.
- There should be legislation for the installation of domestic solar power panels.
- Encourage awareness by granting support to green economy initiatives and reducing taxes on imported material to be used in green economy initiatives.

- Combined engagement by encouraging young people to get involved while educating them effectively.
- Use media to ensure more people are engaged in the renewable discussions so that green economy is give the right attention in the eyes of every citizen.
- Encourage public seminars.
- Create education programs beginning at elementary level.
- Provide and encourage the usage of both personal electric vehicles and public transport.
- Provide subsidies for importers and investors.
- Introduce legislation with possible taxes and sanctions for people who will not align their business and production lines with renewable energy requirements.
- National government and local authorities should provide a supporting budget.
- All government sectors should embrace green economy.
- After the government has fully implemented the green economy strategies, it is expected all other sectors should follow without excuses.
- Implement legislative policies to support the development of various green industries.
- Design well-structured public education systems that encourage renewable energy.
- Encourage creative incentives for the private sector to participate.
- Increase public awareness.

12. If you answered "Yes" or "To some extent" to the previous question, please specify the green practices you are willing to adopt. (Open-ended)

20 responses

- Willing to adopt solar powered cars when available.

- Recycling, reducing waste, organic gardening, using of solar panels.
- Reduce the use of electricity and encourage solar power.
- I don’t know much about it but I am doing my research
- I intend not to use plastic containers and am willing to start using electric or hybrid cars.
- I intend to avoid hybrid vehicles due to poor charging infrastructure
- Encourage bicycling.
- Encourage reusable straw usage.
- Encourage recycling to ensure less power at home is used.
- Avoid using plastics as well as the proper disposal of radioactive materials.
- Only use chemicals which are friendly to the environment.
- Reduce carbon emissions and engage in the promotion of renewable energy sources
- Try to reduce my fuel and electricity consumption and start composting
- Encourage conservation practices (water, electricity), installing solar panels (dependent on the provision of government support and sufficient rebates to reduce the upfront costs).
- Already started switchover to LED lights and use of energy efficient inverter air conditions.
- Encourage energy efficient vehicles and alternative power for homes
- Use green products.
- Encourage energy reduction at home while recycling products.
- Recycling and correct disposal of household waste.
- Encourage and demonstrate to people how green economy can transition the country.

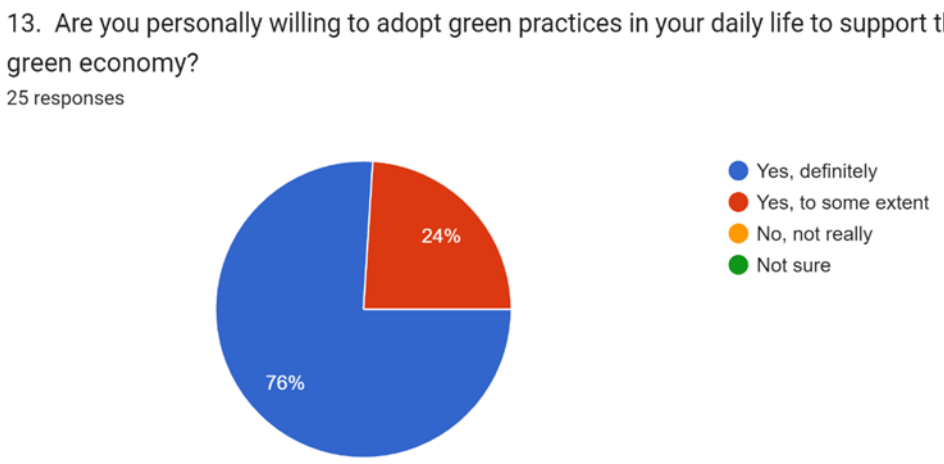

Figure 17: Willingness to adopt green practices to Transition into a Green Economy

4.3 Qualitative Results

Qualitative findings from the study on creating a plan to move Trinidad and Tobago toward a green economy offered important insights into the viewpoints, difficulties, and opportunities connected with this crucial development. These qualitative results provided a greater comprehension of the transition's social, economic, and environmental elements. According to interviews and focus group discussions, some stakeholders and community members were happy about the transition and saw it as a chance for positive change, while others expressed doubt or suspicion about its viability and advantages. These disparate viewpoints highlighted the significance of efficient communication and education in fostering agreement and comprehension among various stakeholders.

Qualitative findings underscored the significance of involving local communities in the green economy transition. Community members interviewed often stressed their desire to actively

participate in decision-making processes related to sustainable initiatives. This suggested that community engagement, inclusion, and empowerment should be central components of the transition strategy to ensure that it aligned with the needs and aspirations of the people of Trinidad and Tobago (Mentis & Moonsammy, 2022). The potential for economic diversification through green projects was stressed by respondents from both the public and commercial sectors. The development of renewable energy sources, sustainable agriculture, and eco-tourism were cited in interviews as promising sectors for job generation and economic expansion (Andres et al., 2023). These results highlighted the requirement for focused policies and financial infusions into industries that foster a green economy.

The findings identified a number of obstacles and problems to the transition. These included a lack of funding, technology deficiencies, regulatory barriers, and a need to grow capacity. Concerns from stakeholders about the financial consequences of the demise of established businesses, such as fossil fuel extraction, were also noted. A comprehensive strategy that included government assistance, public-private partnerships, and international cooperation was needed to address these difficulties (Centobelli et al., 2021). The results also showed that the general public was not aware of, or did not fully grasp the principles of the green economy. Many interviewees emphasized the significance of educational programs and public awareness campaigns to educate the public on the advantages and opportunities offered by a green economy. Educating and enlisting the public's support was essential to the success of green efforts.

The qualitative findings highlighted the fundamental significance that stakeholders and communities alike place on environmental conservation. Many interviewees showed a great desire to preserve Trinidad and Tobago's biodiversity and natural resources. This viewpoint supported the more general objectives of sustainability and emphasized the need for policies that strike a

balance between environmental preservation and economic growth (Stevis, 2021). These results highlighted the value of education, effective legislation, community involvement, and economic diversification in easing the transition. Trinidad & Tobago may take important steps in the direction of a sustainable and environmentally friendly future by resolving the highlighted issues and seizing the available opportunities.

4.4 Integration of Quantitative and Qualitative Findings

One essential phase in the research process that enabled researchers to have a thorough grasp of the phenomenon being examined was the integration of quantitative and qualitative results. By triangulating the results, this integration offered a more substantial and complex viewpoint. A crucial part of building a factual foundation for the transition plan was played by quantitative research. Key metrics including carbon emissions, energy consumption, GDP, and environmental indicators could all be quantified through the gathering and analysis of quantitative data (Gehring, 2016). These measurements offered crucial information about the economy and ecology of the country currently. An analysis of carbon emissions, for instance, helped determine the environmental impact of current practices, and economic measures like GDP revealed information about the nation's economic health.

In order to comprehend the scope and patterns of environmental deterioration and economic performance, quantitative data was necessary for trend analysis, modeling, and the discovery of linkages. Such empirical data acteed as a compass, directing the creation of particular goals and standards as part of the green economy plan.

In contrast, qualitative research complemented quantitative data by offering a nuanced understanding of the contextual factors, stakeholder perspectives, and societal dynamics that shaped the transition process. The investigation of attitudes, perceptions, and behavioral factors among stakeholders, including officials from the government, corporations, communities, and environmental organizations, was made easier by qualitative approaches including interviews, focus groups, and document analysis. These qualitative insights unearthed intricate narratives that illuminated the barriers and enablers of sustainability transitions. By engaging stakeholders in open-ended discussions, researchers uncovered hidden complexities and potential points of contention. Document analysis further enriched the qualitative aspect by providing historical context and policy-related insights. Qualitative research, therefore, brought the human dimension to the strategy development process, fostering a deeper understanding of the challenges and aspirations of the diverse stakeholders involved.

These findings illuminated key aspects of the transition strategy, including sustainable agriculture, eco-tourism promotion, and the adoption of solar-powered vehicles. The survey results indicated that a significant majority of respondents, 80%, supported the prioritization of sustainable agriculture and food production as part of the country's transition to a green economy. This quantitative finding underscored the importance of agriculture in the sustainability agenda, highlighting a consensus among the populace. Sustainable agriculture not only addressed food security but also contributed to environmental conservation and the reduction of greenhouse gas emissions (Heffron & Heffron, 2021). This strong support from the public suggested that sustainable agriculture should be a central component of the transition strategy, aligning economic growth with environmental responsibility.

The survey also found that 68% of respondents supported promoting eco-tourism as a way to further Trinidad and Tobago's green economy strategy. This result highlighted how eco-tourism had the ability to create job opportunities while protecting the nation's natural resources. A sizable portion of the population agreed that environmental conservation and economic growth should go hand in hand. In order to ensure a sustainable and culturally aware approach, qualitative study further explored the specific eco-tourism development areas that were in line with local values and resources. On the other hand, only 4% of respondents expressed agreement with the idea of embracing solar-powered vehicles as a part of the green economy strategy. This low level of support may be indicative of concerns related to technology readiness and energy infrastructure in Trinidad and Tobago.

4.5 Discussion of the results

In recent years, there has been a notable shift in people's attitudes towards the environment. Growing awareness of climate change, pollution, and resource depletion has fueled a collective desire for change. This heightened environmental consciousness has given rise to intentions and actions aimed at preserving the planet for future generations (Andres et al., 2023). The findings of the data showed a strong dedication to sustainable practices and environmental protection in all aspects of daily life. It was admirable that people were making steps to reduce their impact on the environment by recycling, avoiding plastics, using ecologically friendly chemicals, and promoting the use of reusable straws.

The results of the data indicated a strong commitment to environmentally friendly practices and sustainability across various aspects of daily life. Encouraging the usage of reusable straws,

recycling, reducing power consumption, avoiding plastics, and using environmentally friendly chemicals were all commendable efforts to minimize the ecological footprint (Shah et al., 2018). For instance, promoting the use of reusable straws reduced the amount of single-use plastic waste, a major source of environmental contamination, particularly in the seas and other bodies of water. Individuals could help reduce plastic waste, which can take hundreds of years to degrade, by encouraging recycling.

Qualitative findings reveal that tourists were increasingly seeking environmentally responsible and sustainable travel experiences. This shift in preferences presented an opportunity for Trinidad and Tobago to position itself as a destination that caters to the growing market of eco-conscious travelers. The qualitative data suggested that the tourism industry should adapt its offerings to align with these preferences, such as promoting eco-tours, sustainable accommodations, and nature-based activities. Their concerns, benefits, and aspirations must be considered in the transition. The data suggested that community support for green tourism initiatives is essential. Engaging local communities in the planning and decision-making processes could foster a sense of ownership and cooperation, contributing to social sustainability.

Stakeholders within the tourism industry may hold divergent views on the transition to a green economy because some might see it as an opportunity for innovation and differentiation, while others might view it as a challenge due to potential costs or resistance to change. These perspectives should inform collaborative strategies that address concerns and capitalize on opportunities. The respondent data provided valuable insights into individual attitudes and intentions related to environmentally friendly practices and the transition towards a green economy (Cooper, 2014). These responses collectively reflected a strong commitment to sustainable living

and provided a foundation for understanding the role of individual actions in driving broader environmental and economic transformation.

The mention of using only environmentally friendly chemicals highlighted a commitment to reducing harm to ecosystems and promoting sustainable practices. This intention aligned with the broader goal of minimizing the negative environmental impacts of various products and processes. The respondents' focus on reducing carbon emissions and promoting renewable energy sources was a significant finding. This reflects an understanding of the critical role that transitioning to renewable energy plays in mitigating climate change. It also underscored the importance of individual contributions to reducing carbon footprints, both in daily life and through support for renewable energy initiatives. Intentions to reduce fuel and electricity consumption, as well as composting, highlighted a commitment to energy conservation and waste reduction. These actions directly contributed to lowering greenhouse gas emissions and minimizing resource depletion (Centobelli et al., 2021). Additionally, actions such as switching to LED lights and using energy-efficient inverter air conditioners demonstrated a proactive approach to energy conservation. These technological shifts contributed to reducing energy consumption and lowering electricity bills.

It is of the outmost importance to establish that preference for green products and energy-efficient technologies underscored the influence of consumer choices on market dynamics. Businesses were more likely to adopt sustainable practices and offer eco-friendly products when there was a demand for them (Lewis & Su, 2021). The data revealed that individuals were not passive actors in the pursuit of sustainability but were actively engaged in adopting eco-friendly practices. This empowerment of individuals was a critical aspect of transitioning to a green economy (Eicke & De Blasio, 2022). It signified that sustainable change was not solely reliant on top-down policies or corporate initiatives but was also driven from the grassroots level. When

individuals make conscious choices to reduce their environmental impact, they contributed to a collective effort that can bring about substantial change.

4.6 Limitations

Conducting an in-depth investigation in this field called for investigating the constraints faced in data gathering, both quantitative and qualitative, for the purpose of converting Trinidad and Tobago to a green economy. Comprehensive and up-to-date quantitative information is the cornerstone of evidence-based decision-making when formulating a strategy for transitioning. One of the primary challenges lies in the collection and availability of quantitative data on various aspects of the transition. According to (Yakubu, 2023), transitioning to a green economy involves multifaceted changes across sectors such as energy, agriculture, transportation, and waste management. To gauge progress in these areas, researchers require reliable data on environmental metrics such as greenhouse gas emissions, air and water quality, biodiversity, and natural resource consumption. In many cases, quantitative data may be fragmented, outdated, or simply unavailable. The lack of standardization and coordination can result in gaps and inconsistencies in the data, making it challenging to paint a clear picture of the current status of the green economy transition.

Environmental metrics and economic indicators are subject to constant change, and to make informed decisions, policymakers and researchers require real-time or at least up-to-date data. In some cases, data updates may lag behind, leading to an incomplete understanding of recent developments. This time lag can be especially problematic when responding to rapidly evolving environmental and economic challenges. The process of combining data from several sources

might bring about a number of complications. In circumstances where precise translations are not possible owing to data restrictions, it first needs researchers to make assumptions and estimates (Gahman & Thongs, 2020). These approximations may result in errors in the analysis, which could jeopardize the validity of the results. Second, mixing data from multiple temporal and spatial resolutions throughout the reconciliation process may make it more difficult to analyze and identify trends (Gehring, 2016). For instance, regression or extrapolation may be needed when monthly energy consumption statistics and annual GDP figures are combined, adding further uncertainty to the research.

Additionally, efforts to reconcile data may not always be perfectly in line with the precise study questions or aims. Researchers may have to make concessions or give some data sources more weight than others, which could result in an inaccurate portrayal of the shift to a green economy. This priority may not always correspond with the most accurate or complete depiction of reality because it can be affected by data availability, reliability, and relevance. Secondly, the development and adoption of common measurement methodologies and data collection techniques can contribute to greater coherence in the data landscape (Iwama et al., 2021). Collaboration between government agencies, research institutions, and international organizations can facilitate the harmonization of data practices, reducing discrepancies and uncertainties in the data.

Chapter 5: Data Analysis and Discussion

5.1 Descriptive Statistics

Descriptive statistics play a pivotal role in any research endeavor, offering a comprehensive snapshot of the surveyed population and their viewpoints. In the context of the transition to a green economy in Trinidad and Tobago, these statistics are invaluable for several reasons. Understanding these demographics is crucial as it allows researchers to discern if there are any particular groups within the population that hold distinct opinions or perspectives on the transition to a green economy. For instance, younger respondents may be more environmentally conscious and supportive of green initiatives, while those in specific industries like renewable energy may have specialized insights.

5.2 Hypothesis Testing

Null Hypothesis (H0): The proportion of respondents who believe in transitioning Trinidad and Tobago into a green economy is equal to 50%.

Alternative Hypothesis (H1): The proportion of respondents who believe in transitioning Trinidad and Tobago into a green economy is not equal to 50%.

Given:

Sample size (n) = 25

Proportion of respondents believing in transitioning to a green economy (p) = 76% or 0.76

Assuming a significance level (α) of 0.05 (5%).

Performing the Z-test:

The standard error (SE) of the proportion is:

$SE = \sqrt{[(p * (1 - p)) / n]}$

$SE = \sqrt{[(0.76 * 0.24) / 25]} \approx 0.085$

Calculate the z-statistic:

$z = (p - P0) / SE$, where P0 is the assumed proportion (50% or 0.5)

$z = (0.76 - 0.5) / 0.085 \approx 3.06$

Since we are using a z-test, the critical value for $\alpha/2 = 0.025$ is approximately 1.96.

Compare the calculated z-value with the critical z-value. If the calculated z-value is greater than the critical z-value, we reject the null hypothesis.

Interpretation:

The calculated z-value of 3.06 is greater than the critical z-value of 1.96. Therefore, we reject the null hypothesis. This suggests that the proportion of respondents who believe in transitioning Trinidad and Tobago into a green economy is significantly different from 50%.

5.3 Interpretation of Results

The sample consisted of 25 respondents, with 48% being males and 52% females. This indicated a fairly balanced representation of both genders in the survey. The study captured a diverse set of perspectives from both men and women. This distribution highlighted a diverse range of age groups, with a substantial portion falling within the 55-64 category. This suggestd that the opinions gathered are reflective of a broad spectrum of age-related experiences and perspectives. A significant majority, 68%, of the respondents were employed. This indicated that the sample largely represented individuals who were actively participating in the workforce. Their perspectives may be influenced by their engagement in economic activities. The data indicated that 96% of respondents resided in Trinidad, while 4% lived in Tobago. This suggests that the study predominantly captures the views and opinions of individuals residing in Trinidad and is representative to the national demographic population. It's important to consider that regional variations might influence perspectives on transitioning to a green economy.

A notable finding was that only 20% of respondents were familiar with the concept of a green economy, while the majority (80%) were not. This highlighted a potential area for education and awareness-building initiatives to enhance understanding and knowledge about green economic principles. The data revealed that a substantial majority, 76% of respondents, believed that transitioning Trinidad and Tobago into a green economy was important. On the other hand, 24% held a different perspective. This indicated strong support for the transition among the majority of respondents, emphasizing a collective interest in sustainable economic practices.

The sample provided a diverse representation of both genders and a broad range of age groups. A majority of respondents are actively employed. The study primarily captures the perspectives of individuals residing in Trinidad. Notably, there is room for increasing awareness and

understanding of the green economy concept. Importantly, the overwhelming support for transitioning to a green economy indicates a shared belief in the significance of sustainable economic practices.

Chapter 6: Recommendations and Conclusions

6.1 Summary of Key Findings

Transforming Trinidad and Tobago into a green economy is a multifaceted and intricate undertaking that encompasses numerous sectors and involves various parties.

The following is a summary of significant knowledge and elements recommended by the researcher to take into account when developing such a strategy:

i. Resource Diversification:

The extraction of oil and gas, in particular, has historically been a major contributor to Trinidad and Tobago's economy. As indicated by the economic difficulties it has had during times of oil price volatility, the nation is very vulnerable to changes in the price of energy on a global scale due to its reliance on a single industry (Andres et al., 2023). It is essential for the nation to diversify its resource base and look into different economic opportunities in order to address this vulnerability. Promoting sustainable agriculture, eco-tourism, and renewable energy are essential aspects in this diversification process.

ii. Renewable Energy:

Transitioning to a green economy represents a fundamental shift in how societies produce and consume energy and resources, with a primary focus on sustainability, environmental conservation, and reducing carbon emissions. One of the central pillars of this transition is the

adoption of renewable energy sources like wind, solar, and hydroelectric power (Gahman & Thongs, 2020). Carbon emissions are greatly decreased by switching to renewable energy sources. For instance, the utilization of solar and wind energy results in the production of electricity without the release of any greenhouse emissions. Nations that invest in renewables can significantly advance toward their climate targets. The construction and upkeep of renewable energy infrastructure requires a professional workforce of engineers and technicians, therefore the renewable energy sector may also be a significant source of employment creation for the people of Trinidad and Tobago.

iii. Environmental Conservation:

The country's natural beauty, which is exemplified by its varied ecosystems, breathtaking landscapes, and distinctive biodiversity, is a priceless resource with enormous potential for sustainable development. Biodiversity conservation is crucial for maintaining the health of these ecosystems and preserving species that may have ecological, cultural, or economic significance (Shah & Niles, 2016). Establishing protected areas and sustainable agricultural practices can create new economic opportunities, generate employment, and reduce reliance on sectors like oil and gas, making the economy more resilient.

iv. Eco-Tourism:

The tourism sector holds substantial potential for contributing to a green economy, and eco-tourism stands out as a promising avenue to harness this potential. Eco-tourism focuses on providing travelers with unique, nature-based experiences while prioritizing sustainability and

environmental conservation. Ecotourism places a strong emphasis on ethical behavior to reduce its impact on the environment (Gahman & Thongs, 2020). Responsible wildlife viewing, garbage management, and sustainable land usage are essential elements. Operators in Trinidad and Tobago may follow stringent regulations for trash disposal, limit the number of visitors in sensitive locations, and inform tourists about the value of protecting the environment. The strategy plays a vital role in raising awareness about the importance of environmental conservation. It connects tourists with nature on a personal level, fostering a sense of responsibility.

v. Government Policies and Incentives:

The successful shift to a green economy is undoubtedly fueled by effective government policies and incentives. These policies create a supportive environment that encourages businesses, individuals, and industries to adopt sustainable practices, invest in green technologies, and reduce their environmental impact. The state should introduce clear and well-defined regulations that provide businesses and individuals with a roadmap for compliance. These regulations set standards for emissions, waste disposal, energy efficiency, and other environmental aspects. Similar to other nations, Trinidad and Tobago environmental regulations set targets for reducing carbon emissions to restrict the emissions of dangerous pollutants from industries (Cooper, 2014). Companies are encouraged to adopt greener technologies and procedures by such explicit regulations.

vi. Education and Awareness

Raising public awareness and providing education on environmental issues and sustainable practices “from nursery to tertiary” are indeed essential components of a successful transition

to a green economy. Informed and engaged citizens are more likely to support green initiatives, adopt environmentally conscious behaviors, and actively participate in the sustainability movement. Public education and awareness campaigns give people the information and understanding they need to make wise decisions about their daily lives, such as energy use, waste reduction, and sustainable purchase decisions.

6.2 Implications for Policy and Practice

The development of a green economy in Trinidad and Tobago is a complicated and varied undertaking that calls for much thought to be put into both policy and practice. Such a change has significant effects on many societal spheres and elements. For Caribbean nations, such as Trinidad and Tobago, to increase their resilience in the face of climate change, they must make the transition to a green economy (Lewis & Su, 2021). These countries are particularly vulnerable to the effects of climate change, including rising sea levels, more frequent hurricanes, disruptions to their vital tourism and agricultural industries (Dore, 2023). The Caribbean Community Climate Change Centre (CCCCC) runs educational and outreach initiatives aimed at spreading the word about climate change adaptation and mitigation measures (Shah et al., 2018). Communities are given the tools they need to take initiative and decide for themselves.

The investment in green infrastructure, which includes facilities for renewable energy, public transit networks, numerous sustainable technologies and projects, is crucial to this transition. In addition to tackling environmental issues, these investments are crucial for promoting long-term resilience, economic growth, and the creation of new jobs. The need to cut greenhouse gas emissions is one of the main drivers for investing in green economy (Stevis, 2021). Traditional

infrastructure frequently depends on fossil fuels, a significant contributor to carbon emissions, especially in the energy and transportation sectors. As opposed to conventional infrastructure, green infrastructure places a higher priority on clean and renewable energy sources, hence lowering the carbon footprint of energy production and consumption (Centobelli et al., 2021). Facilities for renewable energy, like solar, wind, and hydropower plants, are crucial to this transformation.

Technology advancement and the creation of green technologies are crucial to the shift to a green economy. These innovations aim to increase resource efficiency, foster sustainability, and lessen their negative effects on the environment (Gahman & Thongs, 2020). Countries can reap a variety of benefits by expanding investment in research and development (R&D) of green technology, from resolving environmental issues to strengthening economic competitiveness on the international stage.

Initiatives for a green economy are intrinsically connected to global environmental problems, which call for international cooperation for efficient mitigation and resolution. Initiatives like the Paris Agreement serve as platforms for countries to collectively set emission reduction targets and implement strategies to limit global warming (Eicke & De Blasio, 2022). International cooperation is vital for achieving the agreement's objectives. Collaborative efforts facilitate the sharing of clean technologies and financial resources between developed and developing nations. This helps less economically advanced countries transition to greener economies. Global cooperation enables the exchange of scholarly work, best practices, and knowledge, hastening the creation and application of climate solutions.

Establishing and administering protected areas and conservation corridors that cross national boundaries require international cooperation. These networks are essential for protecting

habitats and biodiversity. Cross-border collaboration is frequently necessary for conservation efforts for threatened species in order to safeguard habitats, control populations, and stop the illegal wildlife trade (Stevis, 2021). Global conservation efforts are aided by the vital information on trends in biodiversity provided by collaborative research projects and monitoring programs.

6.3 Future Research Directions and Recommendations

The pursuit of a green economy encompasses more than just environmental considerations; it must also prioritize social equity and inclusivity. Understanding and addressing the social dimensions of this transition is critical for ensuring that the benefits are shared equitably across society. It is crucial to identify and rectify any potential environmental justice concerns that may arise. This includes ensuring that no community is unfairly burdened by pollution or other environmental harms, and that they have access to the benefits of a green economy (Gahman & Thongs, 2020). Future research should delve into how green policies affect different socioeconomic groups. This entails understanding whether certain communities, particularly those historically marginalized or vulnerable, bear a disproportionate burden or receive fewer benefits from the transition. Studies should assess how the green transition impacts income and wealth distribution (Middelbeek et al., 2014). It's essential to prevent situations where certain groups, especially low-income communities, face economic hardships due to the transition.

An important area of research with far-reaching consequences for sustainability, economic growth, and environmental preservation is the transition of Trinidad and Tobago to a green economy. Research should assess the effectiveness of policy initiatives aimed at promoting a green economy in Trinidad and Tobago. This involves evaluating the impact of specific policies, such as

incentives for renewable energy adoption, tax breaks for eco-friendly businesses, and conservation regulations (Dore, 2023). Understanding the factors that influence policy implementation and compliance will be crucial. The pursuit of a green economy encompasses more than just environmental considerations; it must also prioritize social equity and inclusivity. Understanding and addressing the social dimensions of this transition is critical for ensuring that the benefits are shared equitably across society.

Given the vulnerability of small island states like Trinidad and Tobago to climate change, it is imperative to prioritize adaptation strategies. These strategies are essential for building resilience in the face of changing environmental conditions (Yakubu, 2023). This includes the development of robust infrastructure, coastal protection measures, and climate-resilient agricultural practices. Additionally, research on climate risk assessments and early warning systems is crucial for effective preparedness and response. Investing in resilient infrastructure involves designing and constructing buildings, roads, and utilities that can withstand extreme weather events and rising sea levels (Centobelli et al., 2021). This can be achieved through the use of durable materials, elevated structures, and improved drainage systems. Like the Maldives, a small island nation vulnerable to sea level rise, Trinidad and Tobago should adopt similar measures (Shah et al., 2018). Their government has made investments in the development of infrastructure that is resistant to climate change, such as raised roadways, flood barriers, and reinforced buildings. These precautions are used to guard against flooding and coastal erosion.

In order to advance a green economy, it is essential to look into the variables that affect people's attitudes toward sustainable behaviors on an individual and societal level. This field of study explores the complex interactions that influence how individuals perceive, adopt, and maintain environmentally beneficial activities. Additionally, it aims to comprehend the underlying

attitudes, motivations, and thought processes that influence people and communities to make eco-friendly decisions. Fostering sustainable habits and technology requires research on how innovation and entrepreneurship are accelerating the shift to a green economy (Andres et al., 2023). This line of inquiry aims to comprehend how entrepreneurial activities and creative methods might act as catalysts for a more environmentally responsible future.

A crucial component is to research the mechanisms that can help green startups. Understanding the particular difficulties and chances faced by green entrepreneurs is necessary for this. These businesses frequently encounter challenges getting capital, breaking into new markets, and navigating regulatory environments. As a result, studies in this field focuses on individualized solutions. This could entail setting up specialized programs, such as incubators and accelerators, that provide mentorship and access to essential resources in addition to financial support. For instance, a city or region may establish a special green technology incubator, giving businesses a supportive setting complete with specialists and equipment for developing prototypes.

6.4 Concluding Remarks

This study has shown that Trinidad and Tobago's move to a green economy is essential for long-term sustainability. The need of implementing comprehensive policies that strike a balance between economic growth and environmental stewardship is highlighted by the islands' great biodiversity and vulnerability to environmental threats (Mentis & Moonsammy, 2022). The research discussed here has looked into a variety of aspects of this shift and has provided insights and suggestions that can help with practical implementations and policy decisions. A supportive regulatory environment that includes regulations that promote and uphold green corporate

practices, such as emissions standards, renewable energy goals, and pollution controls, is essential (Stevis, 2021). In addition, it is essential for promoting information transfer and collaboration between enterprises, government organizations, and research institutes. The creation of a Green Innovation Hub, which would act as a focal point for green firms, research facilities, and governmental organizations, may be an excellent project. This center would provide access to financial options, allow for networking, and offer common resources.

Through rigorous analysis and consideration of various sectors, from energy and agriculture to tourism and policy frameworks, the research identified key pathways to foster sustainable growth, reduce environmental vulnerabilities, and enhance the overall well-being of its citizens. The results of this study show that shifting to a green economy is not only morally required but also a wise move in the direction of long-term economic stability and environmental stewardship. Trinidad and Tobago can dramatically lessen its reliance on unpredictable international energy markets while at the same time minimizing environmental effects by diversifying its resource base, fostering renewable energy, eco-tourism, and sustainable agriculture (Centobelli et al., 2021). Future research might examine the unique opportunities and problems within each sector and offer specialized implementation advice. To measure progress, pinpoint problem areas, and guarantee the ongoing success of the transition to a green economy, robust monitoring and evaluation procedures will also be necessary.

6.5 Summary

The responses provided reflect a diverse range of perspectives on how the government can encourage and support the transition to a green economy. Developing public understanding of the

advantages of sustainable practices emerges as a basic strategy, with a significant focus on awareness campaigns, open forums, and teaching initiatives that begin in the primary grades. As the Father of the Nation of Trinidad and Tobago Dr. Eric Williams said at the Independence Celebrations Youth Rally on August 30th 1962 “You the children, yours is the great responsibility to educate your parents. *You* carry the future *of the nation* in your school bags” . This emphasizes the significance of developing an attitude of environmental care from a young age. The necessity for legislative action to enforce green practices was stressed by respondents. The development of recycling programs and the outlawing of environmentally hazardous products like Styrotex were suggested. An understanding of the legislative framework necessary to make the transition to a green economy is shown in the proposal for legislation requiring the installation of household solar power panels.

An important issue that developed was raising awareness through multiple platforms. The recommendations included holding open seminars to spread information and leveraging media outlets to engage the public in conversations about renewable energy. It was also emphasized to start educational initiatives at the primary school level because it is crucial to inculcate environmental awareness at a young age. The willingness of respondents to adopt green practices is indicative of a growing environmental consciousness. Many expressed a readiness to embrace practices such as recycling, reducing waste, and using solar panels. Some respondents also indicated an interest in adopting solar-powered cars when available, showcasing an openness to innovative green technologies. The objective of lowering emissions from the transportation sector is aligned with encouraging the usage of both personal electric vehicles and public transportation. Subsidies for green technology importers and investors act as a driving force behind the transition's economy. Green methods were generally welcomed; however, several issues were brought up.

Concerns like the availability of electric vehicle charging infrastructure and the requirement for government support for programs like the installation of solar panels were brought up. This emphasizes how crucial it is for the government to get involved in creating the infrastructure and backing for sustainable practices.

In conclusion, the responses provide a comprehensive array of strategies and recommendations for the government to facilitate the transition to a green economy. These suggestions encompass educational, financial, legislative, and infrastructural interventions, reflecting a multi-faceted approach to sustainable development. The willingness of individuals to adopt green practices indicates a positive shift towards a more environmentally conscious society. To fully realize the transition to a green economy, it is imperative that the government of Trinidad and Tobago to continue engaging, educating, and providing the necessary support for individuals and businesses to make sustainable choices. This collective effort is pivotal in creating a more resilient and environmentally-conscious society.

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Appendix : On line questionnaire

A. Informed Consent Form

Title of the Study: A Strategy to Transition Trinidad and Tobago to a Green Economy

Principal Investigator: Lloyd Straker

Date: August, 2023

Introduction:

You are invited to participate in a research study. Before you decide whether or not to participate, it is important for you to understand why the research is being conducted and what it will involve. Please take your time to read this informed consent form carefully. If you have any questions, feel free to ask. Your participation in this study is voluntary.

Purpose of the Study:

The purpose of this study is to investigate and propose a comprehensive strategy for transitioning Trinidad and Tobago to a green economy. This involves examining various aspects, including renewable energy, eco-tourism, and sustainable agriculture.

Risks and Benefits:

There are no anticipated risks associated with your participation in this study. Your input will be valuable in shaping the proposed strategy, which aims to benefit the environment and economy of Trinidad and Tobago.

Confidentiality:

Any information obtained during this study will be kept confidential. Your identity will not be disclosed in any research reports or publications. Data will be anonymized and stored securely.

Consent:

I have read and understood the information provided above. By participating in this survey, it indicates that I freely and voluntarily consent to participate in this research study.

B. **Demographic Questions**

1. What is your age range?

- 18-30
- 31-40
- 41-50
- 51-65
- 65+

2. What is your gender?

- Male
- Female

3. What is your occupation?

- Student

- Employed
- Unemployed
- Retired
- Other

4. Where do you live?

- Trinidad
- Tobago

C. Perception and Evaluation of strategy to transition Trinidad and Tobago to a green economy

1. How familiar are you with the concept of a green economy?

- Very familiar
- Somewhat familiar
- Not familiar at all

2. Have you heard about any initiative or projects related to transitioning Trinidad and Tobago to a green economy?

- Yes
- No

3. Do you think transitioning the country to a green economy is important?

- Yes, very important
- Yes, but not that important
- No, not that important
- Not sure

4. What do you think are the potential benefits of transitioning to a green economy?

- Reduced pollution and improving air quality
- Creating new job opportunities
- Reducing dependencies on fossil fuels
- Preserving the environment for future generation
- Attracting sustainable tourism
- Other

5. What do you perceive as the biggest challenges or concerns in transitioning to a green economy in Trinidad and Tobago?

- High initial costs of implementing green technologies
- Resistance from industries and stakeholders
- Lack of public awareness and education about green practices
- Potential job losses in traditional sector
- Insufficient government support and policies
- Others

6. In your opinion, what sectors and areas should be prioritized in the transition to a green economy in Trinidad and Tobago?

- Renewable energy production
- Sustainable agriculture and food production
- Waste management and recycled items
- Green transportation
- Eco-tourism and sustainability
- Other
- Solar vehicles

D. Open-ended Questions

This interview is having the purpose of collecting data for an academic research project on the topic “Renewal energy: A strategy to transition Trinidad and Tobago to a green economy.” The data collected will be treated as confidential and the responses will be anonymous.

Q 1: Are you personally willing to adopt green practices in your daily life to support the transition to a green economy?

Q 2: Can you provide some specific examples of projects or initiatives you have been involved in related to renewable energy?

Q 3: Could you elaborate on any specific strengths or unique features of green economy that made it attractive to the citizens of Trinidad and Tobago?

Q 4: Are there any specific factors or trends that you believe might influence the decision of the stakeholders to engage in green economy transition?

Q 5: Could you expound on any particular advantages or distinctive qualities of the green economy that appealed to people of Trinidad and Tobago?

Q 6: Could you provide further information on any potential difficulties or obstacles the green economy might encounter as it transitions?

Q 7: How do you think the government can encourage and support the transition to a green economy?