REGULATED INDUSTRIES COMMISSION

Energy Road Map Series

Towards Renewable Energy Deployment in the Electricity Sector of Trinidad and Tobago

July 2019

RIC Staff Discussion Paper

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LIST OF ACRONYMS AND ABBREVIATIONS

EE	-	Energy Efficiency
DFI	-	Development Finance Institution
EIA	-	U.S. Energy Information Administration
EMA	-	Environmental Management Authority
EOI	-	Expressions of Interest
FIP	-	Feed in Policy
FIT	-	Feed in Tariff
GoRTT	-	Government of Trinidad and Tobago
GWh	-	Giga-Watt Hour
IRENA	-	International Renewable Energy Agency
LOCE	-	Levelised Cost of Energy
MEEI	-	Ministry of Energy and Energy Industries
MPD	-	Ministry of Planning and Development
MPU	-	Ministry of Public Utilities
MW	-	Megawatts
NGC	-	National Gas Company of Trinidad and Tobago
NGO	-	Non-Governmental Organisation
PPA	-	Power Purchase Agreement
PV	-	Photovoltaics
RE	-	Renewable Energy
RIC	-	Regulated Industries Commission
T&TEC	-	Trinidad and Tobago Electricity Commission
TTBS	-	Trinidad and Tobago Bureau of Standards
WtE		Waste to Energy

EXECUTIVE SUMMARY

This Staff Discussion Paper is part of a series of papers on crucial energy issues in Trinidad and Tobago. It seeks to stimulate the national dialogue on Renewable Energy (RE) matters and to sensitize key stakeholders of the opportunities and options to advance the uptake of RE at the national level by outlining critical actions for advancing RE in Trinidad and Tobago. The paper presents some of the best practices from countries around the world in the development and deployment of commercial RE in the electricity sector and examines the current RE framework and initiatives for RE integration into the electricity sector. It discusses the apparent hindrances to RE integration in the country and it presents some critical success factors for integration of RE.

In jurisdictions where RE has been successfully integrated the associated benefits of emissions reduction, energy security, economic growth, new employment opportunities and overall enhanced human welfare have been realized. In these jurisdictions, the success has often been credited to clear decision-making by government and a supportive regulatory environment to incentivize RE investment. Undeniably there is a discernable role for government in supporting the development of RE by creating an environment where risks are minimized and investors have confidence in the market. Best practice in terms of government leadership and action in RE development and creating an enabling environment demonstrates the importance certain critical factors for successful RE integration.

Despite the clear benefits and the success of RE integration in jurisdictions around the world, the development and use of RE sources in the electricity sector of Trinidad and Tobago are still in their nascent stages, notwithstanding the activities over the last 8 years towards RE integration. This delay is often attributed to low electricity prices and the absence of a legal and regulatory framework to facilitate its integration. While this may be the case and needs to be urgently addressed, these elements are only part of what is required to create the overall enabling environment.

To develop RE in Trinidad and Tobago, it is essential to establish a facilitating environment, which includes appropriate policies, regulations, focused institutions, tailored education and skill

development initiatives, and focused development projects. The Government of the Republic of Trinidad and Tobago (GoRTT) must also demonstrate its commitment by dedicating human resources and funding to the RE agenda. The priorities of GoRTT's RE agenda should be:

- To establish a clear RE policy, targets and strategy/roadmap by:
    - Articulating objectives for the policy and a rationale for its established targets, and a budgetary commitment.
    - Undertaking a comprehensive RE resource assessment.
    - Outlining its strategy to harmonize prevailing generation and transmission with RE targets, considering the retirement age of existing generation fleet and forecasted demand patterns and to avoid stranded assets.
    - Outlining its strategy to ensure long term investment certainty for RE developers:
    - Outlining its strategy to facilitate financing with commercial and other financing agencies.
    - Outlining its strategy to streamline administrative processes for RE applications.
    - Outlining its actions to facilitate grid access to RE developers of different scales.
    - Outlining its strategy to address market distortions favoring conventional sources.
- To establish legislative, institutional and regulatory structure for RE by:
    - Developing a Renewable Energy Act for Trinidad and Tobago that would seek to establish the legal, economic and institutional bases to promote the use of RE resources.
    - Establishing a "National Renewable Energy Agency" with a clear mandate and the necessary resources that will help give RE prominence at a national level.
        - The agency can be the central coordinating arm for all RE operational related matters.

    - Outlining management roles and responsibilities across institutions and agencies which are tied to the operations and objectives of the RE sector.

- To facilitate institutional capacity building by;
    - Coordinating and providing appropriate funding for training across key institutions (MEEI, MPU, MPD, RIC, EMA, T&TEC, RE installers and other local content and services) so as to maximize the use of resources.
- To create markets for and support the commercialization of RE by:
    - Articulating the type of incentive mechanism it intends to use for RE projects of different scales and technologies.
    - Engaging local financial institutions in RE finance to improve access to affordable finance.
    - Exploring opportunities for funding from international financial institutions.
- To undertake public awareness on RE by:
    - Developing a national strategy to educate citizens about the benefits of RE and GoRTT's plan for its integration.
    - Enlightening citizens about the opportunity for their participation in RE projects.
    - Updating citizens on the progress of RE integration towards meeting established targets.
- To undertake a limited rollout of commercial small scale/distributed RE by:
    - Facilitating commercial RE projects at the distributed scale to allow for the evaluation of operational and financial implications and testing of customer interest.

1. INTRODUCTION

Depleting fossil fuels, their volatile prices and concerns over climate change are among the global challenges that have raised awareness and prompted action, over the last four decades, towards the development of RE technologies and their integration into the electricity network. To date, many countries have successfully integrated renewable energy (RE) and have realized the associated benefits of carbon emissions reduction, energy security, economic growth, new employment opportunities and overall enhanced human welfare. Although Trinidad and Tobago produces the natural gas used for electricity generation in the country and does not face the price volatility for fossil fuel experienced by countries who import fuel at market prices, it has recognized that there are benefits of RE and has committed to integrating RE into its energy mix. Several years have now passed since the commitment was first made to integrate RE into the electricity sector by the Government of the Republic of Trinidad and Tobago (GoRTT) but, to date, there is minimal off grid and no commercial grid-connected RE electricity systems.

Within the Caribbean, many countries are further along the RE value chain than Trinidad and Tobago. The impetus for RE development has been greater for those Caribbean countries that are dependent on imported fossil fuels for electricity generation, because of balance of payments issues, and the higher relative prices, which their citizens pay for electricity. For countries, like Trinidad and Tobago, that produce and export fossil fuels, RE integration presents the opportunity to monetize those resources that are used in electricity generation, and thereby increase its foreign exchange earnings. While the drivers are present, there are critical barriers that have prevented the development of RE in Trinidad and Tobago.

In jurisdictions where RE integration has been successful, this has often been accredited to clear decision-making, a supportive regulatory environment, and a strong partnership between the public and private sector. As such, governments play an integral role in supporting the development of RE. Government targets for RE provide a high-level, important signal of commitment to citizens, investors and other stakeholders. Targets must however, be credible, well defined and supported by stable, long-term and reliable policies for a sustainable RE sector.

Overview of Renewable Energy Technologies

Renewable energy is energy from sources that are naturally replenishing. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time[1].While there are significant economic and social considerations for the development of RE sources, a major appeal of RE systems is that they produce less emissions than conventional energy sources. The major types of RE are defined in table 1 below.

Table 1: Renewable Energy Types and Definitions

Type	Definition
Solar energy	Solar energy is energy generated from the sun's heat or sunlight. Solar power is energy captured from the sun which is converted into electricity, or used to heat air, water, or other fluids.
Hydropower	Hydropower uses the force or energy of moving water for different purposes, including generation of electricity.
Bioenergy / Waste to Energy (WtE)	Bioenergy is derived from biomass to generate electricity and heat, or to produce liquid fuels for transport. Biomass is any organic matter of recently living plant or animal origin, such as agricultural products, forestry products, municipal and other waste.
Geothermal	Geothermal energy is stored as heat in the earth. This source of energy comprises residual heat from molten rocks deep within the Earth's core as well as radioactive decay of materials in the crust.
Ocean energy	Ocean energy is a term used to describe all forms of RE derived from the sea. There are two types of ocean energy: mechanical energy from tides and waves, and thermal energy from the sun's heat.
Wind energy	Wind energy is generated by converting wind currents into other forms of energy using wind turbines. Wind turbines convert the force of the wind into a torque (rotational force), which propels an electric generator to create electricity.

Source: Various sources

[1] U.S. Energy Information Administration (EIA)

Purpose of Document

The purpose of this paper is to explore what is required to create the conditions for the development and commercial implementation of RE technologies in the electricity sector in Trinidad and Tobago. It is hoped that this paper will provoke discussion, that will lead to action and the development of a viable and vibrant RE market in Trinidad and Tobago.

This paper presents some of the best practices in the development and deployment of commercial RE in the electricity sector of countries around the world. It examines stakeholder undertakings in RE integration in electricity sector of Trinidad and Tobago and discusses the apparent hindrances to RE integration in the country. It also presents the essential elements for the successful integration of RE into the electricity sector in Trinidad and Tobago.

Structure of Document

The rest of this document is structured as follows:

Section 2: Renewable Energy Integration Globally

Section 3: Renewable Energy in Trinidad and Tobago

Section 4: Barriers to Renewable Energy Integration in Trinidad and Tobago

Section 5: Enabling the Transition to Renewable Energy in Trinidad and Tobago

Responding to this Document

All persons wishing to comment on this document are invited to submit their comments.

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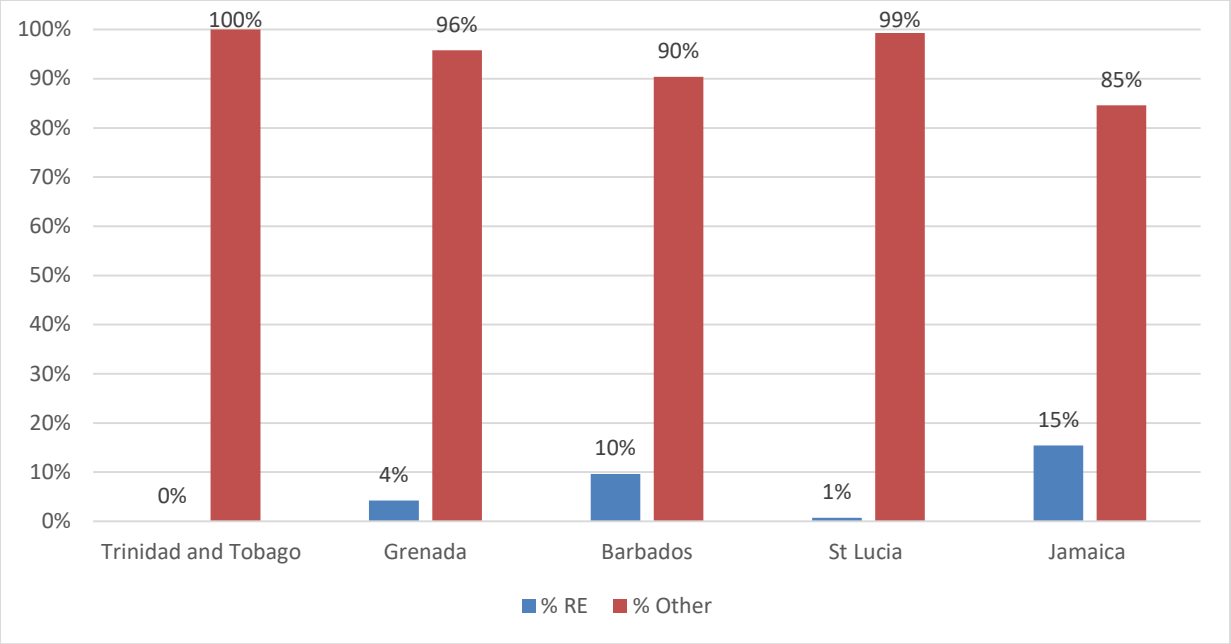
2. RENEWABLE ENERGY INTEGRATION GLOBALLY

Renewable energy has been successfully integrated into the electricity sector in many territories including some countries in the Caribbean, not chiefly to assist in meeting commitments of the Paris Accord[2], as other objectives such as energy security and diversification of energy sources have been prioritized. As a result of targeted efforts the global renewable share in electricity has increased from 18% in 2000 to 25% in 2018[3]. Compared to other sectors targeted for RE integration, the electricity sector is projected to have the fastest RE growth, providing almost 30% of power demand in 2023. During this period, renewables are forecast to meet more than 70% of global electricity generation growth, led by solar photovoltaic (PV) and followed by wind, hydropower, and bioenergy. Hydropower remains the largest renewable source, expected to meet 16% of global electricity demand by 2023, followed by wind (6%), solar PV (4%), and bioenergy (3%).[4]

There are wide variations in installed RE capacity in countries around the world. In countries like Germany and the United Kingdom (UK), RE accounted for 41.9%[5] and 33%[6] of generation capacity respectively in 2018. Countries like Costa Rica and Uruguay are further along and are almost 100%[7,8] powered by renewables, after less than 10 years of concerted effort. Within the Caribbean region, several countries have successfully integrated RE into their electricity grid. Figure 1 below shows that Jamaica is leading in the region with RE (wind, solar and hydro) plants accounting for 15% of net generation. The country has been actively working towards meeting targets for the development of RE sources, as outlined in its National Energy Policy, 2009-2030.

[2]At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal. The agreement sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C.
[3] International Renewable Energy Agency (IRENA), Global Energy Transformation- A Roadmap to 2050, 2019
[4] International Energy Agency, Renewables 2018 -Market analysis and forecast from 2018 to 2023, 2018
[5] Federal Ministry for Economic Affairs and Energy, Germany, 2018
[6] Department for Business, Energy & Industrial Strategy, United Kingdom, 2018
[7] Costa Rican Electricity Institute, 2018.
[8] Ministry of Industry, Energy and Mining, Uruguay, 2019.

Figure 1. RE Percentage of Net Generation Capacity



Source: Various Sources

For many years a major deterrent of RE integration into the electricity sector has been its high cost compared to that of generation from conventional sources of energy, but supportive policy for RE has resulted in reductions in RE generation costs. According to the International Renewable Energy Agency (IRENA), in its report titled Renewable Power Generation Costs in 2017, "Renewable power generation is currently benefitting from a virtuous cycle, in which policy support for renewable power generation technologies leads to accelerated deployment, technology improvements and cost reductions, with these then reducing the cost of electricity from renewable power generation technologies and encouraging greater uptake of these technologies". The importance of the right mix of supportive policies and thus government action, as driver of RE diffusion must, therefore, be underscored.

It is widely agreed that one of the most important stimuli for emerging industries is government leadership and for development of a RE industry, it is no different. Globally, national and subnational governments remain key players in establishing policies and targets in support of RE[9]. Governments have a critical role in supporting RE development by clearly articulating their vision

[9] IRENA, Renewable Energy Policies in a Time of Transition, 2018.

and policy position on RE and establishing targets for RE integration. While rapid RE deployment may be the main goal that is prioritized by government, additional objectives also guide government policy actions for the emerging RE sector. Some of the common goals outlined in a typical RE policy include:

- Greenhouse gas reduction;
- Peak shaving;
- Targeted distribution generation;
- Job creation and economic development;
- Minimisation of policy costs and rate payer impact;
- Innovation and early adoption of technologies;
- Community ownership; and
- Policy transparency.

The goals determine the policy choice and guide decision-making at various stages of RE development. Targets provide the signal to encourage investment and are the basis upon which support policies are built. As the transition evolves, a mix of targeted incentives is required to create an enabling environment for RE investment. At the development phase, supporting policies must focus on competency building and knowledge creation, while at the deployment phase the policies should focus on stimulating market development though fiscal policies, public financing and regulation. The responsibility to ensure that an appropriate legal, financial, regulatory and institutional framework is in place is also that of national governments. Undeniably there is a discernable role for private sector in the integration of RE into the electricity sector. However, the successful integration of RE will not happen without government supporting its development by creating an environment where risks are minimized and investors are confident in the process. Best practices in terms of government leadership and action in RE development and creating an enabling environment demonstrates the importance of the following for successful integration.

1. Development of national RE policy with a strategy and roadmap for RE Integration;

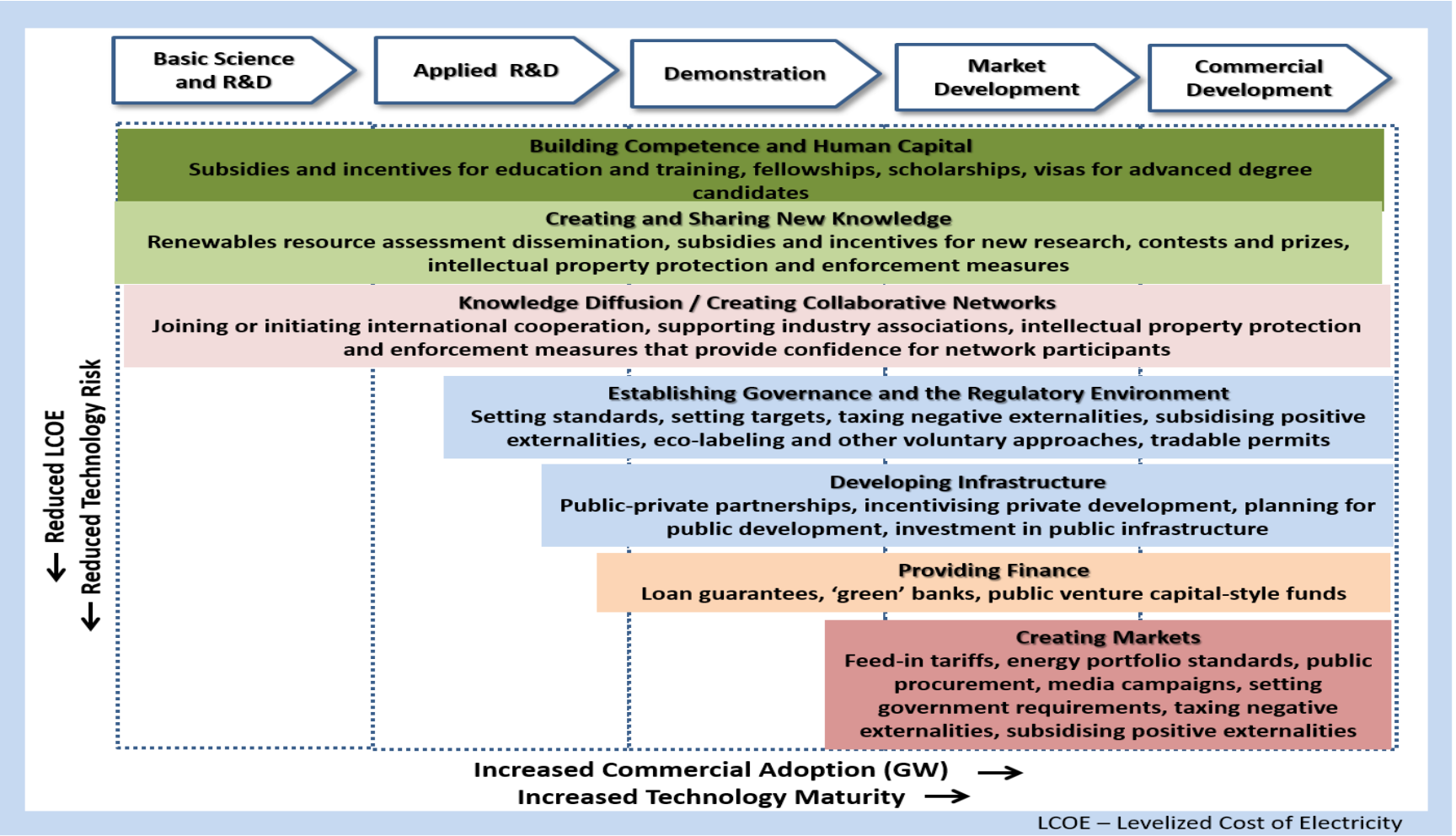
2. Development of competence and human capital in RE Technologies and the aptitude to facilitate its integration;
3. Assessment of RE resource potential and technical and economic feasibility;
4. Establishment of a legislative, institutional and regulatory framework;
5. Creating markets for / commercialization of RE; and
6. Development of a plan for information sharing and public awareness.

It is important to note also that government's policies and actions for RE development can vary depending on which aspect of the technology life cycle that it wants to impact upon as shown in figure 2, IRENA's guide for policies in the technology life cycle. Moreover, if these actions are properly done in the development of RE, they can result in both reduced levelised cost of energy (LOCE)[10] and technology risk and increased commercial adoption and technology maturity.

Renewable energy expansion needs to take place in a sustainable way, so deployment has to be undertaken in a holistic manner that takes into account the overall context, including, use of land for projects, financing for RE generators and cost recovery. A successful RE strategy requires an integrated approach across policy areas such as fiscal, energy, economic, as well as infrastructure development. This also includes an approach that spans different governance levels. It entails collaboration across government departments, as well as between all levels of society. Policy makers must therefore increase the coherence of their policy and planning and deepen the policy dialogue between stakeholders.

[10] The levelised cost of energy is a measure of a power source that allows comparison of different methods of electricity generation on a consistent basis. It is an economic assessment of the average total cost to build and operate a power-generating asset over its lifetime divided by the total energy output of the asset over that lifetime. The LCOE can also be regarded as the average minimum price at which electricity must be sold in order to break-even over the lifetime of the project.

Figure 2: IRENA's guide for policies in the technology life cycle



Source: IRENA, Remap 2030, A Renewable Energy Roadmap, Summary of findings

Critical Factors for the Successful Development of Renewable Energy

Development of a National RE Policy with a Strategy and Roadmap

The development of a national RE policy is often the first step towards achieving RE integration. It provides among other things the basis for the development of RE, establishes a formal target of the volume of RE to be integrated, outlines a roadmap and identifies key milestones necessary for implementation. Setting the RE target and outlining strategy for its achievement demonstrates political commitment. This may provide both stakeholders and the population with an understanding of the long-term vision for the jurisdiction as well as, a better understanding of how they can contribute to achieving the targets. For key stakeholders, government's policy and targets also catalyses change by providing an official mandate for action.

Workforce Development

Capacity-building and workforce development for renewables is another important exploit that is necessary for creating an enabling environment. The RE sector requires the development of knowledge and qualifications in new areas along the RE technology value chain. It also affects traditional work processes in government institutions and supporting enterprises involved. Capacity building for RE therefore relates to a broad ecosystem, including RE engineers and technicians, planners, lawyers, utilities, and even banks (commercial and development). To be effective, capacity development measures have to be defined in the context of an individual country, and their scope, content and intensity need to be suited to that particular country. The proper assessment of the existing and required capacities in a particular country can provide the different stakeholders in the RE sector with the orientation needed to plan and implement such measures in a balanced way.

Resource Assessment and Technical and Economic Feasibility

Renewable energy resource assessment is also critical to successful RE integration. Unavailability of high quality data on RE resource potential, limits the capability for informed policy development including, transmission network planning, and price regulation or incentives. It also

narrows the field of potential commercial developers, and raises the cost of undertaking preliminary site identification and financial analyses.[11]

The resource assessment identifies geographic areas with RE resources that are technically feasible. The intent is to estimate the achievable installed capacity and generation of a specific technology, based on, the topographic limitations, land use constraints, and system performance. Economic analyses further filter the study areas based on economic considerations such as the cost of generation. The information gained from the assessment guides government policy options and provides a basis for prudent RE investment.

Development of appropriate Institutional and Regulatory Framework

The development of an institutional and regulatory framework is critical because the quality of permitting procedures and regulations can significantly impact transaction cost for generators. The aim is to have transparency, clearly outlined procedures, legal consistency and clear division of responsibilities between approving and implementing agencies. In addition, explicitly specified and enforceable deadlines for approving agencies and RE developers must be established. The remit of key agencies must therefore be congruent with the designated policy, in order to provide the necessary enabling environment for the achievement of policy goals. Further, offtake agreements, licences, permits and markets rules are to be developed and the sequence of regulatory procedures need to be sufficiently detailed to help create a conducive regulatory environment for RE.

A number of models for institutional frameworks for RE integration have been utilized around the world. In some jurisdictions the RE agenda has been successfully led from within existing government ministries, while in others the RE agenda, sometimes combined with the energy efficiency (EE) agenda, has been led by newly created government agencies. In the case of the latter, these agencies are often created by special legislation and have the advantage of commonality of goals and functions within the organization. Other models for institutional frameworks for RE range from the establishment of an independent statutory authority to non-

[11] World Bank, Energy Sector Management Assistance Program, Assessing and Mapping Renewable Energy Resources,2016

governmental organizations (NGOs). Limited funding and the lack of authority to implement, are some of the challenges faced by NGOs leading the RE thrust.

While different models have been used successfully around the world, the trend seems to be moving away from broad-based agencies to the creation of singular agencies to lead the RE agenda and implement the appropriate policies and programmes. For effective institutional frameworks the desired characteristics of the RE agency are as follows:

- Ability to work collaboratively with multiple government agencies involved in RE implementation;
- Ability to leverage private sector participation in and resources for RE implementation; Involvement of multiple stakeholders;
- Independence and flexibility in decision-making;
- Ability to engage utilities and energy companies;
- Cooperation with energy regulatory agencies;
- Adequate resources, including staff and funding;
- Credibility with RE stakeholders; and
- Credible monitoring and evaluation plans.

Market Creation /Commercialization of RE

A key feature that determines the attractiveness of entry into a RE market is whether the RE plant will benefit from a long-term offtake agreement, with a guaranteed price for the duration of the agreement, thereby lowering the risk associated with the recovery of the investment. Only in advanced markets where RE technologies can be deployed at or below grid parity will the absence of this feature not represent a handicap for RE market development.

Policy mechanisms that have been used to improve economic attractiveness and incentivize investment in RE include Renewables Portfolio Standards (RPS), public tenders or auctions, feed-

in policies (FIP), net metering[12], net billing[13] policies, fiscal incentives and grants, mandates, emission standards, and technology standards. In the UK and in many US states, RPS have been used to encourage electricity producers to supply a certain minimum share of their electricity from designated renewable sources. With auctions, a government issues a call for tenders to install a certain capacity of RE in line with their RE deployment plans. Feed-in policies are long-term contracts that guarantee a minimum price per unit of electricity or a premium on top of the market price. In many countries, such as, Germany, Italy and Malaysia, FIP were used to stimulate decentralized private, small-and-medium scale and cooperative and community investments in renewable power capacity, while RPS tendering and auctioning procedures have been successfully applied for utility-scale investment.

Auctions are being increasingly adopted, given that they allow for a more market-driven price discovery. In 2016, auctions for solar PV, realized electricity prices equal to almost a fifth of what they were in 2010, reflecting developments in the sector.[14] In China, solar and wind auctions conducted in 2011 served as price-discovery mechanisms used to set the tariffs for FIP in various provinces[15]. Notably, however, the success of an auction in achieving policy deployment and development objectives relies on its design. This is also true for any other instrument and there is no one policy that can serve as the preferred policy in all contexts.

The choice of the policy instrument should depend on the specific country conditions, state of the energy market, technology, and desired objectives. In many contexts, auctions are used for large-scale projects and FIP for small-scale installations. Distributed generation can also be supported through net metering and net billing. However, careful consideration is needed to avoid

[12] A Net metering system meters (or measures) the energy customers generate for themselves via solar panels, wind turbines, etc., each billing cycle. Customers send excess electricity back to the utility and accumulate kWh credits when their solar panels generate more energy than home or businesses can use. Customers then get charged based on their net usage of kWh at the end of each billing cycle.

[13] Net billing allows green power users to offset their retail electricity purchases. Under a net billing system, customers can sell any excess energy they generate back to the utility company at pre-determined wholesale prices. Both consumption and generation are recorded and bill separately. As a result, customers get charged their full retail rate per kWh when they use energy from the grid, and are paid a wholesale price by their utility when they sell it back.

[14] IRENA, Renewable Energy Policies in a Time of Transition, 2018

[15] IRENA, 2013

jeopardising the system's cost recovery and to prevent cross-subsidisation among those customers who self-consume and those who do not.[16]

Information Sharing and Public Awareness

Implementing a RE strategy requires the participation of a variety of stakeholders, which makes both the breadth and the depth of awareness crucial to long-term success. Educating and informing the public as well as businesses facilitate the growth of public support and acceptance. Local opposition to energy infrastructure can be a major barrier to achieving targets RE, therefore educating citizens, fostering engagement, and improving public outreach must be a top priority for policy makers. Experience in the European Union and in many other jurisdictions around the world demonstrates that targets can also help build awareness, with the citizens as well as among external investors. This awareness can be essential to building public support among citizens and businesses to help to achieve local content objectives.

[16] IRENA, Renewable Energy Policies in a Time of Transition, 2018

3. RENEWABLE ENERGY IN TRINIDAD AND TOBAGO

3.1. Context

Sector Overview

In Trinidad and Tobago, electricity is supplied by a state owned and operated statutory utility, the Trinidad and Tobago Electricity Commission (T&TEC). Electrification coverage in Trinidad and Tobago is approximately 99.8% and T&TEC supplies electricity to customers on both islands via a single interconnected grid. At present, approximately 95% of the electricity supply is generated by three independent power producers (IPPs) [17], which provide generation capacity (MW) and supply energy (kWh) to T&TEC under the terms of Power Purchase Agreements[18] (PPAs). The remaining 5% is supplied by T&TEC's plants. Under the PPAs T&TEC is responsible for procuring all the fuel used to generate the electricity from the National Gas Company (NGC) of Trinidad and Tobago.[19]. Electricity generation in Trinidad and Tobago is fueled primarily by natural gas.

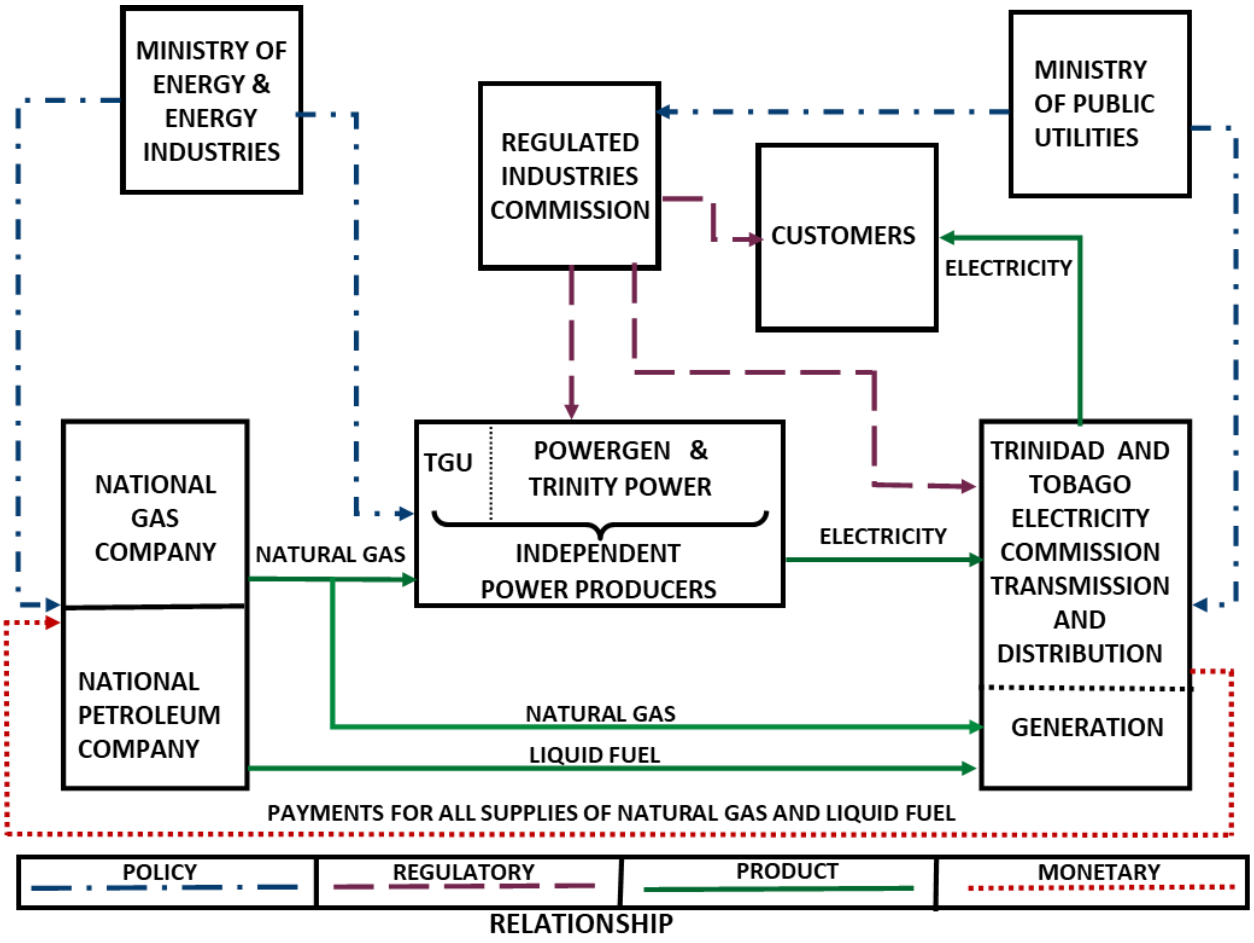
Institutional Arrangements

The two key ministries in the electricity sector are the Ministry of Public Utilities (MPU) and the Ministry of Energy and Energy Industries (MEEI). The MPU is responsible for policy formulation for the electricity sector and is currently the line ministry for T&TEC. The MEEI is currently responsible for electricity generation and also has responsibility for the policy direction of the NGC, the sole seller of natural gas to T&TEC for electricity generation.

The Regulated Industries Commission (RIC) is a statutory body and is responsible for economic regulation of the electricity sector. A major part of its responsibility as economic regulator of the electricity sector involves ensuring that T&TEC has sufficient revenue to fund its operations while maintaining a minimum level of service quality to its customers. The current structure and institutional relationships are shown in figure 3 below.

[17] Power Generation Company of Trinidad and Tobago Limited (Powered), Trinity Power Limited and Trinidad Generation Unlimited (TGU).
[18] PPA's are long-term contracts that specify the amount of electricity that is to be supplied to T&TEC, the price to be paid by T&TEC and the conditions of service.
[19] Approximately 8% of Trinidad and Tobago's natural gas production is used for electricity generation.

Figure 3: Institutional Structure for the Electricity Sector in Trinidad and Tobago



Governing Legislation

The two main pieces of legislation governing the electricity sector are the Trinidad and Tobago Electricity Commission Act, Chapter 54:70 and the Regulated Industries Commission Act, Chapter 54:73. Key requirements of these legal instruments and some which may affect the integration of RE into the existing framework are highlighted below.

- Trinidad and Tobago Electricity Commission Act, Chapter 54:70 *inter alia*:
    - Specifies a reporting and oversight role for the line Ministry;

- Specifies that the right to generate, transmit, distribute and sell energy in any part of Trinidad and Tobago for the public or any member thereof is vested in T&TEC;

- Specifies that T&TEC may, enter into a licence agreement with an approved generator of electricity permitting the approved generator of electricity the nonexclusive right to generate electricity;
- Specifies that T&TEC may, with the approval of the Minister, by Order declare a body corporate or firm to be an approved generator of electricity; and

- Does not distinguish between types (fossil fuel vs. RE) of approved generators.

- Regulated Industries Commission Act, Chapter 54:73 *inter alia*:

    - Specifies that the RIC may advise the Minister on matters relating to the operation of this Act, including the granting of licences;
    - Specifies that the Minister is responsible for granting licences (transmission and distribution and generation); and
    - Refers to service providers for the supply of electricity as "any entity, including a statutory authority or a company incorporated under the Companies Act, listed in the First Schedule". Also refers to "the Chairman or Chief Executive Officer of the service provider, and to large fines that would be detrimental to small generators.

Electricity Statistics for Trinidad and Tobago

Capacity, Generation and Sales

Thermal power plants essentially account for 100% of net generation in Trinidad and Tobago. In 2018, peak demand was 1319 MW. T&TEC currently has excess contracted capacity of approximately 388 MW. However, in terms of installed capacity, there is an excess of 600 MW.

Table 2: T&TEC's Capacity, Generation and Sales 2017& 2018

		2017	2018
Power Capacity (MW)	T&TEC – Fossil Fuel (derated[20])	75	95
	Contracted - Fossil Fuel (derated)	1632	1629
	Total Fossil Fuel	1707	1724
	T&TEC -Renewable	0.00640	0.00640
	Total Power Capacity	**1707**	**1724**
Net Generation (GWh)	Contracted	8992.2	8893.7
	Renewable	0.00663	0.0066
	Total Net Generation	**8992**	**8894**
Sales (GWh)	Commercial	1014	980
	Industrial	4488	4408
	Street Lighting	123	124
	Total Sales	**8565**	**8463**

Source: Trinidad and Tobago Electricity Commission

T&TEC sells electricity to different classes of customers, grouped into residential, commercial and industrial customer classes based on their demand characteristics. The total number of customer accounts were approximately 470,000 at the end of 2017, with residential customers accounting for the majority (90%) of the customer base, while the industrial and commercial customers accounted for the majority (52%) of the total electricity demand. Between 2017 and 2018 sales to both commercial and industrial customers decreased by 3.37% and 1.78% respectively, while sales to residential customers increased marginally by 0.41% over the same period.

[20] Derate: A decrease in the available capacity of an electric generating unit, commonly due to: • A system or equipment modification • Environmental, operational, or reliability considerations. Causes of generator capacity deratings include high cooling water temperatures, equipment degradation, and historical performance during peak demand periods.

Tariffs

Retail electricity prices have been stable and relatively low because the price for fuel has been set below market price, in long-term contracts between T&TEC and the National Gas Company. Electricity consumers are, as a result, not subject to volatility of fuel prices. Additionally, electricity customers have not experienced a rate adjustment since 2009.

3.2. Undertakings in RE Integration into the Electricity Sector

The Government of Trinidad and Tobago has publicly committed to the development of a national energy program that recognizes RE combined with EE *inter-alia*, as important strategies for the promotion of sustainable development of the nation. The aim is to manage natural resources in a more sustainable way by encouraging EE and to integrate RE into the energy mix.[21] Specific to the electricity sector, a commitment to diversify the energy mix has been made, with the establishment of a target of 10% (190 MW) of generated power, from RE by 2021 as part of the country's adoption of the Paris Accord.

To date, the MEEI has spearheaded Government's initiatives for RE development in the country. In January 2011, the Ministry of Energy published its "Framework for the development of a Renewable Energy Policy for Trinidad and Tobago". The document identified RE development as a strategy to achieve sustainable growth and development in Trinidad and Tobago. The framework outlined drivers and barriers to RE development in Trinidad and Tobago and the essential elements of RE Policy implementation including capacity building and awareness creation, enabling environment and institutional arrangements for policy implementation.

In September 2014, Cabinet appointed an Inter-Agency Committee to consider the development of a Feed in Tariff (FIT) Policy. The outcome of the Committee's work was a FIT Policy to support

[21] Ministry of Energy and Energy Industries, Framework for Development of a Renewable Energy Policy for Trinidad and Tobago, 2011

renewable electricity integration in Trinidad and Tobago. Some of the major areas addressed were as follows:

- Design of FIT rates;
- Classes of RE generators (dispatchable and non-dispatchable) (micro-installation, macro installation and mega installations);
- Connection obligation;
- Purchase obligation;
- Application and implementation procedures; and
- Funding for the feed in tariff policy.

Specific details regarding the funding of the feed in tariff and application procedures for the scheme are some of the issues that were to be addressed outside the policy. The policy also highlighted the regulatory and legislative changes that are needed to facilitate interconnection and a permitting regimes for small RE generation. However, the FIT policy has not been implemented and is currently under review.

GoRTT has since requested expressions of interest (EOI) for utility scale RE projects in August and December 2017, followed by requests for proposals (RFPs) for wind and solar and waste to energy (WtE) plants in 2018 and 2019 respectively. The close of the RFP for the wind and solar projects and the WtE plant are June 28th and August 30th, 2019 respectively.

In October 2018, a dedicated unit, the Renewable Energy Division, was formally established to attend to all RE matters at the MEEI. Other initiatives by GoRTT include a TTD 9 million allocation for RE development in its 2019 budget. The areas planned for development are recreational grounds (play parks and basketball courts) solar lighting, CARICOM Outreach/Awareness Programme, National Wind Resource Assessment and Solar LED Street Lighting[22].

[22] The Government of the Republic of Trinidad and Tobago, Public Sector Investment Programme 2019

Alongside the MEEI's activities other agencies have done work in the areas of capacity building and research and development. A summary of the major activities by the various agencies between 2011 and 2019 include:

- **Policy**
    - **Policy Framework**
        - MEEI, Feed in Tariff Policy, 2015.
        - RE Target of 10% (190 MW) of electricity generation by 2021, 2015[23].
        - MEEI, Renewable Energy Policy Framework, 2011.
    - **Operational/Implementation Policies**
        - MEEI, Request for Proposals (RFP) for the Supply of up to 10 MW of Electricity Generation from Waste to Energy Resources, 2019.
        - MEEI, Request for Proposals for Supply of between 3 MW and 130MW Solar and/or Wind, 2018.
        - T&TEC, Draft Wiring for Renewables – a guide for the wiring in installation of small photovoltaic systems, 2017.
- **Research and Development**
    - MEEI and the University of Trinidad and Tobago (UTT) Solar house, 2015.
    - Solar PV installations
        - 2.2kW Solar Energy Pilot Project at UTT's O'Meara Campus.
        - 2.2kW Solar Energy Pilot Project at TTEC's Mt. Hope.
- **Capacity Building**
    - MEEI, Establishment of a Renewable Energy Division, 2018.
    - University of the West Indies (UWI) Master of Science in Renewable Energy Technology programme, 2014.
    - Arthur Lok Jack Graduate School of Business, Masters in Business Administration in Sustainable Energy Management.
- **Demonstration**
    - T&TEC, 80 Solar Light-Emitting Diode (LEDs) in Manzanilla/Mayaro (after the Ortoire Bridge).

[23] The Government of the Republic of Trinidad and Tobago, Budget Statement,2015

- MEEI, Off-Grid Photovoltaic (PV) systems and solar stills in 21 secondary schools (1.4kW)
- MEEI, PV lighting for the exterior of 15 Community Centres.

The installed capacity for RE in Trinidad and Tobago is approximately 74 KW[24] (see table 3). The total installed capacity of off grid RE by private individuals is unknown, as there is no requirement for GoRTT to be notified.

Table 3: Installed RE capacity in Trinidad and Tobago

Agency	Installation	Capacity (KW)
MEEI/T&TEC	Solar Photovoltaic (PV) pilot at O'Meara (grid connected)	2
MEEI/T&TEC	Solar PV pilot at TTEC Mt. Hope (grid connected)	2
MEEI/UTT	Solar House energy pilot at University of Trinidad and Tobago Point Lisas Campus	2
MEEI	Combined solar and wind at the Islamic Home for Children in Gasparillo.	2.5
MPU	Provision of solar panels to households under the Utilities Assistance Programme	16
Savannah East (Private)	Solar PV system, Queens Park Savannah	20
MEEI	Solar PV systems and solar stills in 21 secondary schools (1.4kW)	29.4
	Total	**73.90**

Source MEEI and MPU

[24] Based on desktop research and data from MEEI and MPU

4. BARRIERS TO RE DEVELOPMENT IN TRINIDAD AND TOBAGO

The development and use of RE sources are still in their nascent stages despite the activities over the last 8 years towards RE integration in Trinidad and Tobago. The sluggish pace for RE integration in Trinidad and Tobago is indicative of impediments to realizing the established targets. Also, limited elements of a supportive policy framework have been enacted by GoRTT. Based on an assessment of the existence of critical success factors in Trinidad and Tobago, Table 4. summarizes analysis of barriers for utility scale and distributed scale RE technologies in Trinidad and Tobago.

Table 4: Barriers to Economically Viable Renewable Energy Technologies at the Utility and Distributed Scale.

Policy Barriers	
No RE policy	There is still no clear mandate for the development of RE in the country as there is no written policy outlining the rationale, strategy and execution plan for achieving set RE targets.
Subsidies for fossil fuel generation	The existence of subsides for fossil fuel for electricity generation make RE generation uncompetitive, thus there is little or no financial incentive to invest in RE.
Legal and Regulatory Barriers	
Limitations in current legislative framework	There is no legislative barrier for the development of utility scale RE projects, however, current legislation does not accommodate interconnection of small-scale RE installations.
Lack of permitting regime	There are no processes delineating how to develop RE sites and which agencies are responsible for granting permissions at the various stages.
Lack of clear rights to use a resource	The legal and regulatory framework does not outline clear processes for establishing the right to use renewable resources.
Inadequate regulatory framework	No rules have been developed to ensure good quality of service is provided at a reasonable cost from RE developers. A Regulatory body with the power and ability to effectively administer and enforce those rules has not been assigned the responsibility to develop such a framework.

Institutional Barriers	
Limited institutional capabilities and assignment of roles and responsibilities	There has not been a coordinated approach to institutional development in RE. Institutions involved in the sector lack adequate financial and human resources, and adequate skills in the RE field, including, policy makers, legislative drafters and technical expertise in assessing, installing, operating and maintaining, and inspecting projects. Roles and responsibilities across institutions and agencies have not been clearly delineated.
Commercial Barriers	
Lack of commercial viability for RE projects	A sectoral business model for the emerging RE sector has not been developed. No benchmarks for tariffs for RE generators of different scales have been established. Offtake agreements and tariffs that allow for reasonable rates of return to incentivize investment in RE plants at both the utility scale and distributed scale, are still to be determined.
Limited financing	Commercial banks and other financing agencies have not been sufficiently engaged to facilitate the availability of sufficient funding at terms that correctly reflect project risk.
Information Barriers	
Limited information on equipment availability	There is a lack of knowledge about the sufficiency of quality equipment at competitive prices.
Limited information and awareness	There is a lack of knowledge about the potential of RE in the country, the costs, benefits, and functioning of RE projects.

As such, there is a need for more concerted efforts to address the aforementioned barriers if there is to be the successful integration of RE into the electricity sector in Trinidad and Tobago.

5. ENABLING THE TRANSITION TO RENEWABLE ENERGY IN TRINIDAD AND TOBAGO

Policy support for RE is a key factor in accelerating RE deployment in the electricity sector. There are specific actions that will create an enabling environment for accelerated RE investment in the electricity sector of Trinidad and Tobago. Policy considerations for the legislative and regulatory framework, institutional development, commercialization of and funding for RE integration in Trinidad and Tobago are presented as follows.

Action 1: Establish clear Polices, Targets and Strategy for Implementation

In Trinidad and Tobago, no policies or strategies to develop the RE sector have been specifically enunciated and published. Until recently, when specific request for proposals documents were issued, it was unclear how GoRTT expected to meet the target for RE of 10% of generation by 2021. It is still unclear what role small and medium scale RE installations are expected to play to meet this target. GoRTT must also be cognizant that the Policy must clearly articulate its objectives and present a rationale for its course of action.

As part of its rationale, GoRTT must outline the drivers and benefits of RE development to the public, especially given the current situation of excess generation capacity. To support its rationale, GoRTT must also present clear evidence of the opportunity cost of natural gas used for electricity generation in Trinidad and Tobago to illustrate and demonstrate to the public the benefits to be derived from having such resources available for export. Notwithstanding efforts by various NGOs etc. in this regard, this must be done by GoRTT.

The absence of a full policy document effectively mapping the underlying institutional framework for RE and the broad plans to ensure that this framework is in place, creates uncertainty that can impact on the success of the current undertakings for RE projects by GoRTT. GoRTT therefore needs to clearly outline its strategy for RE development which should incorporate the following:

- Clearly articulated objectives for the policy and a rationale for its established targets, and a budgetary commitment.

- A comprehensive RE resource assessment:
    - Currently there is limited publicly accessible information about the potential of RE resources in the country. While it has been acknowledged that some of the more commercial areas of RE are applicable to the Caribbean region in general, there are no comprehensive resource-mapping studies done for any RE source in the country. To attract investors, therefore, there is a need for comprehensive mapping of all RE resources to produce bankable information.
- Its plan to harmonize prevailing generation and transmission plans with RE targets:
    - Consider the retirement age of existing generation fleet and forecasted demand patterns to show how it plans to avoid stranded assets[25].
    - Develop alternative energy mix/optimum energy mix.
    - Develop geographical installation target.
- Its strategy to ensure long term investment certainty for RE developers:
    - Strategy to minimize investment risk.
    - Incentive mechanisms and other support schemes.
    - Strategy to facilitate financing with commercial and other financing agencies.
- Its strategy to streamline administrative processes for RE applications.
- Actions to facilitate grid access to RE developers of different scales.
- Its strategy to facilitate the development of RE supply chain:
    - The Government's financial incentives for RE will provide greater market confidence about future deployment levels, helping to stimulate supply chain

[25] The International Energy Agency defines stranded assets as "those investments which have already been made but which, at some time prior to the end of their economic life (as assumed at the investment decision point), are no longer able to earn an economic return as a result of changes in the market and regulatory environment brought about by climate policy" (IEA, 2013, p. 98).

development. Action will be required, for example, developing certification and assessment of installers for small scale projects and testing of equipment.

- Its strategy to address market distortions favoring conventional sources:
    - In order for Trinidad and Tobago to eventually have a sustainable competitive RE sector, RE generation would need to be able to effectively compete with the local cost of fossil-fuel generation. Therefore, it is imperative that the cost of natural gas for electricity generation move towards market based prices, if GoRTT's vision for the RE sector is one of sustainability and efficiency. The phased approach that has recently been adopted to unwind subsidies in the transportation sector is an example of how fuel cost into electricity generation can be adjusted, to ensure market participants can adapt easily to the new environment. A phased approach may also help dampen the possible inflationary effects that can otherwise occur with a one-off movement in gas prices.

Action 2: Develop the Legislative, Regulatory and Institutional Framework for RE

Legislative review for the electricity sector has been ongoing for several years. Owing to inconsistencies and deficiencies in current legislation there is merit in the development of comprehensive RE legislation that should contain all the important provisions for RE deployment, inclusive of a clearly defined roles and responsibilities for all key agencies, inclusive of the regulatory bodies and the grid operator. A Renewable Energy Act for Trinidad and Tobago would seek to establish the legal, economic and institutional bases to promote the use of RE resources.[26]

The creation of a dedicated unit for RE matters at the MEEI is a positive signal of Government's commitment to the RE development. However, consideration should be given to the establishment of a "National Renewable Energy Agency" with a clear mandate and the necessary resources that will help give RE prominence at a national level. The agency can be tasked with mapping of RE

[26] Examples can be drawn from countries like Germany, The Gambia and Antigua and Barbuda in the region.

resources, managing an RE Fund, and establishment of entry mechanisms/ incentive schemes and permitting regimes for all scales of RE generation, in addition to other responsibilities. The agency can be the central coordinating arm for all RE operational related matters. In order to maximize the use of resources the agency can also be tasked with GORTT's EE agenda, as well as matters related to electric vehicles and energy storage.

Overall, it is important that clear management roles and responsibilities across institutions and agencies be identified since the commercial development of RE resources requires focused institutions and smooth bureaucratic application procedures. With respect to the former, organizations need clearly defined responsibilities which are tied to the operations and objectives of the RE sector. The institutional framework is also important because the integration of RE could potentially add another dimension to the relationship between the electricity utility and customer, where the latter becomes distributed generators. The envisioned roles and responsibilities of key agencies are outlined in table 5.

Table 5: Responsibility in RE development and Deployment

Entity	**Roles and Responsibilities**

Ministry of Energy and Energy Industries	• Develop and Publish RE policy/mandate:
	  ○ Vision.
	  ○ Rationale.
	  ○ Opportunity Cost Analysis.
	  ○ Targets of RE integration.
	• Lead development of RE Act.

"National Renewable Energy Agency" (proposed)	• Map RE resources and publish results.
	• Establish entry mechanisms/ incentive schemes and permitting regimes for all scales of RE generation.
	• Establish funding mechanism for RE.
	• Manage an RE Fund.
	  ○ Allocate funds R&D/ resource mapping.
	  ○ Allocate funds for capacity building.
	  ○ Allocate funds for payment to RE generators
	• Establish framework and rules for procurement of RE
	• Establish licensing and permitting framework for RE generators for utility scale and small scale generation

Entity	Roles and Responsibilities
	• Assist with the development of licence instruments and permits for RE generators for utility scale and small scale generation. • Public awareness campaign. • Be the repository of all information on RE.
Ministry of Public Utilities/Electrical Inspectorate	MPU: • Award of utility scale RE licences. • Arbitration of interconnection disputes in conjunction with regulatory body. Electrical Inspectorate: • Inspecting RE installations. • Enforcing safety and operating standards.
T&TEC – System planner, grid operator, Off-taker	• Variable renewable grid integration study. • Develop rules and codes for interconnection. • Outline procedure for interconnection. • Develop PPAs.
Regulation Industries Commission	• Develop licence instruments and permits for RE generators for utility scale and small scale generation. • Establish regulatory framework for RE generators, inclusive: o Advise on the award of utility scale licences. o Establish tariffs for small and medium RE generators. o - Approve rules and codes for interconnection.
Trinidad and Tobago Bureau of Standards	• Inspection, testing and certification of equipment.

Clear and simple administrative procedures (inclusive of appropriate regulations where necessary) for the award of licences required for the building and operation of RE systems of different scales are also critical and need to be developed. The necessary legislative amendments to the T&TEC and RIC Act must also be undertaken to accommodate grid interconnection and suitable permitting

regimes for RE generators. To facilitate waste to energy plants laws that dictate the separation of waste may need to be developed.

Action 3: Institutional Capacity Building

Capacity building is critical to the success of RE integration. Understanding of RE resources and technologies and their commercial application in Trinidad and Tobago is critical. Capacity building is necessary at all stages of RE development for the various actors including policy makers (MEEI, MPU, MPD[27]), regulators (RIC, EMA[28]), utility engineers (T&TEC) and RE installers and other local content and services. Specific training may be required in planning for the commercial integration of RE and operating and integrating generation from intermittent sources. Further RE comprises various technologies and applications, therefore, it is essential to facilitate development of appropriate skills and local capacities across the various technologies for success in Trinidad and Tobago. The "National Renewable Energy Agency", once established, can be responsible for coordinating training across key entities, so as to maximize the use of resources.

Action: 4 Creating Markets for /Commercialization of RE

To date, the GoRTT has not signaled its intention to facilitate a market for small and medium scale RE by publicly stating the intended policy or pricing mechanism and permitting regimes that it intends to utilize to incentivize such installations. For utility scale RE projects GoRTT has solicited proposals through a bidding process without mapping resources and fully establishing a licensing and regulatory framework. The absence of these elements which are key policy and regulatory cornerstones can result in an undeveloped or under-developed or unsustainable RE market, where in the case of the latter, off takers are locked into contracts with detrimental terms.

To signal its commitment, the Government should articulate the type of incentive mechanism[29] it intends to use for different scale RE projects, technologies it intends to promote and the funding means. There is merit in incentivizing deployment of both small to medium scale RE installations

[27] Ministry of Planning and Development
[28] Environmental Management Authority of Trinidad and Tobago
[29] The specific incentive mechanisms referred to here are the implementation instruments to enforce GORTT's plans inclusive of feed-in tariffs, fiscal incentives and any other appropriate subsidies.

and utility scales. The policy mechanism for incentivizing RE investment in all RE projects should facilitate a "buy all" arrangement between the appointed off-taker and all RE producers and use levelised cost in computing tariffs for generators. The policy mechanism should also allow for a reasonable payback period and a reasonable rate of return on investment. Auctions can be used to achieved the aforementioned for utility scale and a feed-in tariff policy can be used to incentivize small and medium-scale RE projects. Despite the recent auction process for utility scale and ongoing discussions to finalize a FIT Policy, these mechanisms require a broader framework to be established in order for intended outcomes to materialize.

A scheme, that is managed by the "National Renewable Energy Agency" or other Government entity, can be developed to build a Fund for the RE agenda by applying a "minimal charge" on the bills of utility customers. The charge should be proportionate to electricity consumption to encourage more efficient use of electricity, thus supporting the EE agenda. The fund can be disbursed to cover costs including, payments for RE generators, costs associated with capacity building initiatives and also to fund the "Renewable Energy Agency". This charge can be displayed as a "RE" line item on customer bills as it makes the costs associated with RE rollout fully transparent.

In terms of unlocking RE investment, GoRTT will need to engage local financial institutions in RE finance, to improve access to affordable finance. GoRTT can provide technical assistance on RE to local institutions to help increase the availability of financing for developers and reduce the local banks' risk. Further, making the RE sector a priority lending sector can allow for an increased lending cap and preferential interest rates for RE projects in Trinidad and Tobago. GoRTT must also explore opportunities for funding from international financial institutions, which include global and regional multilateral development banks that provide funds, financing instruments and risk mitigation instruments and from development financial institutions[30] (DFIs).

[30] Development Finance Institutions (DFIs) include most of the international financial institutions and in addition encompass bilateral development agencies, such as the AFD (the French Development Agency), KfW (the German Development Bank) and JICA (the Japanese International Cooperation Agency).

Action 5: Public Awareness/ RE Information Sharing

There is a need to develop a national strategy to raise awareness and boost understanding of RE sources and their benefits to the country and its citizens. As part of knowledge sharing for RE, assessment data should be disseminated to key stakeholders and the public at large. The GoRTT should undertake a comprehensive public awareness and engagement campaign aimed at all levels of society. The objective should be to educate people about the benefits of RE and GoRTT's plan for its integration since the public is neither fully informed nor well engaged.

Local institutions and citizens must also be enlightened about the opportunity for their participation in RE projects. Information, including cost and energy output attained from demonstration plants and/or commercial applications, should be publicly disseminated to encourage RE uptake. To support the public awareness initiative, GoRTT should establish a RE database that collates information on RE at a project level as well as aggregated data. GORTT should provide timely updates to stakeholders and the wider population on the progress of RE integration towards meeting established targets. These activities can also be undertaken by the" National Renewable Energy Agency" if such an organization is established.

Action 6: Limited Rollout of Commercial Small Scale/Distributed RE

Although it has not been fully explored for the country, there are great benefits to be derived and possibly great potential for distributed RE generation and this should be implemented as soon as feasible, to allow citizens to participate in the RE sector and to improve understanding and awareness of RE among citizens. There is need for action which supports the transitional phase between the demonstration and commercialization of small scale, distributed RE in the country. GoRTT should facilitate a limited rollout of commercial RE projects at the distributed scale. This project should be managed by the "National Renewable Energy Agency". The project would allow the "Agency" to evaluate operational and financial implications and test customer interest. It will also provide time to prepare for broader uptake.