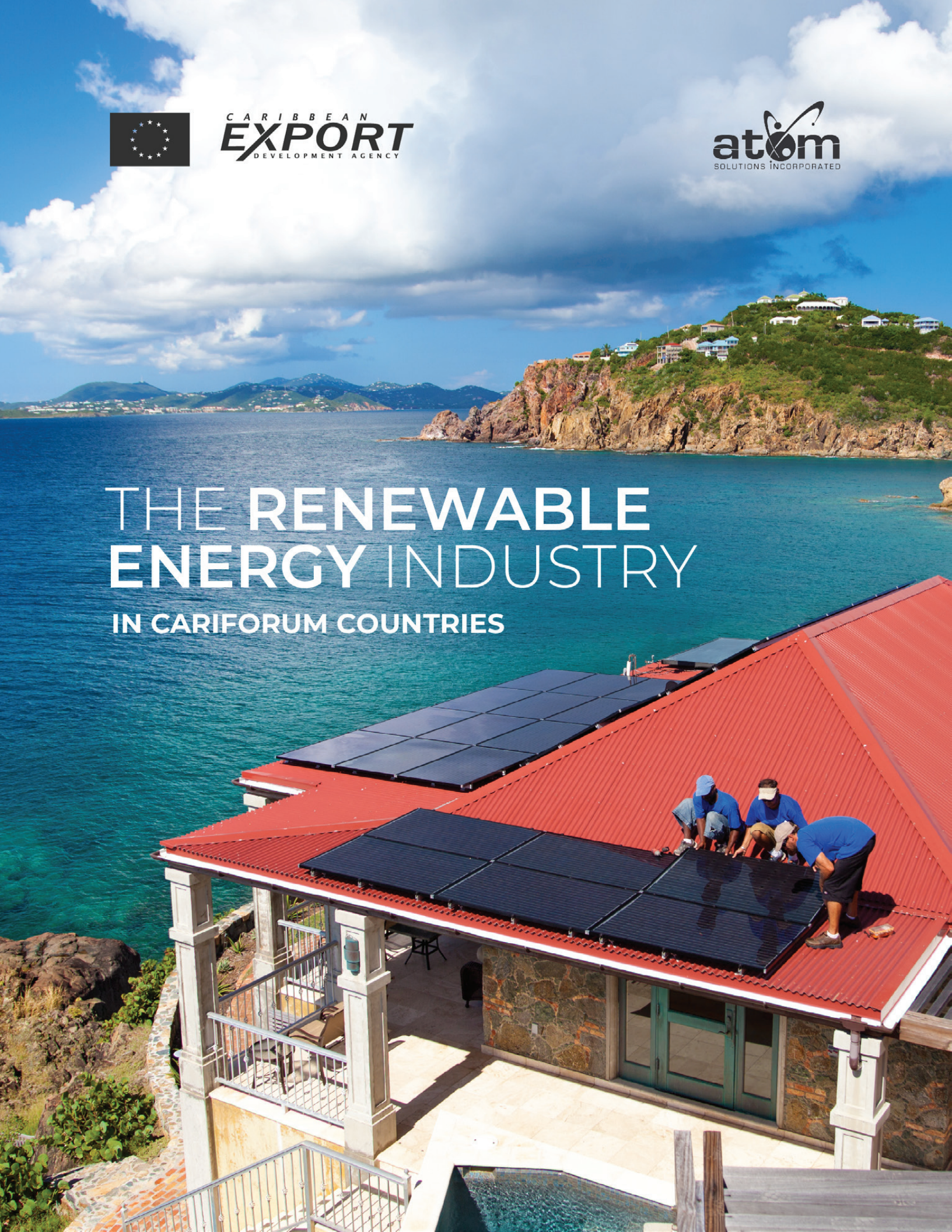
CARIBBEAN
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SOLUTIONS INCORPORATED
THE RENEWABLE ENERGY INDUSTRY
IN CARIFORUM COUNTRIES

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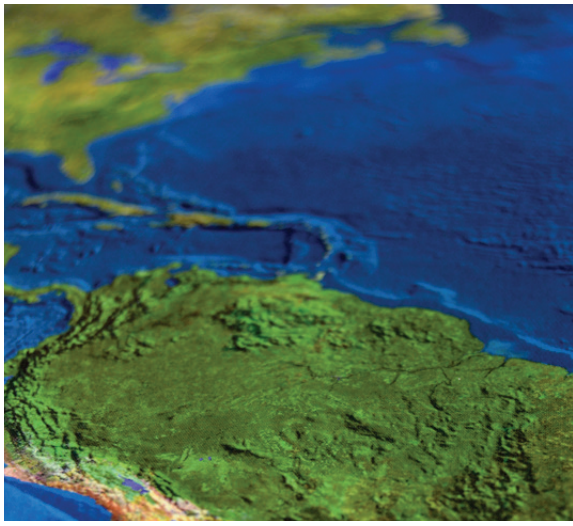

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# **EXECUTIVE** SUMMARY

This study provides a comprehensive mapping of the renewable energy (RE) industries in the CARIFORUM region. Accordingly, it will determine the status of key industry variables which are of interest to the Caribbean Export Development Agency (Caribbean Export). It comes after the 2013 CARICOM Energy Policy (CEP) and the Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS) which recommended regional sustainable energy targets for RE and energy efficiency (EE).

Along with other studies, these two documents focused primarily on the regional level. Additionally, most national governments have also developed policy documents and some have completed road maps, but neither of these addressed the entire local RE industries. In many cases, national studies focused on a single area.

This assignment covers all the stakeholder groups across 15 CARIFORUM countries including Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines, Suriname and Trinidad and Tobago. Caribbean Export's rationale for this study is based on their mandate to improve the competitiveness of micro, small and medium sized enterprises (MSME) in CARIFORUM. While the Caribbean Export approach is different, their approach is in sync with the global, regional and national approaches.

The methodology utilized desk research, survey instruments and group meetings. Stakeholder assessments were performed at the country level first in order to understand the dynamics of the local RE industry and the relationships which may or may not exist between stakeholders. Institutions which operate regionally were also considered. Apart from the Dominican Republic, all the countries included in the study are member states of CARICOM which qualifies them for assistance from its agencies. Some of these regional institutions which administer international funds also include the Dominican Republic; like Caribbean Export and the CARICOM Regional Organisation for Standards and Quality (CROSQ).

A working definition of the RE Industry includes both RE and EE. The CEP and C-SERMS reference these two areas extensively and while separate targets are set, they are treated with the same urgency and always collectively. The relationships in the RE industry drive the activities between stakeholders and influence the sustainability of that industry. The research found that all these relationships require strengthening with the greatest effort required for financial institutions in every country, followed by the effort required for higher education institutions. The best relationships were observed with the donor agencies and the regional institutions. Antigua, Barbados and Jamaica are the only countries whose stakeholder relationships are delivering most of their mandates. The Bahamas, Suriname and Trinidad and Tobago are currently delivering the least, with the others ranging from between 28% to 48% of their mandates. As expected, the late starters and those with few committed resources have delivered the least while the first movers have delivered the most.

While the influence of foreign firms on the regional RE installation market is minimal, it has been observed that the largest of these firms (not registered in the region), tend to pursue RE and EE consultancies and studies for governments, regional and multilateral institutions. The average age of regional firms is about 12 years old and have an average staff complement of approximately 12. This represents a lack of capacity based on the national demands. They offer services in RE systems design and installation, energy auditing, energy service companies (ESCOs), energy consulting services, RE and EE product manufacturing, solar water heating (assembly, sales and installation), energy equipment and efficient appliances retailing. Regionally, about 150 active RE firms exist alongside the local utilities which are mostly state owned. They all operate in different regulatory environments that support varying levels of liberalization. With about 1.5GW RE capacity installed regionally (15% of total generation capacity), there is still over 8GW to be replaced along with storage to handle the intermittent nature of most renewables. The better estimates suggest that between US$50 Billion to US$60 billion is required to complete the transformation.

In seeking to execute energy plans, countries tend to access the same capital and insurance markets given the common banks and insurance companies that exist there. The region needs to mobilize an estimated US$6 billion annually but the national requirements will depend on the energy road map established for each country. Those focused on large independent power producer (IPP) utility scale implementations will depend heavily on financing from multilaterals and international funding agencies along with direct investment from local and foreign investors and less on local financial institutions. Those focused on all-scale generation will depend less on financing from multilaterals and international funding agencies and more on direct investment with a greater focus on local financial institutions. Financing agencies and institutions provide financial assistance in the form of grants, low interest loans, equity financing, blended financing and other variations. While many are multilateral institutions, there are also regional and local development banks which also operate.

The demand for RE and EE products and services are significant in all the countries in this study. Given the fluidity of the market status which depends on the regulatory frameworks, it is difficult to quantify the real opportunity beyond what is mathematically required. However, RECs in some territories have seized the opportunities to export their RE and EE products and services while other territories simply have no capacity to pursue external opportunities.

Nationally capacity building and awareness campaigning is paramount, alongside regional technical capacity and cooperation. Sectoral development and execution among sectors with strong economic linkages with the RE Industry is also recommended; the main one being tourism but depending on the dominant local economic activity in each country.

As emphasized in most studies, creating that enabling environment remains a priority for all countries. Working together as a region is key as well and should continue to be promoted by the regional institutions in the sustainable energy space so that appropriate solutions may be developed and shared.

## **LIST OF** ACRONYMS

| ACRONYM | DEFINITION |
|---|---|
| **AdekUS** | **Anton de Kom University of Suriname** |
| AE | Accredited Entity |
| **AUC** | **American University of the Caribbean** |
| BCC | Barbados Community College |
| **BECOL** | **Belize Electric Company Limited** |
| BEL | Belize Electricity Limited |
| **BELCOGEN** | **Belize Co-generation Energy Limited** |
| BEPI | Barbados Energy Professionals Incorporated |
| **BPL** | **Bahamas Power and Light (BPL)** |
| BREA | Barbados Renewable Energy Association |
| **CARDI** | **Caribbean Agricultural Research and Development Institute** |
| CARILEC | Caribbean Electric Utility Services Corporation |
| **CCCCC or 5Cs** | **Caribbean Community Climate Change Centre** |
| CCREEE | Caribbean Centre for Renewable Energy and Energy Efficiency |
| **CDB** | **Caribbean Development Bank** |
| CDF | CARICOM Development Fund |
| **CDM** | **Clean Development Mechanism** |
| CFBC | Clarence Fitzroy Bryant College |
| **CHCL** | **Campus Henry Christophe de l'Universite d'Etat d'Haiti a Limonade** |
| CHENACT | Caribbean Hotel Energy Efficiency Action Programme |
| **CNE** | **National Energy Commission** |
| CRAF | Credit Risk Abatement Facility |
| **CROSQ** | **CARICOM Regional Organisation for Standards and Quality** |
| CSME | CARICOM Single Market and Economy |
| **CTO** | **Caribbean Tourism Organization** |
| DFC | Development Finance Corporation |
| **DNA** | **Designated National Authority** |
| DOMLEC | Dominica Electricity Service Limited |
| **DSM** | **Demand Side Management** |
| EIB | European Investment Bank |
| **ESDF** | **Energy and Sustainable Development Fair** |
| ESIH | Ecole Superieure d'Infotronique d'Haiti |
| **EU** | **European Union** |
| FA | Funding Agencies |
| **FI** | **Financial Institutions** |
| FIT | Feed In Tariff |
| **FTC** | **Fair Trading Commission** |
| GBPC | Grand Bahama Power Company |

| ACRONYM | DEFINITION |
|---|---|
| **GCF** | **Green Climate Fund** |
| GEF | Global Environment Facility |
| **GEI** | **Government Electrical Inspectorate** |
| GHG | Greenhouse Gas |
| **GIZ** | **Deutsche Gesellschaft für Internationale Zusammenarbeit** |
| GM | Government Ministries |
| **GPL** | **Guyana Power and Light Incorporated** |
| GRENLEC | Grenada Electricity Services Limited |
| **GTI** | **Government Technical Institute** |
| HEART-NTA | Human Employment and Resource Training Trust -National Training Authority |
| **HEI** | **Higher Education Institutions** |
| IDB | Inter-American Development Bank |
| **INTEC** | **Instituto Tecnologico de Santo Domingo** |
| IPP | Independent Power Producers |
| **IRC** | **Independent Regulatory Commission** |
| IRENA | International Renewable Energy Agency |
| **IRP** | **Integrated Resource Plans** |
| JPS | Jamaica Public Service Company Limited |
| **LEED** | **Leadership in Energy and Environmental Design** |
| MAPS | Mainstreaming, Acceleration, and Policy Support |
| **MDB** | **Multilateral Development Banks** |
| MoU | Memorandum of Understanding |
| **NABCEP** | **North American Board of Certified Energy Practitioners** |
| NCR | Normal Customer Rate |
| **NDC** | **Nationally Determined Contributions** |
| NETS | National Energy Transition Strategy |
| **NGO** | **Non-Governmental Organizations** |
| PAHO | Pan American Health Organization |
| **PMU** | **Project Management Unit** |
| PP | Payback Period |
| **PPA** | **Power Purchase Agreements** |
| PSI | Private Sector Institutions |
| **PTB** | **Physikalisch-Technische Bundesanstalt** |
| PTC | Polytechnic College Suriname |
| **PUC** | **Public Utility Commission** |
| PURC | Public Utilities Regulatory Commission |
| **PV** | **Photo Voltaic** |

| ACRONYM | DEFINITION |
|---|---|
| R&D | Research and Development |
| **REC** | **Renewable Energy Companies** |
| REET | Renewable Energy Engineering Technology |
| **REETA** | **Renewable Energy and Energy Efficiency Technical Assistance** |
| RFP | Request for Proposals |
| **RI** | **Regional Institutions** |
| RIC | Regulated Industries Commission |
| **RMI** | **Rocky Mountain Institute** |
| SALCC | Sir Arthur Lewis Community College (SALCC) |
| **SDG** | **Sustainable Development Goals** |
| SEA | Suriname Energy Authority |
| **SGF** | **Small Grants Fund** |
| SGU | St. George's University |
| **SIDS** | **Small Island Developing States** |
| SJPI | Samuel Jackman Prescod Institute of Technology |
| **SPACC** | **Special Programme on Adaptation to Climate Change** |
| SVGCC | St. Vincent and the Grenadines Community College |
| **SWRO** | **Saltwater Reverse Osmosis** |
| TAC | Technical Advisory Committee |
| **TAMCC** | **T. A. Marryshow Community College** |
| TAPSEC | The Technical Assistance Programme for Sustainable Energy in the Caribbean |
| **UB** | **University of Belize** |
| UG | University of Guyana |
| **UNASAT** | **University of Applied Science and Technology Suriname** |
| UNDP | United Nations Development Program |
| **UNFCCC** | **United Nations Framework Convention on Climate Change** |
| UNIDO | United Nations Industrial Development Organization |
| **UR** | **Utilities Regulator** |
| URCA | Utilities Regulation and Competition Authority |
| **UTECH** | **University of Technology** |
| UTT | University of Trinidad and Tobago |
| **UWICHL** | **University of the West Indies, Cave Hill** |
| UWIMON | University of the West Indies, Mona |
| **UWISTA** | **University of the West Indies, St. Augustine** |
| WtE | Waste to Energy |

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**RENEWABLE ENERGY INDSUTRY**
MAPPING STUDY

# 1.0 | INTRODUCTION

## 1.1 | BACKGROUND

The CARIFORUM region is faced with several threats stemming from the high cost of electricity, in many cases the importation of foreign sources of energy and the impacts of climate change. This has led to an increased cost of doing business and reduced competitiveness amongst many small and medium-sized businesses in the CARIFORUM region. As a result, some interventions are necessary to cope and advance the countries' Sustainable Development Goals (SDG) as set by the United Nations General Assembly in 2015 for the year 2030 (UN, 2015) and incorporated into the national development strategies of CARIFORUM countries. The SDGs are part of Resolution 70/1 of the United Nations General Assembly, the 2030 Agenda.

A significant investment of financial and other resources is required to fund the work that is necessary to transform the energy sector. Unfortunately, the Caribbean Community (CARICOM) Member States already struggle with their individual economic challenges which are often exacerbated by energy challenges. The deployment of the less expensive energy efficiency (EE) measures requires additional support from the utilization of indigenous renewable energy (RE) sources which may further lower the cost of doing business in this region.

Their utilization of indigenous sources of energy removes the international logistics involved in traditional supply, the requirement for foreign exchange and the volatility of fuel prices. It creates a more cost-controlled local environment in which energy generators operate. Whilst mitigating the macro-economic challenges relating to energy dependency, the utilization of indigenous energy sources also provides opportunities for employment and additional value chain activity related to production, delivery and generation. This would therefore contribute positively to economic growth.

## 1.2 | OBJECTIVES

This study provides a comprehensive mapping of the RE industries in the CARIFORUM region. Accordingly, it will determine the status of key industry variables which are of interest to the Caribbean Export Development Agency (Caribbean Export). In developing the required RE industry mapping, it will: -

1. **Define** and size the RE industry in CARIFORUM by country.

2. **Identify** the primary activities of private and public sector actors involved in the RE industry in CARIFORUM by country.

3. **Classify** the types of firms involved in the RE industry in CARIFORUM (e.g. origins of their technological innovations and determinants of competitive advantage) and their relative concentrations by country.

4. **Prepare** a comprehensive list of: -
   - Registered firms in the renewable energy industry in CARIFORUM countries.
   - Industry associations and government ministries competent authorities etc. along with key contacts.

5. **Present** RE industry market structures (e.g. degrees of liberalization, structure of competition) by country.

6. **Map** the economic linkages of the RE industry to the broader energy sector and other economic sectors.

7. **Define** capital and insurance markets in CARIFORUM by country, and assess their adequacy.

8. **Classify** types of exports, identify export markets and export volumes by country.

9. **Provide** graphical and cartographic representation of the spatial distribution of the RE industry across the geography of CARIFORUM with respect to the deliverables.

*Their utilization of indigenous sources of energy removes the international logistics involved in traditional supply, the requirement for foreign exchange and the volatility of fuel prices.*

## 1.3 | DESCRIPTION

The project seeks to execute a critical piece of research which is very necessary for the region to execute its energy transformation plans. While the territories in CARIFORUM understand the importance of implementing RE technologies, they lack the resources to transition their energy sources in a short timeframe. Unfortunately, some also lack the technical know-how but have proceeded anyway to put their best effort forward. All responses are admirable but vary in their effectiveness given their unique local circumstances. The net result is a fragmented RE sector and limited returns for invested resources.

Even with available resources from institutions like the Inter-American Development Bank (IDB) and the Green Climate Fund (GCF), it is difficult to focus the required efforts and intervention in the correct areas due to the industry's fragmentation and general lack of a clear understanding of the state of the industry.

This study will provide a clearer picture of the state of the RE Industry and allow the mobilized resources to be effectively deployed in the priority areas. Responses are expected to vary by country given their different stages of implementation. E.g. countries like Trinidad and Tobago which have an abundance of petroleum products and cheap energy, Suriname and Belize which have a significant percentage of RE but still suffer from high energy rates.

Not only will the study highlight what is required and where, it will also create an opportunity for sharing and cross-pollination of strategies within the CARIFORUM region. Hopefully this will lead to the growth of an indigenous RE industry, better energy security, lower energy rates, a positive emissions impact and an ease in foreign exchange pressures. Ultimately, we hope for more competitive and productive businesses in CARIFORUM.

## 1.4 | LITERATURE REVIEW

In order to establish the context of the study commissioned by Caribbean Export, an examination of the relevant existing literature was carried out. A key overarching document is the CARICOM Energy Policy (CEP) which took a decade to be realised, finally being approved in 2013 (CARICOM, 2013). During this process the policy sought to examine several critical areas in the energy sector including: -

- CARICOM energy trends
- A survey of energy generation in the region
- The existing regulatory frameworks
- The impacts of fossil fuel imports on the region's economies
- Member State concerns

The document presents the trends, energy generation profiles and the inadequacies in the regulatory frameworks across the region. It further recognized the dependence on imported fossil fuels within the region and the significant macro-economic impact this has had on the economies of the fuel importing countries (all except Trinidad and Tobago). The energy imports bill compared to total imports reflected an increase from previous years and this was deemed harmful to the macroeconomic sustainability of these economies. For Jamaica and Guyana with a larger industrial base, these imports represented between 40% and 60% of their total export earnings while for tourism and services-

oriented economies like Belize, Grenada, St. Lucia and Barbados, petroleum imports represented between 13% and 30% of export earnings.

In order to address the concerns of the Member States, the CEP set out some key objectives including:

- Accelerated deployment of renewable and clean sources of energy supplies towards increased energy supply diversification and affordability.
- Increased energy efficiency and conservation in all sectors.
- Increased investment in production, transformation and distribution of viable energy sources.
- Strengthening and enhancement of the human and institutional capacities in the regional energy sectors.
- A coordinated approach to exploring and establishing an institutional framework for leveraging financing mechanisms for the development of viable energy resources
- Established regional and national targets for emissions reduction with corresponding mitigation actions
- Strengthened research, development and innovation efforts in the energy sector especially in areas of clean and renewable energy sources and technologies

The document did not adequately address the concerns of Energy Pricing in CARICOM States and this led to the commissioning of an additional study to do that instead of further delaying the CEP adoption. The key issue addressed was pricing with respect to non-discrimination and national treatment under the Revised Treaty of Chaguaramas. As critical as the policy and these subsequent studies were to the national approaches of the Member States, they did not extend their reach into the makeup of the national RE Industries in any specific way.

The CEP was subsequently supported by the **Caribbean Sustainable Energy Roadmap and Strategy (C-SERMS)** after the recognition that "a regional sustainable energy roadmap was required to guide, encourage and expedite the increased use of renewable energy and energy efficiency"[1]. It was developed under the CARICOM Energy Programme in collaboration with CARICOM Member States and other partners to assist with sustainable energy planning, management and implementation frameworks, as well as a communication tool (CARICOM, 2015). It focused on building on existing efforts in the region and providing Member States with a coherent strategy for transitioning to sustainable energy. The document recommended regional sustainable energy targets for renewable energy and energy efficiency in the short (20% RE by 2017), medium (28%RE by 2022), and long (47% RE by 2027) terms. A 33% reduction in energy intensity was proposed by 2027 based on observed global uptake of energy efficiency measures.

The document reported that there was broad consensus that a regional energy approach was needed to achieve the set C-SERMS targets, since this would encourage greater commitment from national governments. As dictated by the CEP, the Energy Roadmap focused on improving energy efficiency and increasing the use of renewable energy by paying closer attention to planning and communicating priorities and policy goals, and for identifying strategies to overcome the various technical and non-technical barriers that limit RE and EE deployment. Though very useful, it was not intended to address specific issues within the national RE industries even though there would be clear support and benefit to all involved in RE.

Equally of importance is the report produced by the **Task Force on US Caribbean and Central American Energy Security** (USA, 2016). The

1 | CARICOM Energy Policy, Pg. 14

history of US Caribbean cooperation is extensive and includes technical assistance in governance, the implementation of cleaner energy, capacity-building, workforce development, support for innovative approaches to low-carbon economic growth and nationally oriented programs focusing on specific in-country opportunities. The task force document references the Caribbean Energy Security Initiative (CESI) which seeks to enhance governance, improve access to energy finance, and increase donor coordination. Its programs are intended to support and complement the regional policy and strategy for sustainable energy, through the C-SERMS platform and the Caribbean Centre for Renewable Energy and Energy Efficiency (CCREEE) which is designed to address the implementation deficit in executing RE and EE projects and activities within CARICOM. This joint task force was also intended to provide a forum for the collaborative identification of challenges and opportunities for energy diversification, clean energy investment, regional energy cooperation and integration.

Efforts were also focused on evaluating the scope for regional energy cooperation and identifying approaches to advance energy sector reform and integration within the respective countries. Specific areas include energy security, access to energy, human and economic development, and environmental and climate goals. These benefit from and contribute to sustainable, modern, clean and diversified energy sectors. While not ignoring local opportunities, the work of the task force was pitched at the regional level.

Under the IDB climate change evaluation project, a study was conducted on the development of the RE markets in Latin America and the Caribbean. While it did not focus on the Caribbean alone, the study did present the barriers to the advancement of RE and the opportunities to overcome them. Also highlighted was the Caribbean's vulnerability to climate change, and adaptation strategies which may be applicable to the energy generation sector. Even though not seen as the only source of financing for the sector, multilateral development banks are seen as very important in the support of RE development from the point of view of funding projects, and also playing a role in developing potential public-private partnerships and de-risking projects which might otherwise not be attempted. The study did not look at the RE industry or the RE businesses which operate in the context of the local energy sector.

Collectively, there is a significant amount of critical work that has been done regionally but little at the national level. Most governments have developed a policy document and very few have completed road maps, neither of which address the RE industry which would have developed post document development. In most cases, national studies focused on a single area. Some of the specific studies which have been done are:

1. Environmental and Social Impact Assessment and feasibility for geothermal energy in Saint Lucia (2018)
2. Geothermal feasibility, solar feasibility and Grenadine microgrid study for islands in St. Vincent (1990)
3. Castillo study on potential increase of hydropower in Suriname (2019)
4. RE study on intermittent supply in St. Kitts (2013)
5. Geothermal energy in St. Kitts and Nevis (2019)
6. Renewable Readiness Assessment and Energy
7. Transition Initiative in Grenada (2013)
   Expansion of Biomass Cogeneration at the BELCOGEN power plant to use wild cane in 2019 for Belize (2019)
8. Study on market understanding of the liberalization of the electricity sector and a Study on the RE stakeholder relationships in Barbados (2017)
9. Regarding Guyana:
   Technology Needs, Assessment, Optimal

Generation and Expansion Study, Update of Feasibility Studies for small hydropower sites, Assessment of fiscal and Regulatory Barriers to Deployment of Energy Efficiency and Renewable

Energy Technologies in Guyana, Arco Norte Interconnection Study, Transitioning to National Energy Security Project (Bartica) Phase 1, Sensitization and Awareness Programme, Household Baseline Study and Street Lighting

10. Study for Guyana (2010-2019)

Waste Characterization study, Integration of RE into the Antigua grid, and a Pre-Feasibility Study for a grid-parallel Wind Park at Crabbs

11. Peninsula, for Antigua (2008-2019)

Wind Power in Jamaica, Feasibility study for the introduction of Solar Energy in Jamaican Schools, Hydro feasibility studies on Eight Rivers, Renewables Potential in Jamaica and

12. Energy Efficiency Potential in Jamaica (2008-2018)

13. Studies on Hydro, Geothermal and PV potential in Dominica (2012-2020)
14. Unique approach to sustainable energy in
15. Trinidad and Tobago (2014)

Renewable Energy for all in Haiti (2020)

IRENA Renewable Energy Prospects in Dominican Republic (2016)

The Barbados RE stakeholder study did examine the relationships of RE stakeholders but did not include much of the analysis being proposed now. Based on the regional documents and the types of national studies done, it may be concluded that a regional mapping of the RE Industry would add value to the body of work available. Such work would reveal the existing structure of the RE industry in CARIFORUM and create an evidence-based platform for the formulation of interventions aimed specifically at developing indigenous RE capabilities, through support to industry actors and their evolving networks.

## 1.5 | SCOPE

The assignment covered all the stakeholder groups (shown in section 2.1) across 15 CARIFORUM countries including Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines, Suriname and Trinidad and Tobago.

It is important to note that Caribbean Export's rationale for this study is based on their mandate to improve the competitiveness of micro, small and medium sized enterprises (MSME) in CARIFORUM. RE is expected to assist businesses to access a less expensive energy service which will allow them to be more competitive and support greater exportation of products and services. In turn, this implies the development of capabilities on the supply side to deliver engineering, procurement and construction and other services, with the inherent potential for the diversification and enhancement of regional exports. To this extent, some technical areas are not focused on; like integrated resource planning (IRP), grid and utility challenges, etc. The relationship between energy and MSMEs is further contextualized in the sections below.

### 1.5.1 | GLOBAL APPROACH TO RE INDUSTRY

Several international institutions have been working in the Caribbean region in the RE sector to assist countries in attaining their goals and targets set as part of their international responsibilities to positively impact the effects of climate change. Institutions which lead these efforts include the Green Climate Fund (GCF), Inter-American Development Bank (IDB), European Union (EU) and others. They support countries in relation to reducing emissions from several sources including electricity generation, transportation and other business and personal activities. These interventions are driven by a global agenda overseen by the United Nations Framework Convention on Climate Change (UNFCCC) and focused on Climate Change. This effort includes RE and EE and engages the attention of the Government Ministries responsible for energy, environment and others.

## 1.5.2 | REGIONAL APPROACH TO RE INDUSTRY

The regional approach has been spearheaded by the CARICOM Secretariat with support from the recently established Caribbean Centre for Renewable Energy and Energy Efficiency (CCREEE), the Organization of American States' (OAS) Global Sustainable Energy Islands Initiative and others. The Secretariat has documented its approach in two key documents; the CARICOM Energy Policy (CEP) and the C-SERMS. Support for the regional approach has come from the CEP, the Caribbean Renewable Energy Development Program (CREDP), the Caribbean Sustainable Energy Program (CSEP), amongst other initiatives. It has also benefited from support from the OAS Global Sustainable Energy Islands Initiative which has been established to address sustainable development challenges in the Region. They have resulted in many important studies and projects, recognising the need for energy sector reform.

The Secretariat's approach articulated in its CEP aims for: -

*"A Fundamental transformation of the energy sectors of the Member States of the Community through the provision of secure and sustainable supplies of energy in a manner which minimizes energy waste in all sectors, to ensure that all CARICOM citizens have access to modern, clean and reliable energy supplies at affordable and stable prices, and to facilitate the growth of internationally competitive Regional industries towards achieving sustainable development of the Community."*

The CEP and C-SERMS provide the necessary orientation for the desired transformation and is now supported by the identification of energy in the regional strategic plan as a crosscutting theme. They are designed to create solutions to the common challenges in the regional energy sector such as: -

- Weak energy security in most Member States and the need to optimize the use of regional indigenous energy resources.
- High energy costs, low economic competitiveness and threats to macro-economic sustainability in most Member States.
- Energy poverty in some Member States.
- The need to lower carbon footprints and increase climate compatibility of the energy sector.

The scope of the Secretariat's approach includes assisting Member States to develop comprehensive national energy policies with action plans, clear targets and the required legislative and regulatory reforms to promote the use and development of renewable energy sources. As a result, the CEP seeks to increase energy security, diversify the energy sources through increased use of renewable energy, promote energy efficiency across sectors, encourage clean transportation, and create an environment conducive to greater investment in the energy sector. This work depends on stronger human capacity and skills at the national and region levels and greater public education and awareness to ensure energy sector development.

## 1.5.3 | NATIONAL APPROACH TO RE INDUSTRY

At the national level, countries have also set targets in relation to their levels of energy consumption and percentage of clean energy which make up their energy mixes. In their responses and using their Nationally Determined Contributions (NDC), they engage in mitigation measures including RE and EE activities. These actions do support the global agenda for emissions reduction but are based on additional motivations routed in common challenges that face most of these countries; including high and unpredictable cost of fuel, the impact on foreign reserves and energy security. Regional institutions that fully understand and support these efforts include CARICOM, Caribbean Development Bank (CDB) and Caribbean Community Climate Change Centre's (CCCCC or 5Cs).

In this respect countries similarly have targets in relation to RE and EE in electricity generation, transportation and other business and personal activities. In their responses, Governments plan RE and EE projects and programmes which engage the electricity utilities and the wider RE industry. National action plans seek to establish the appropriate legal and regulatory environments and pursue the appropriate investments and technologies required to effect the necessary transformation in the energy sector. These interventions are driven by a national agenda to develop lower cost, indigenous, clean energy, managed by the public and private sectors and may ultimately benefit all sectors directly or indirectly. This also engages the specific attention of the ministries responsible for energy, planning and others.

## 1.5.4 | CARIBBEAN EXPORT APPROACH TO RE INDUSTRY

Caribbean Export's approach to the RE industry is different to the previous three approaches above. While it enjoys clear synergies with the previous approaches, its focus is primarily on the MSMEs in each country. If their programming is to be focused on the competitiveness of the MSME by making the EE and RE products and services options more accessible to businesses, there must be an understanding of some key indicators in the industry, as presented in section 1.2 above. Since such a study has not been done before, it should provide Caribbean Export with critical decision-making information that can lead to programs to lower MSMEs' operating costs.

While the Global and National approaches must address all categories of energy consumption in order to exert the maximum impact, this may not necessarily be the case with the Caribbean

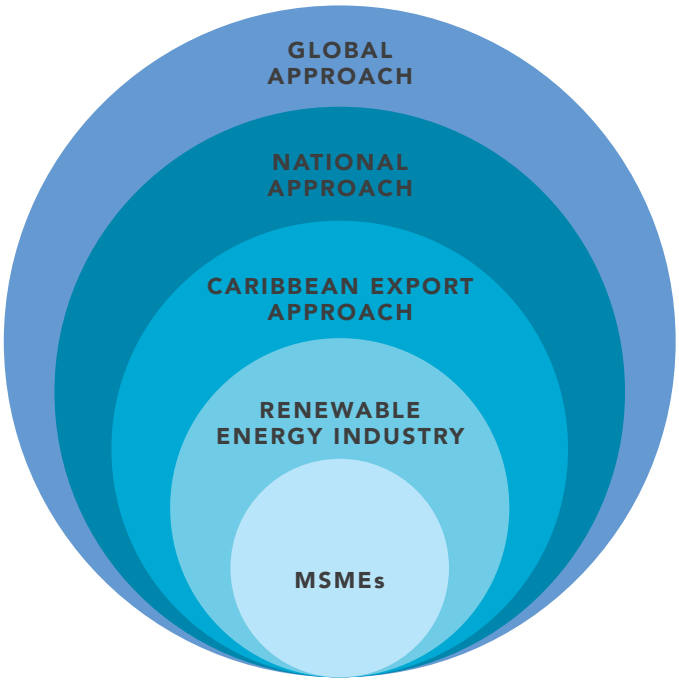



***Figure 1.1 | Approaches to Renewable Energy Industry Impacts***

Export approach due to the nature of the MSMEs' operations.

The importance of each consumption category to the MSMEs in the CARIFORUM region is examined briefly below.

Regionally, we observe a relatively even distribution of energy consumption across the three main categories previously mentioned; a) electricity generation at power plants, b) transportation and c) other business and personal activities.

**a) Electricity Generation**

Electricity consumption is common to all MSMEs in the region. It therefore contributes to the cost of 100% of these businesses even though their level of consumption will vary. In most cases it represents a significant portion of the overall operating cost and would therefore have a significant impact on their competitiveness at home and abroad. RE generation, EE products and services like training and process engineering in relation to electricity related activities, would be very relevant to this study.

**b) Transportation**

Outside of the public transportation system and private transportation, some MSMEs incur a transportation cost which is related to the delivery of products and services to clients. However less than 5% of MSMEs are involved in providing a transportation service and these are candidates for the use of biofuels and electric vehicles (EVs) charged by RE. Without the use of RE charging ports, EVs have no significant impact on the global and national agenda but may still positively impact MSME costs and competitiveness if there is a disparity between the cost of petroleum-based fuels and the cost of electricity. Given the high landed cost of EVs however, this sub-sector may not be a primary consideration for MSMEs in most countries.

**c) Other Business and Personal Activities**

Residential activities and businesses which engage in highly specialized activities or large-scale operations are represented in this final category of energy consumption. As an example, specialized operations in the MSME sector may include laundries which convert a traditional energy source to heat in water and may benefit from solar water heating (SWH). Unfortunately, laundry MSMEs in our economies, are not direct exporters of their services. However, SWH firms do export their products and would therefore benefit from general support for EE promotion.

Additionally, other specialized operations may include large operations like sugar, rice or wood mills which may benefit from co-generation (COGEN) which is most beneficial within larger operations.

Residential consumption is not the direct focus of this study, but they will benefit alongside MSMEs from a vibrant RE Industry.

## 1.6 | REPORTING

After the analysis was completed, the report was compiled and structured as follows.

- Chapter 1.0 Introduction
- Chapter 2.0 Research Methodology
- Chapter 3.0 RE Industry Stakeholder Relationships Assessment
- Chapter 4.0 Country Indicator Analysis
- Chapter 5.0 Recommendations and Conclusion
- References
- Appendix A – Renewable Energy Course Information

# 2.0 | **RESEARCH** METHODOLOGY

The methodology centered around three main tools in order to execute the mapping. These are explained below and depicted in the following figure.

**Desk research** and experience was used to identify a few countries which were either representative of the larger population or unique countries in CARIFORUM. These were Barbados, Belize, Saint Lucia and Trinidad and Tobago. They were used as test sites for the data collection instruments and amendments made accordingly.

**Survey** instruments were used to collect data from stakeholders on products, services, capacity, financial and insurance markets, exports, local environments and stakeholder relationships.

**Group meetings** were used to verify and validate findings.


*Figure 2.1 | Research Tools*

## 2.1 | STAKEHOLDER SELECTION

Throughout the stakeholder landscape of the 15 CARIFORUM countries included in this study, several groups were identified. Not all groups were visibly active in all countries and they also operated at different levels where they existed. This reflected the state of the renewable energy industry in each country, whether as a result of their set policies, the lack of policies or the stage of development within the industry itself.
The various roles, impacts and intensities varied amongst the different stakeholder groups. These final set of key stakeholder groups included:

- Lead Government Ministry (LGM)
- Utilities Regulator (UR)
- Financial Institutions (FI)
- Funding Agencies (FA)
- Regional Institutions (RI)
- Private Sector Institutions (PSI)
- Higher Education Institutions (HEI)
- Renewable Energy Companies (REC)

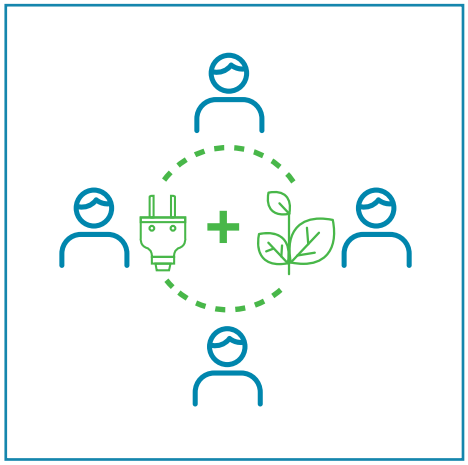


*Figure 2.2 | Stakeholder Network in the Renewable Energy Industry*

Each group was surveyed in order to establish their role and level of participation in the RE industry and their impact on the key factors focused on in this study.

## 2.1 | DATA COLLECTION

- 4 in-house staff were used to execute data collection in the 13 English speaking countries.
- 1 external resource was used to assist with the Jamaica participants due to its size and the incompleteness of the initial contact data.
- 1 external resource was used to collect data from the Spanish speaking Dominican Republic and the French speaking Haiti.
- 8 distinct survey instruments were used to collect the required data.
- Some participants completed the online survey on their own; particularly the education stakeholders since they needed to retrieve their student records.
- Some participants opted for a live interview using the Zoom platform while the interviewer completed the online survey in real time.

## 2.2 | TARGET GROUPS

Given the various stakeholder groups to be surveyed the following estimates were made to determine the population size of the RE Industry. The average number of actors in each stakeholder group was estimated based on the size of the country and direct experience with the regional territories. Stakeholder amounts vary across the territories with some having higher numbers and others having less.

| LGM | LGM | UR | FL | PSI | HEI | REC | FA | RI | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| **Average per Country** | 1 | 1 | 6 | 3 | 3 | 8 | 12 | 10 | 44 |
| **Region (15 countries)** | 15 | 15 | 90 | 45 | 45 | 120 | 12 | 10 | 352 |

***Table 2.1 | Study Population***

In order to achieve a 7% error and a confidence level of 95% it was necessary to obtain a sample size of 127 participants given the population size of 352.

Based on desk research and the stakeholder groups, several entities were targeted. This initial contact list was dynamic, expanding to include newly discovered actors and removing retired companies. Full contact details are provided in a subsequent section. The table below indicates the number of potential participants targeted by country and stakeholder group.

| COUNTRY | LGM | UR | FL | PSI | HEI | REC | FA | RI | COUNTRY TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Antigua & Barbuda | 1 | 1 | 2 | 2 | | 3 | | | 9 |
| Bahamas | 1 | 1 | | 3 | 3 | 5 | | | 13 |
| Barbados | 1 | 1 | 2 | 8 | 3 | 11 | | | 26 |
| Belize | 1 | 1 | 2 | 2 | | 12 | | | 18 |
| Dominica | 1 | 1 | 1 | 4 | 1 | 3 | | | 11 |
| Dominican Republic | | | 2 | 2 | 2 | 6 | | | 12 |
| Grenada | 1 | 1 | 2 | 3 | 1 | 3 | | | 11 |
| Guyana | 1 | 1 | 2 | 2 | 2 | 3 | | | 11 |
| Haiti | 1 | 1 | 3 | 3 | 4 | 6 | | | 18 |
| Jamaica | 1 | 1 | 1 | 2 | 3 | 12 | | | 20 |
| St. Kitts & Nevis | 1 | | | 2 | 1 | 1 | | | 5 |
| St. Lucia | 1 | 1 | 2 | 2 | | 3 | | | 9 |
| St. Vincent & Grenadines | 1 | | 2 | 3 | 1 | 3 | | | 10 |
| Suriname | 1 | | 2 | 1 | 3 | 2 | | | 9 |
| Trinidad & Tobago | 1 | 1 | | 3 | 1 | 8 | | | 14 |
| Regional Total | 14 | 11 | 23 | 42 | 25 | 81 | 9 | 6 | 211 |

***Table 2.2 | Potential Participants in the Study***

***Grey cells indicate the group was not contacted because 1) it did not exist, 2) was not selected, 3) was not reachable or 4) was not applicable (FA, RI)***

## 2.3 | CONTACTS

As is the case with most surveys, the entire market is not sampled. In addition, some potential participants were unwilling to contribute in anyway, citing reasons such as confidentiality of data and trade secrets. The required number of respondents was still attained in order to achieve the error and confidence specifications. For anonymity purposes, the respondents are not specifically identified. All comments are intended to reflect those of the responding group. Table 2.3 below indicates the number of actors who completed the survey by country and stakeholder group.

| COUNTRY | LGM | UR | FL | PSI | HEI | REC | FA | RI | COUNTRY TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Antigua & Barbuda | 1 | 1 | 0 | 2 | | 2 | | | 6 |
| Bahamas | 0 | 0 | | 2 | 3 | 3 | | | 8 |
| Barbados | 1 | 1 | 2 | 6 | 3 | 8 | | | 21 |
| Belize | 1 | 1 | 2 | 1 | | 4 | | | 9 |
| Dominica | 1 | 1 | 0 | 2 | 1 | 2 | | | 7 |
| Dominican Republic | | | 0 | 0 | 1 | 2 | | | 3 |
| Grenada | 1 | 1 | 1 | 1 | 1 | 2 | | | 7 |
| Guyana | 1 | 0 | 1 | 1 | 0 | 2 | | | 5 |
| Haiti | 1 | 1 | 3 | 3 | 4 | 3 | | | 17 |
| Jamaica | 1 | 0 | 0 | 0 | 1 | 3 | | | 5 |
| St. Kitts & Nevis | 1 | | | 2 | 1 | 1 | | | 5 |
| St. Lucia | 1 | 1 | 0 | 1 | | 1 | | | 4 |
| St. Vincent & Grenadines | 1 | | 0 | 3 | 1 | 3 | | | 8 |
| Suriname | 1 | | 0 | 1 | 2 | 1 | | | 5 |
| Trinidad & Tobago | 1 | 1 | | 2 | 1 | 5 | | | 10 |
| Regional Total | 13 | 8 | 9 | 27 | 19 | 44 | 8 | 5 | 133 |

***Table 2.3 | Actual Participants in the Study***

The data collection activities achieved a final sample size of 132, needing only 127 to achieve the 95% level of confidence in the 7% error.

## 2.4 | SAMPLE STATISTICS

Table 2.4 below shows the percentage participation of countries and stakeholder groups.

| COUNTRY | LGM | UR | FL | PSI | HEI | REC | FA | RI | COUNTRY TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| Antigua & Barbuda | 100% | 100% | 0 | 100% | | 67% | | | 67% |
| Bahamas | 0 | 0 | | 67% | 100% | 60% | | | 62% |
| Barbados | 100% | 100% | 100% | 75% | 100% | 73% | | | 81% |
| Belize | 100% | 100% | 100% | 50% | | 33% | | | 50% |
| Dominica | 100% | 100% | 0 | 50% | 100% | 67% | | | 64% |
| Dominican Republic | | | 0 | 0 | 50% | 33% | | | 25% |
| Grenada | 100% | 100% | 50% | 33% | 100% | 67% | | | 64% |
| Guyana | 100% | 0 | 50% | 50% | 0 | 67% | | | 45% |
| Haiti | 100% | 100% | 100% | 100% | 100% | 83% | | | 94% |
| Jamaica | 100% | 0 | 0 | 0 | 33% | 25% | | | 25% |
| St. Kitts & Nevis | 100% | | | 100% | 100% | 100% | | | 100% |
| St. Lucia | 100% | 100% | 0 | 50% | | 33% | | | 44% |
| St. Vincent & Grenadines | 100% | | 0 | 100% | 100% | 100% | | | 80% |
| Suriname | 100% | | 0 | 100% | 67% | 50% | | | 56% |
| Trinidad & Tobago | 100% | 100% | | 67% | 100% | 63% | | | 71% |
| Regional Total | 93% | 73% | 39% | 64% | 76% | 53% | 8 | 5 | 63% |

*Table 2.4 | Percentage Participation in the Study*

The financial sector was most hesitant to participate, followed by the RE companies. The study achieved an overall 63% participation which provided the desired sample size.

## 2.5 | DATA ASSESSMENT

The assessment applied a selected method of evaluation to each stakeholder question in order to allow for subsequent measurement as explained below. Some evaluations were quantitative, and some were qualitative. Some questions were not applicable depending on previous responses and could be omitted. E.g. If YES then what. "Not Sure" was also introduced in some cases to allow for survey completion if the responder was unable to provide a proper response. The measurements used were:

### Ranges

Ranges were used to provide a means of measuring a response in cases where exact numbers may be difficult to determine (e.g. RE industry size/value) and when it was necessary to provide the participant with a measure of protection (e.g. company revenues).

### Binary

Yes and No were used when responses were expected to be clear.

### Rating System

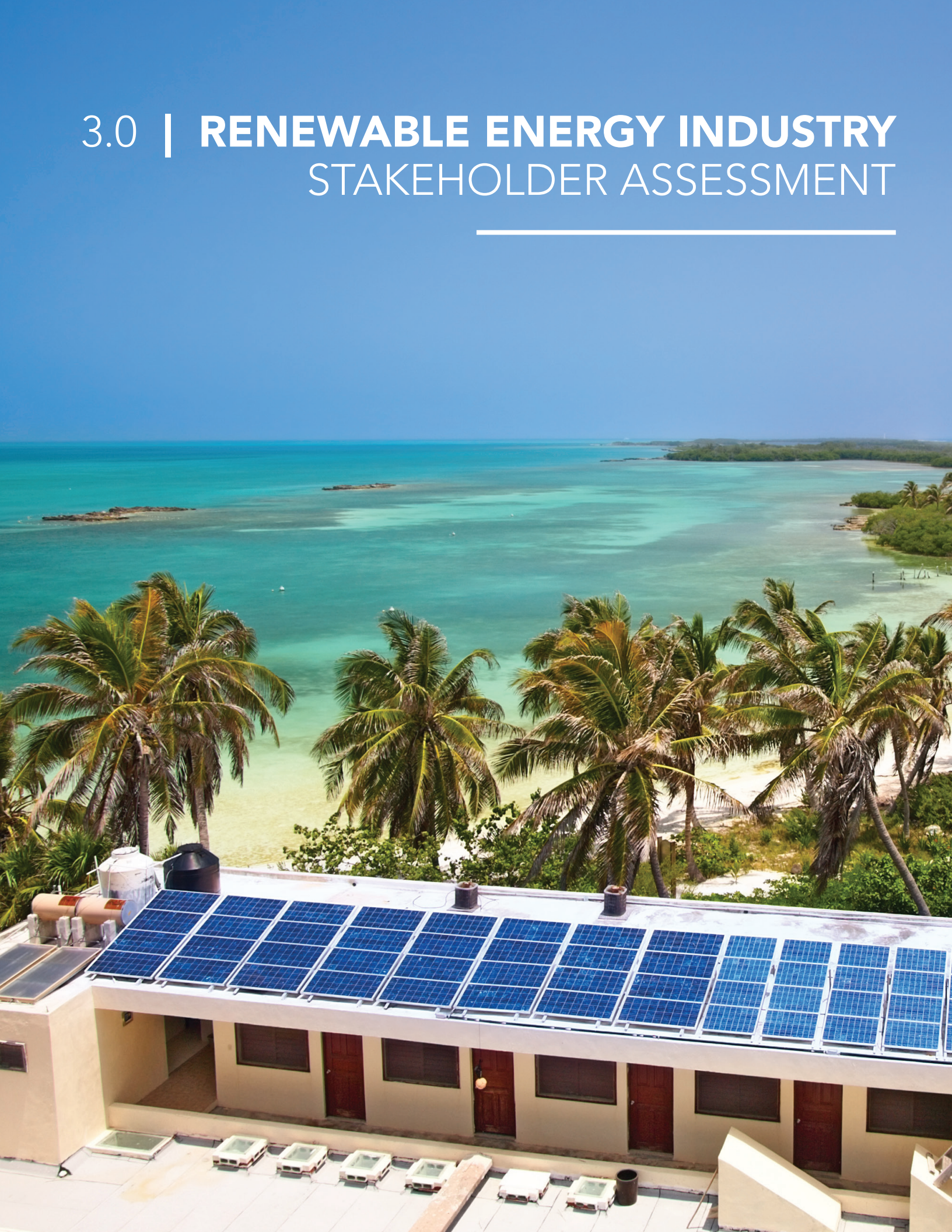
The study used a numeric rating system that assigned a score from 1 to 5 where:
5 indicates a "Poor" rating
4 indicates an "Inadequate" rating
3 indicates a "Fair" rating
2 indicates a "Good" rating
1 indicates an "Excellent" rating

### Text Repsonses

Several responses were collected as written text. Such information was summarized to present a qualitative measurement.

*The assessment applied a selected method of evaluation to each stakeholder question in order to allow for subsequent measurement.*

# 3.0 | **RENEWABLE ENERGY INDUSTRY** STAKEHOLDER ASSESSMENT



Stakeholder assessment was performed at the country level first in order to understand the dynamics of the local RE industry and the relationship which may or may not exist between stakeholders.
The RE Industry comprises of several actors who play specific roles. These stakeholders may easily be considered necessary for a sustainable RE industry but have not been fully manifested in all the countries included in the study.

Countries are at different stages of their RE industry development and may therefore adopt different strategies in pursuit of their national targets. What has been observed is that while each country is different, there are many common characteristics. Ideally, a typical RE industry would have all the following stakeholders represented in a complex network of relationships. For such a model, all the stakeholders are required to be fully functional in order to ensure the industry's sustainability.

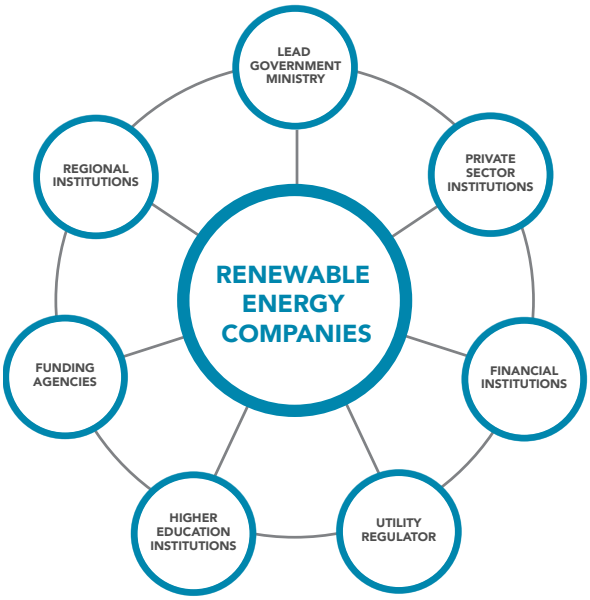



***Figure 3.1 | Relationships Network in a Fully Evolved Typical RE Industry***

The quality of the relationships between stakeholders are rated from 1 to 5. They are represented in the figures below using a colour coded system described here.

In the relationship diagrams presented for each stakeholder in Chapter 3, the colour of the sections indicates the quality (1-5) of the relationship between two stakeholders; a selected stakeholder and each of the other stakeholders (outward perception of the relationship between self and others). Stakeholders not contacted directly, do not have such an outward relationship diagram.

**RED | RATING 4 or 5**

*This rating indicates a non-existent or poor relationship which is not beneficial to the RE Industry stakeholders. In a Typical RE Industry, this would certainly hamper the performance of the industry. However, for a RE Industry shaped by active policy, the weight of any single stakeholder group may be diminished and therefore not have a negative impact on the overall performance of the RE industry or the attainment of set goals and targets.*

**YELLOW | RATING 3**

*This rating indicates a fair existing relationship which needs to be improved to become beneficial in a Typical RE Industry or to the local RE Industry demanded by active policy. In some cases, the level of engagement may be adequate.*

**GREEN | RATING 1 OR 2**

*This rating indicates a good relationship which is beneficial to the RE Industry stakeholders. This usually identifies a critical stakeholder relationship that is part of what the policy requires.*

## 3.1 | ANTIGUA & BARBUDA

Antigua and Barbuda has a land area of about 443 square kilometres and a population of about 97,118 (UN, 2019). Its main economic sectors are tourism, construction and light manufacturing. The Antigua Public Utilities Authority (AUPA) is a government institution which owns the electricity utility. It has responsibility for transmission and distribution with an installed capacity between 77 MW and 81 MW as reported in their energy score card for 2018[2]. About 10.5 MW of their capacity is renewable and this is estimated to be near their current maximum RE allowed on the grid, even though another assessment suggests a much higher percentage. All the renewable supply is from utility scale solar photovoltaics (PV).

APUA is actively involved in RE generation for the grid but not in the installation of RE systems for customers within the competitive RE industry.

### 3.1.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of Public Utilities, Civil Aviation and Energy is the lead ministry for the energy portfolio with some consultation with a few other ministries through a Project Management Unit (PMU) and a Technical Advisory Committee (TAC). This collaboration is usually to obtain the requisite input into the decision-making process and some national reporting like the NDC to the UNFCCC. The department responsible for energy has developed much of the necessary policy and regulations to govern the renewable energy sector.

There are 4 resources available to execute the energy portfolio and the PMU coordinates energy related activities amongst the stakeholder ministries. They actively develop programs to encourage private sector involvement in the RE industry.

The lead Ministry's relationship with the other external stakeholders is depicted in the diagram right.

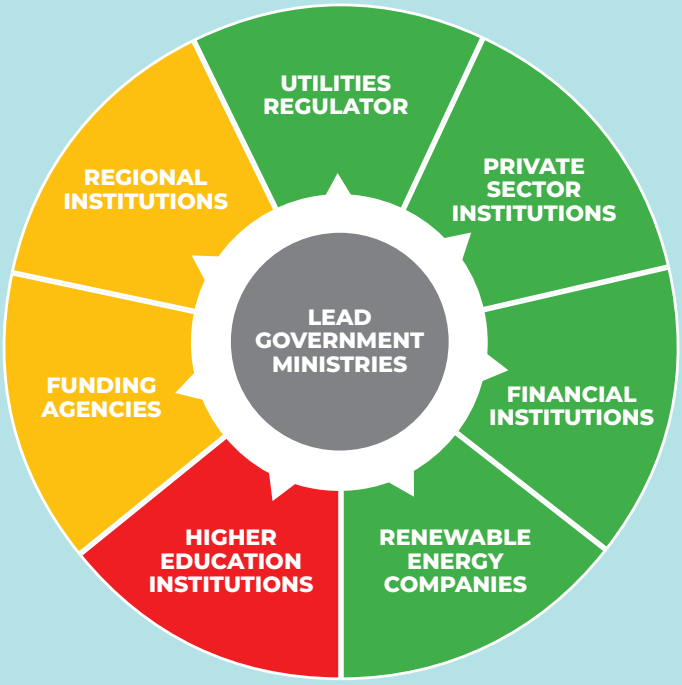



***Figure 3.2 | Relationships of Antigua's Lead Government Ministries***

2 - Energy Report Card 2018 | Antigua & Barbuda

The LGM has established reasonably good stakeholder relationships except for the HEIs which offer no courses at this time and therefore play no significant role.

### 3.1.2 | UTILITIES REGULATOR

The regulator is located within APUA alongside the electricity utility. While this is not the preferred arrangement, it has oversight for the arrangements between RE generators and the electricity utility, and as such, plays an important role in the RE industry. They regulate interconnection policy, compliance to quality, connection configuration and the feed-in tariff. Their relationship with the other key stakeholders is depicted in the diagram right.

The regulatory function is still evolving and may not yet be exploring all the relationships necessary to develop the RE industry.

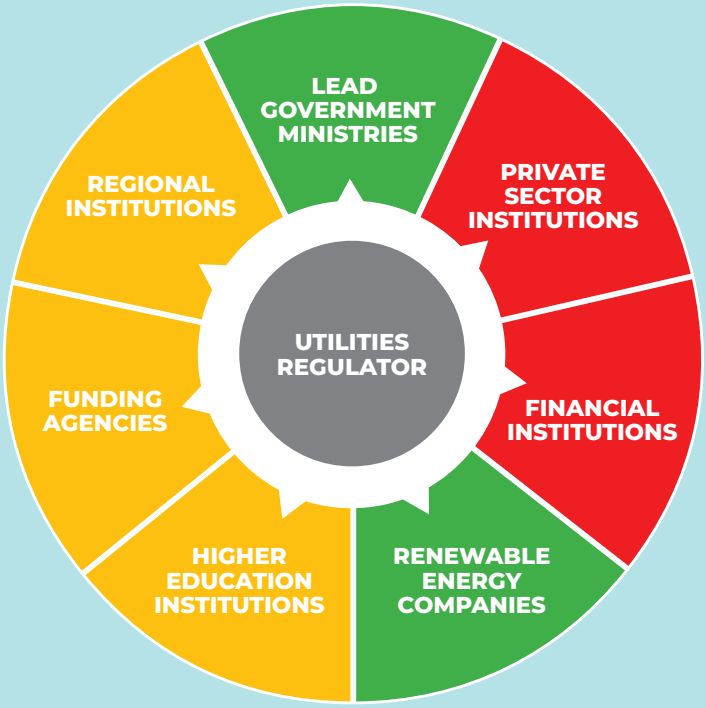



***Figure 3.3 | Relationships of Antigua's Utilities Regulator***

### 3.1.3 | FINANCIAL INSTITUTIONS

The financial institutions in Antigua are not very engaged with the other stakeholders. Commercial banks tend to treat RE requests like any other request and offer no preferential treatment. The RE Industry is also quite small with just single digit operators in the market. Consequently, the FIs currently play no significant role. The FI stakeholder relationships are extrapolated from the other stakeholders which interact with them.

### 3.1.4 | PRIVATE SECTOR INSTITUTIONS

The Antigua and Barbuda private sector institutions seek to support firms within their economy including the RE companies. This includes business development and investment as directed by national policies and directives, increasing the number of successful entrepreneurs and small businesses and advancing entrepreneurial education. They have between 3 and 12 members of staff and 1 REC per institution amongst their clientele. They are fully aware of existing RE goals and initiatives presented by Government but have limited opportunities to make a significant impact on the sector because of a lack of participation on the part of the RECs. Their relationship with the other key stakeholders is depicted in the diagram right.

Resource limitations coupled with a lack of interest from the RECs hamper the PSI's capacity to contribute to the RE industry. Limited resources also impact their efforts to engage widely with other stakeholders.

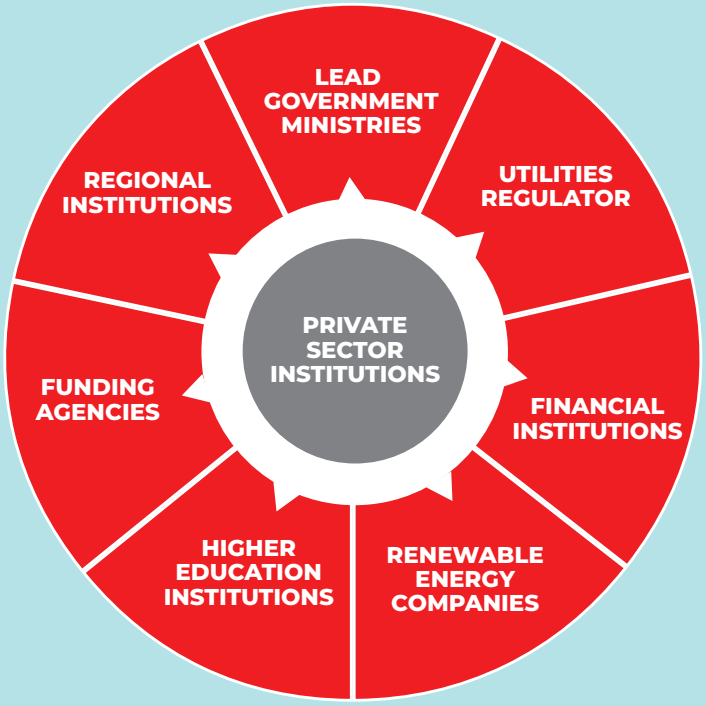



*Figure 3.4 | Relationships of Antigua's Private Sector Institutions*

### 3.1.5 | HIGHER EDUCATION INSTITUTIONS

The tertiary institution in Antigua that could potentially provide teaching and training for RE professionals is the Antigua State College. This college was established in 1977 by the merger of two already existing institutions: Leeward Islands Teachers' Training College and Golden Grove Technical College which was launched in 1972 under British sponsorship. Unfortunately, there are no renewable energy courses being offered and no specific plans exist to do so. Currently, they play no significant role in the RE industry in the area of teaching or research. The HEI stakeholder relationships are extrapolated from the other stakeholders which interact with them.

### 3.1.6 | RENEWABLE ENERGY COMPANIES

Since current regulations permit interconnection between RE systems and the national grid, anyone may implement RE systems of various sizes to supply the grid considering the integration limitations. 34 individuals have been certified and registered with APUA to install PV systems for interconnection. Registration is not done for companies. In any case, very few RECs exist in Antigua.

RECs have on average 5 staff and depend on a mobile labour market to provide additional resources to implement projects. These RECs have only been in business 7 to 9 years with their focus being split between RE and EE, including design and installation for the residential, commercial and industrial sectors. Their relationship with the other key stakeholders is depicted in the diagram right.

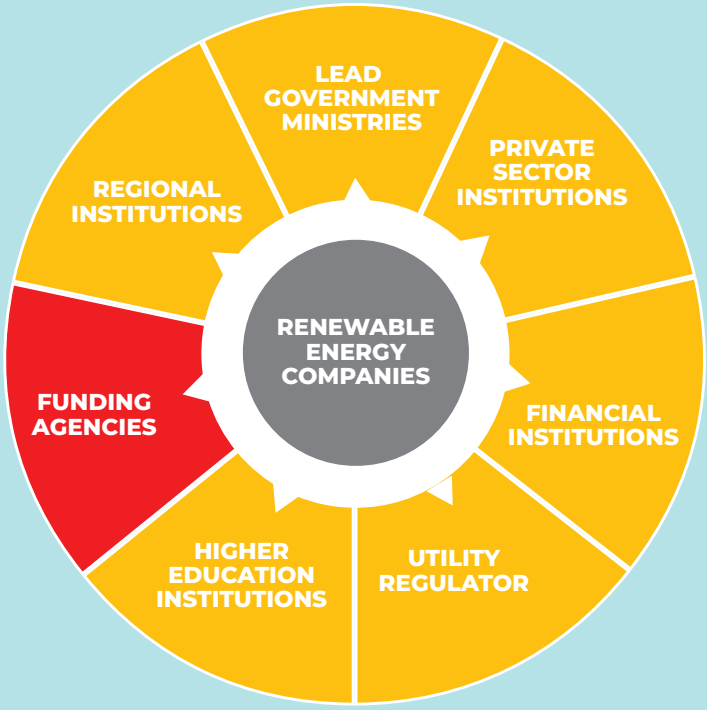



*Figure 3.5 | Relationships of Antigua's Renewable Energy Companies*

## 3.2 | COMMONWEALTH OF THE BAHAMAS

The Commonwealth of The Bahamas is a collection of islands of about 13,943 square kilometres and a population of about 393,482 (UN,2019). Its main economic sectors are tourism and financial services. The electricity utilities have an installed capacity of 536 MW as reported in their energy score card for 2018. Bahamas has a negligible RE capacity in their energy mix and no Independent Power Producers (IPPs).

The Bahamas Electricity Corporation (BEC) is a government owned corporation and the Grand Bahama Power Company (GBPC) is a private utility company. They are not actively involved in RE generation for customers.

### 3.2.1 | LEAD GOVERNMENT MINISTRY

The Ministry of Public Works is the lead ministry for the energy portfolio, even though some consultation does occur between four other ministries which share the responsibilities of generating, distributing and managing the energy resources in the Bahamas. Together they have developed the national energy policy and action plan. There are also RE targets and an established regulatory authority to oversee the energy sector. The policy clearly indicated the government's plan for renewable energy to make an increasing contribution to the Bahamas' energy supplies in the future. All the framework components to allow interconnection to the national grid are still outstanding. This maintains a level of uncertainty in the RE sector and hinders the active participation of the key stakeholders. RE companies are only able to implement small (up to 5KW) RE systems for self-generations, thereby limiting residential and commercial participation in the national energy sector. The LGM stakeholder relationships are extrapolated from the other stakeholders which interact with them.

### 3.2.2 | UTILITIES REGULATOR

The regulator is the Utilities Regulation and Competition Authority (URCA). It has oversight for the arrangements between RE generators and the electricity utility, and as such, plays an important role in the RE industry. The URCA's activities in the RE Sector are guided by the overarching objectives in the National Energy Policy. They have the responsibilities of developing the framework for energy sector licensing and monitoring the implementation of RE IPP agreements. There are currently no regulations to facilitate the interconnection of self-generating RE implementations nor feed in tariffs. The regulatory function in the RE sector is still evolving and may not yet be exploring all the relationships necessary to develop the sector. The UR's stakeholder relationships are extrapolated from the other stakeholders which interact with them.

### 3.2.3 | FINANCIAL INSTITUTIONS

The financial institutions in The Bahamas are not very engaged with the other stakeholders. Commercial banks tend to treat RE requests like any other request and offer no preferential treatment. The RE industry is also quite small and mostly self-financed. Consequently, the FIs currently play no significant role. The FI stakeholder relationships are extrapolated from the other stakeholders which interact with them.

### 3.2.4 | PRIVATE SECTOR INSTITUTIONS

The Bahamas private sector institutions seek to support the evolution of MSMEs in the Bahamas, maximise the creation of economic impact through strategic partnerships, and by equipping and empowering MSMEs, increase their ability to provide employment, create wealth and drive the development of a robust and resilient economy. They therefore provide advocacy, advice and access to business development opportunities to ensure economic growth and environmental stewardship. There is support for and interest in the RECs. There is an average of 6 REC members ranging from 4 to 9 RECs amongst their memberships.

There is adequate capacity to execute their core functions with an average of 20 staff members ranging from 4 to 35 persons per PSI. They are well informed of the existing limited RE support offered by Government and the limited opportunities available due to the lack of legislative support. Their relationship with the other key stakeholders is depicted in the diagram right.

PSIs have focused on delivering their mandates with the resources they have and do recognise the changes which are needed in the environment. However, there has been little activity, to signal any shift in government's priorities.

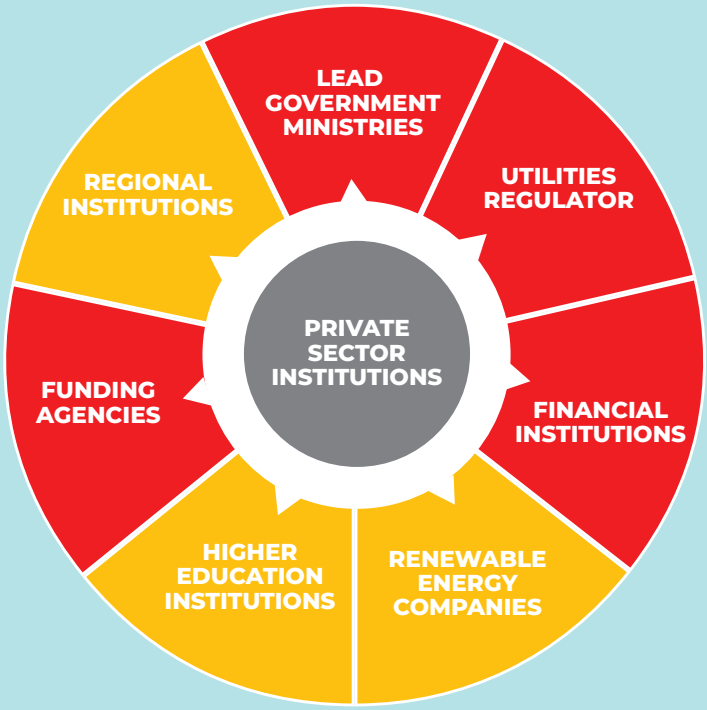



*Figure 3.8 | Relationships of Bahamas' Private Sector Institutions*

### 3.2.5 | HIGHER EDUCATION INSTITUTIONS

The three tertiary institutions in the Bahamas that could potentially provide teaching and training for RE professionals are the University of Bahamas (UB) and the Bahamas Technical and Vocational Institute (BTVI) and the Bahamas Baptist Community College (BBCC). No research is being conducted.

**a.** UB was established under the College of The Bahamas Act in 1974 as a public institution. Unfortunately, there are no renewable energy courses being offered and no specific plans exist to do so. They play no significant role in the RE Industry.

**b.** The BBCC was formed in 1995 and delivers education starting from the pre-college year. It is a private college which caters to the religious sector but is not limited to that group.

Unfortunately, there are no renewable energy courses being offered and no specific plans exist to do so. They play no significant role in the RE Industry.

**c.** The BTVI is also a public institution formed in 1949 and restructured to focus primarily on delivering the required skills to a technical workforce. Its course offering includes: -

- Social Services
- Commerce
- Applied Science
- Education

**BTVI plans to offer renewable energy courses in 2020/2021. The course information is presented in Appendix A**

### 3.2.6 | RENEWABLE ENERGY COMPANIES

The published energy policy does support self-generation from renewable energy systems. This creates a market for RECs which are not required to register in order to install systems. The main technology being focused on is PV and solar water heaters (SWH) with a developing research involvement in biofuels.

RECs have on average 5 staff and depend on a mobile labour market to provide additional resources to implement projects. These RECs have only been in business 7 to 13 years with their focus being split between RE and EE; including design and installation, energy auditing and energy efficiency retrofits mainly for the residential and commercial segments. Their relationship with the other key stakeholders is depicted in the diagram right.

RECs are few in the Bahamas and they have not been able to gain significant attention from the other stakeholder within the RE industry. They are not encouraged or engaged by government in any way to participate in the sector and have limited access to regional institutions that focus on this area.

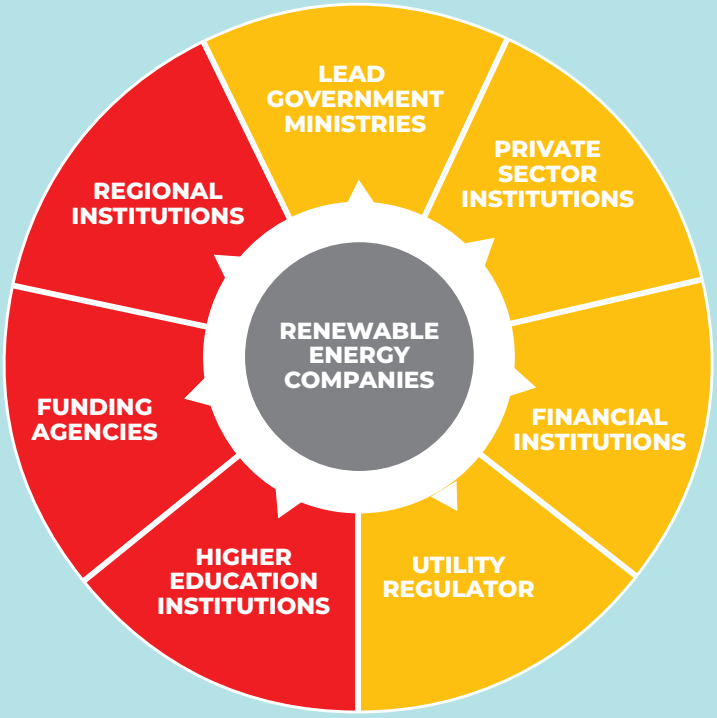



*Figure 3.9 | Relationships of Bahamas' Renewable Energy Companies*

## 3.3 | BARBADOS

Barbados is an island of about 430 square kilometres and a population of about 274,465[3]. Its main economic sectors are tourism and the offshore financial sector. The electricity utility is owned by Emera, a Canadian company, and has an installed capacity of 286.6 MW as reported in their energy score card for 2018. Barbados has about 37 MW capacity of renewables. All the RE is from PVs with about 20 MW from utility scale generation and 17 MW from distributed generation.

The Barbados Light & Power (BL&P) is actively involved in RE generation for the grid but not for customers within the competitive RE industry. Emera, however, also owns a subsidiary which installs PV for customers.

### 3.3.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of Energy, Small Business and Entrepreneurship is the lead ministry for the energy portfolio, and there is significant consultation between eight other ministries; some more than others. This is usually to obtain the requisite input into the decision-making process and some national reporting like the NDC and sustainable development plans. Together they have developed all the National Energy related Policy and Regulatory documentation to facilitate an active RE Industry and energy sector.

There are 40 resources available to execute their functions including a project unit in the Division of Energy which coordinates energy related activities amongst the several ministry stakeholders. They actively develop programs to encourage private sector involvement in the RE industry.

The lead Ministry's relationship with the other external stakeholders is depicted in the diagram right.


***Figure 3.11 | Relationships of Barbados' Lead Government Ministries***

3 - Barbados Statistical Services (2017)

While goverment plays an important role in education and is very consultative in its operations, the translation of policy into actionable items for the HEI's has not been realized.

### 3.3.2 | UTILITIES REGULATOR

The Fair Trading Commission (FTC) is the regulator and functions under the Ministry of Energy, Small Business and Entrepreneurship. However, it has been established as an independent commission. It has been given oversight to regulate three utility companies; water, electricity and telecommunications. The electricity division oversees rates and service standards and investigates queries and complaints. This naturally includes the arrangements between RE generators and the electricity utility, and the regulation of the RE feed-in tariffs.

Their staff complement assigned to the electricity section is 8 including 2 shared resources. Their relationship with the other key stakeholders is depicted right.

The nature of the FTC's role does not currently require any direct discussions with the financial institutions.

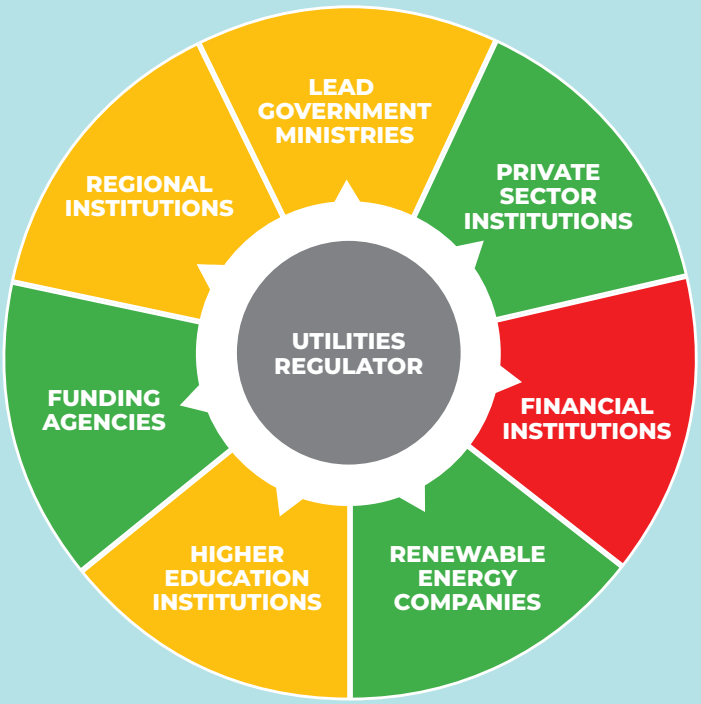



***Figure 3.12 | Relationships of Barbados' Utilities Regulator***

### 3.3.3 | FINANCIAL INSTITUTIONS

The financial institutions in Barbados include commercial banks, credit unions and other non-bank financial institutions. They control the local lending capacity required to supplement that provided by government and external funders. No special emphasis is placed on RE companies or RE projects and their business is targeted towards the private sector. While they see RE as a new lending market, the lending criteria applied to assess risk, payback, ability to pay, management capacity, borrowing ceilings, etc, are determined in the same manner as for all other sectors. Some non-bank entities like credit unions and other financial institutions actively pursue these opportunities but do have bond limits to comply with; in some cases, up to US$175,000. This maximum amount could fund PV systems up to 100KW, covering most MSME needs but not adequate for larger scale commercial or utility scale systems.

RE systems are treated as part of a dwelling for residentials and as a part of a building for commercial entities. The historic concerns of RE systems have therefore faded with this type of investment now being treated evenly amongst all other types of investments, and sometimes on a case by case basis for commercial implementations. Occasional lower interest promotions do present opportunities, but not specifically for RE systems.

Despite a knowledge of national goals and targets there has been no corresponding strategic business alignment within the financial sector. No special dispensation is in place for the RE sector. Their relationship with the other key stakeholders is depicted in the diagram right.

The commercial banking institutions tend to have better relationships with the large funding agencies and local investors, while the smaller non-bank financial institutions tend to have better relationships with the RECs. This may be related to the bond limits which exists for the non-bank institutions.

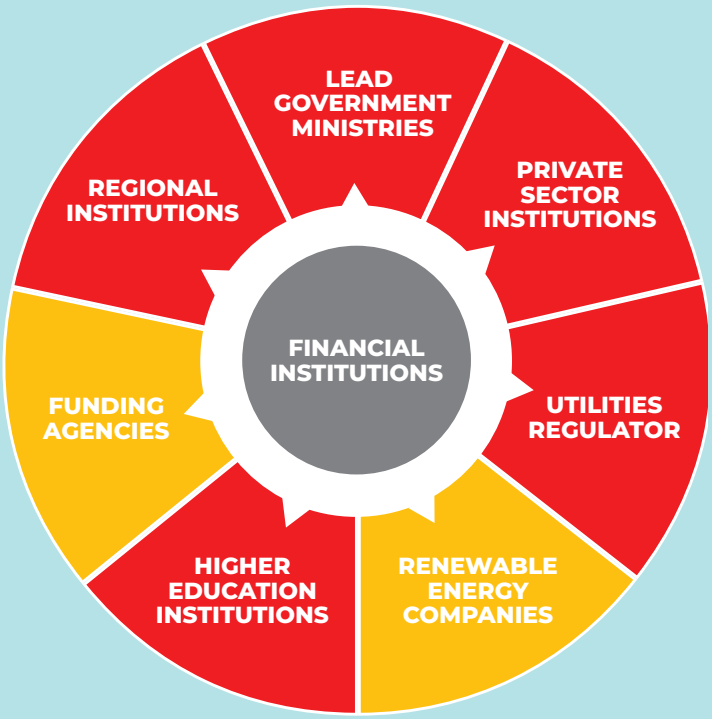



***Figure 3.13 | Relationships of Barbados' Financial Institutions***

### 3.3.4 | PRIVATE SECTOR INSTITUTIONS

The Barbados private sector institutions seek to support the development of business activities at home and abroad. This includes awareness, advocacy, interventions with government and regulator and investment. Two institutions focus specifically on RE and they all have a good appreciation for the need of the country and the RE industry stakeholders. There is sustained involvement in the pursuit of the national goals and targets in relation to RE. This is seen in their levels of consultation and collaboration on issues related to RE. Within each PSI, there is an average of 7 RECs.

Apart from the 2 focused voluntary associations, Barbados Renewable Energy Association (BREA) and the Barbados Energy Professionals Incorporated (BEPI), PSIs cover multiple sectors within the economy. Their average staff of 25 persons provide reasonable cover for the RE industry. They all agree that there needs to be more awareness and sensitization in the consumer market, more training for professionals and more opportunities provided for the local RECs. As associations, members of BREA and BEPI are all effectively part-time; 25 and 5 respectively. BREA's Secretariat has 1 full-time person. Their relationship with the other key stakeholders is depicted in the diagram below.

*Barbados Renewable Energy Association (BREA) and the Barbados Energy Professionals Incorporated (BEPI), PSIs cover multiple sectors within the economy.*

PSIs relationships with other stakeholders are varied. However, they all agree on the necessity for the relationships and the need to improve them.

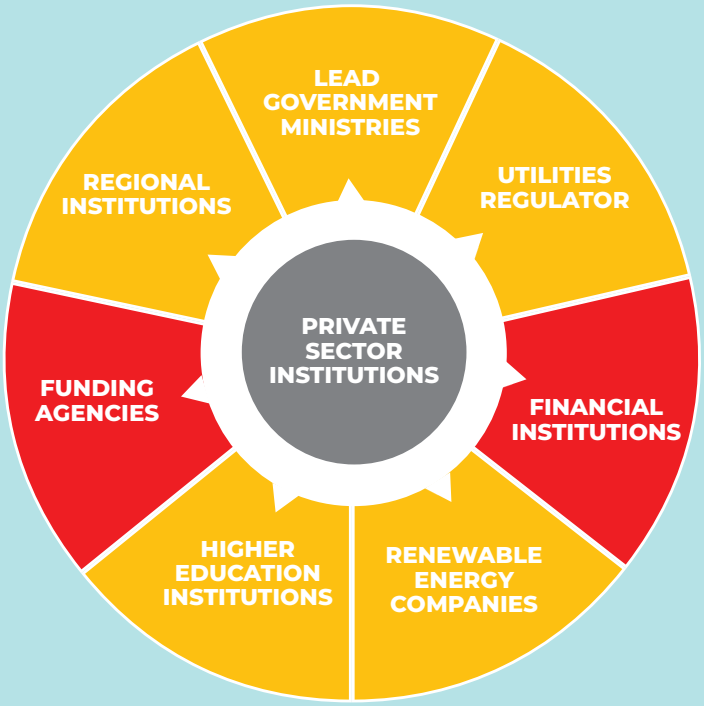



***Figure 3.14 | Relationships of Barbados' Private Sector Institutions***

### 3.3.5 | HIGHER EDUCATION INSTITUTIONS

The three Tertiary Education Institutions in Barbados that could potentially provide teaching and training for RE professionals are the University of the West Indies, Cave Hill campus, (UWICHL), the Barbados Community College (BCC) and the Samuel Jackman Prescod Institute of Technology (SJPI). They are engaged in some RE activities.

**a) UWI Cave Hill Campus** was established in 1962. It has 5 Faculties:

- Faculty of Humanities and Education
- Faculty of Law
- Faculty of Medical Sciences
- Faculty of Science and Technology
- Faculty of Social Sciences

- **MSc. in Renewable Energy Management offered in the Faculty of Science and Technology between 2012 and 2016.**
- **2 sustainable energy courses for a period of 3 months each**
- **Ongoing research in Biomass**
- **Between 50% and 75% of these students are local**
- **There is an annual enrolment of 30 students. UWI does some RE research on PV performance and some innovative work on local plant matter for Biomass energy generation**

**b) The Barbados Community College (BCC)** was established by an Act of Parliament in 1968 to provide post-secondary education to the Barbadian public. Its divisions include:

- Commerce and Continuing Education
- Fine and Liberal Arts
- Health Sciences and Hospitality Institute
- Science and Technology

- **Associate Degrees in related courses include Electrical Engineering, Environmental Science and Mechanical Engineering over a 2-year period**
- **Electrical Installation Level-3 course over a 6-month period**
- **Photovoltaic Design and Installation over a 1-year period**
- **Photovoltaic Design and Practice over a 4-month period**
- **Almost 100% of these students are local**

**c) Samuel Jackman Prescod Institute of Technology** is a public institution established in 1969 and has several divisions:

- Agriculture
- Automotive and Welding
- Building Studies, Business Studies and General Studies
- Electrical Engineering
- Human Ecology
- Mechanical Engineering and Printing.

- **Photovoltaic Installation course over a 3-month period**
- **Almost 100% of these students are local**

Their relationship with the other key stakeholders is depicted in the diagram below.

HEIs have all demonstrated an openness to collaboration and cooperation with RE stakeholders. They depend on public sector and private sector funds in order to serve the job market which is primarily for their existence.

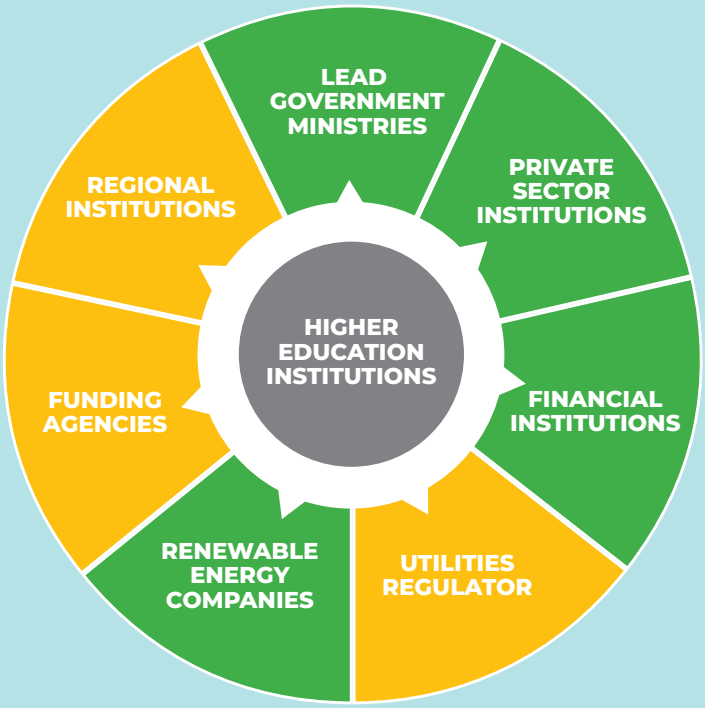



***Figure 3.15 | Relationships of Barbados' Higher Education Institutions***

## 3.3.6 | RENEWABLE ENERGY COMPANIES

The energy policy and related regulations fully support the implementation of RE in Barbados. The target of 100% renewable by 2030 creates the market potential for RECs to be fully occupied. There are over 20 registered RECs but not all are functional. Some contraction did occur around 2015 in response to regulatory changes which led to some closure of smaller companies. The surviving RECs focus mainly on PV installation, manufacturing of LEDs and solar water heating (SWH) along with other energy services. RECs actively export services and assembled SWH and LEDs. There is also a striving EV sub-sector which support the national targets for emissions. Given the national priorities, the RECs have been encouraged by the availability of tax incentives for residential and commercial customers.

RECs have on average approximately 22 staff with only the smallest companies having to depend on freelance labour. Additional experienced technical resources are available if required by a REC to fulfil their contractual obligations to clients. A low level of sub-contracting to the REC does occur on larger utility size projects (5MW+) funded by private investors. This has been driven by local and international private sector investment.

These RECs have been in business for an average of 20 years, varying from 6 to 46 years of experience. Their scope of operations covers the entire local market for the residential and commercial segments along with overseas service and products. Their relationship with the other key stakeholders is depicted in the diagram below.

While the RECs are fully engaged in the Barbados RE industry, there is clearly the need to improve relationships.

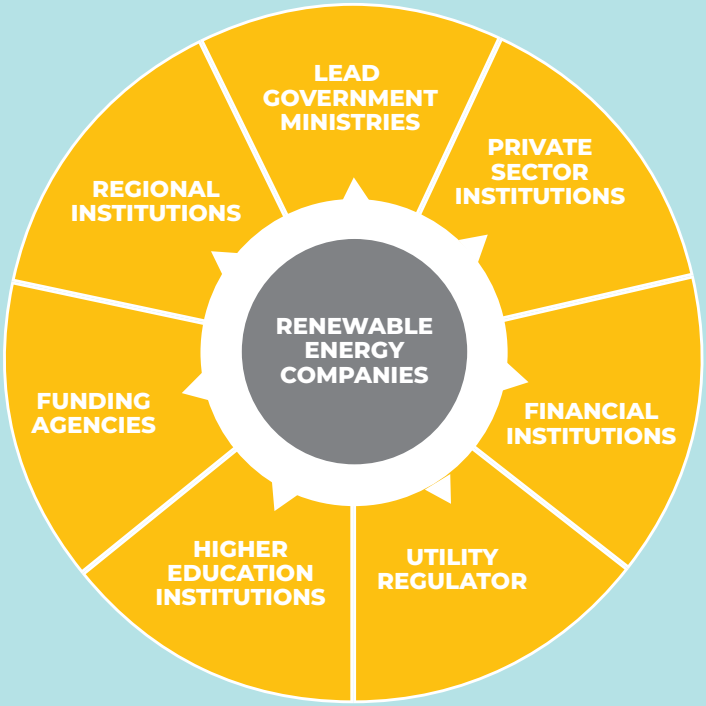



***Figure 3.16 | Relationships of Barbados' Renewable Energy Companies***

## 3.4 | BELIZE


Belize is an independent Caribbean territory bordered by Mexico in the north, Guatemala to the west and south and the Caribbean Sea to the east. It has an abundance of terrestrial and marine species and a diverse ecosystem. Spanning an area of 22,970 square Kilometres, Belize had a population of 398,050 in 2018 (SIB, 2019). It is the only English-speaking country in Central America and its main economic sectors are agriculture and tourism.

The Belize Electricity Limited (BEL) is owned by the government and has an installed capacity of 153.56 MW with 54% renewable. All their electricity is supplied by 9 Independent Power Producers (IPP); 1 being from Mexico (BEL, 2019). 54MW is from hydropower, 43.5MW from Biomass and 0.48MW from PV.

### 3.4.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of Public Service, Energy & Public Utilities is the lead ministry for the energy portfolio, and there is significant consultation between 5 other ministries. This is usually to obtain the requisite input into the decision-making process. The main partner ministry is the Ministry for Sustainable development and Climate Change. There already exists a national energy policy and roadmap to guide their activities. However, specific regulations to allow interconnection and feed-in tariffs for non-utility RE generators have not been completed, resulting in a high level of uncertainty in the market.

The energy unit has grown from 2 persons to 10 persons in the last 10 years and now has more adequate capacity to deal with issues in the RE industry. They actively develop and implement programs to encourage the residential sector in pursuit of their 30% EE savings. The lead Ministry's relationship with the other external stakeholders is depicted in the diagram right.

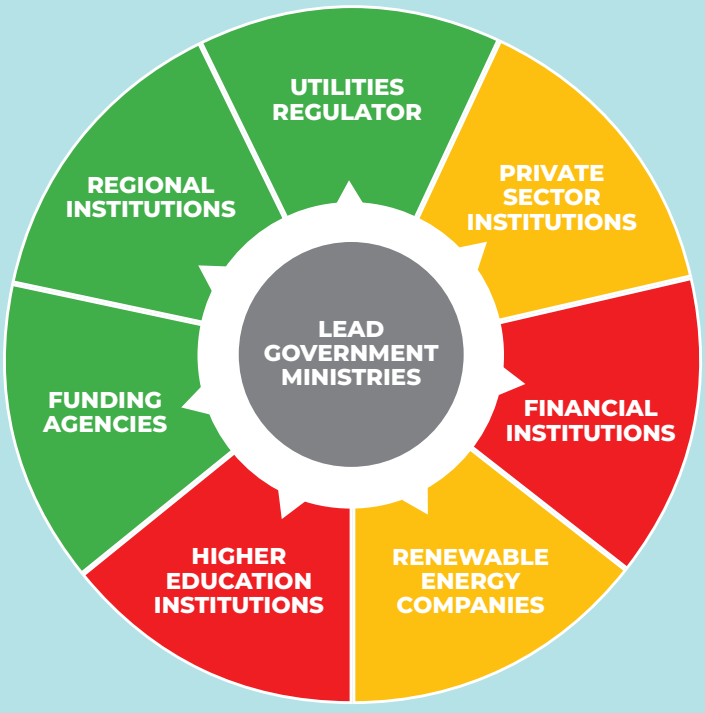



*Figure 3.17 | Relationships of Belize's Lead Government Ministries*

### 3.4.2 | UTILITIES REGULATOR

The regulator for the energy sector in Belize is the Public Utilities Commission (PUC) which is an autonomous institution governed by the provisions of the PUC Act. Its powers are defined within the PUC Act and may also include additional powers provided by any other law conferred by the parliament of the Government. The PUC fulfils much of its statutory obligations through Regulations, By-laws, Orders, Directives or other subsidiary legislation or administrative orders made under the Electricity Act, the Telecommunications Act and the Water and Sewerage Act (PUC, 2018); the Acts which govern the utilities it oversees.

The PUC promotes competition and economy in the generation and supply of electricity and the efficient use of electricity supplied to customers, along with the granting of licences, setting and reviewing electricity rates and investigates queries and complaints.

Their staff complement is 34 to oversee all 3 utilities; water, electricity and telecommunications. Their relationship with the other key stakeholders is depicted in the diagram right.

The nature of the PUC's role does not necessitate significant discussions with the financial and education institutions.

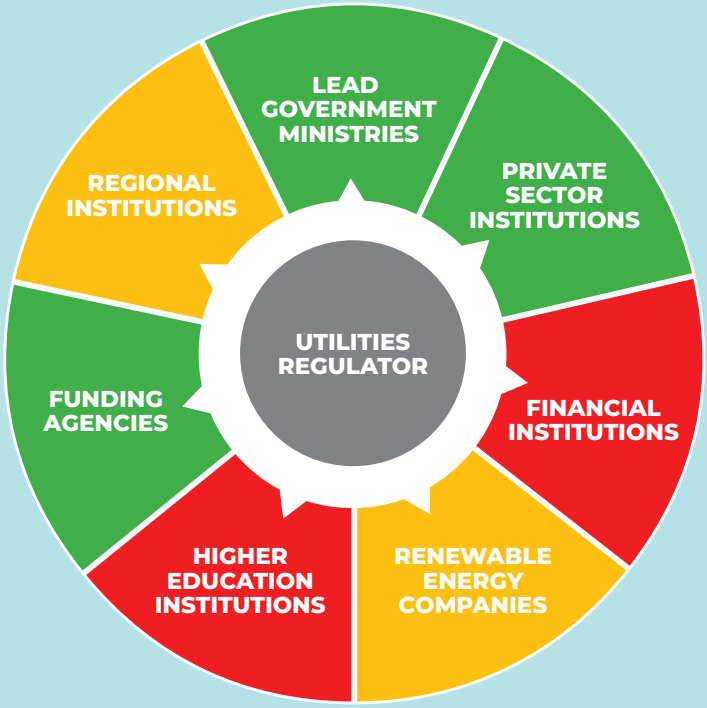



***Figure 3.18 | Relationships of Belize's Utilities Regulator***

### 3.4.3 | FINANCIAL INSTITUTIONS

The financial institutions in Belize include commercial banks, credit unions and other financial institutions. They have most of the local lending capacity required to finance the private sector. There is also a state-owned development bank which extends favourable terms and conditions to the RE sector of 6% (4-6% below market rates) for RE and greening projects. The private commercial entities do not have any special emphasis on the RE sector or related projects. They do acknowledge the new opportunities, but their lending criteria is applied across all sectors; that is, risk assessment, payback, ability to pay, management

capacity, borrowing ceilings, etc. Despite some knowledge of national goals and targets related to RE there has been no engagement with the FIs and hence no business alignment. No special dispensation is in place for the RE sector. Their relationship with the other key stakeholders is depicted in the diagram below.

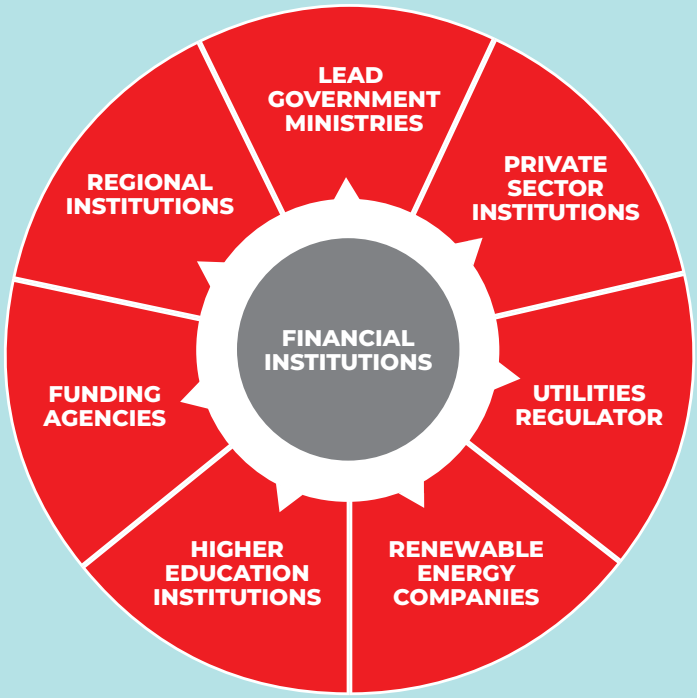



***Figure 3.19 | Relationships of Belize's Financial Institutions***

The slow progress in RE deployment has not created any pressure on the FIs to respond, leaving RE investors to rely primarily on self-financing.

### 3.4.4 | PRIVATE SECTOR INSTITUTIONS

The Belize private sector institutions are well linked together with the overall responsibility to support investment, facilitate export development and promotion, technical assistance, training and advocacy. On average, their membership includes 3 to 4 RECs.

PSI have very few human resources, with an average of 5 persons per PSI. They are currently equipped to adequately execute their mandate on behalf of their members but may be challenged by the demands of a developing RE industry which is young and requires significant public sector support to create a more viable RE industry in Belize. They are also aware of the limited RE initiatives provided by Government but have few requests from RECs due to the lack of regulatory support. They recognize the need to provide training for RE professionals, sensitization and education of all areas of the public and private sector and a

more collaborative approach which includes national stakeholders. Their relationship with the other key stakeholders is depicted in the diagram right.

PSIs have focused on delivering their past mandates with limited resources. There have been limited opportunities in the economy and no requests from their membership/clients, to signal any shift in government's priorities.

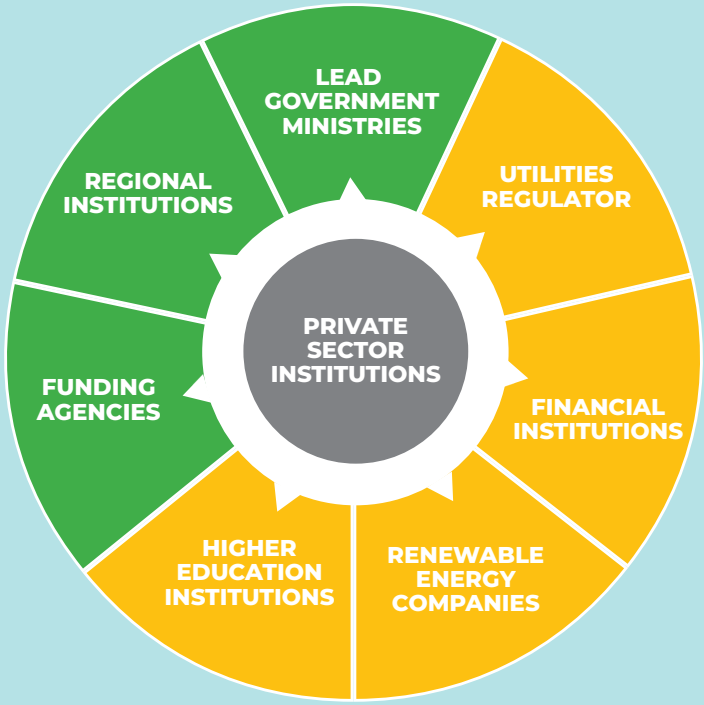



***Figure 3.20 | Relationships of Belize's Private Sector Institutions***

### 3.4.5 | HIGHER EDUCATION INSTITUTIONS

The tertiary institutions in Belize that could potentially provide teaching and training for RE professionals are the University of Belize (UoB) and the Galan University. There is no current research capacity.

**a)** The University of Belize (UoB) was established in 2000 from a merger of five institutions; the University College of Belize (UCB), the Belize Technical College (BTC), the Belize Teachers' Training College (BTTC), the Belize School of Nursing (BSN), and the Belize College of Agriculture (BCA).

**b)** The Galan University was founded in 2003. Unfortunately, there are no renewable energy courses being offered in Belize and no specific plans exist to do so soon. Currently, they play no significant role in the RE Industry. The HEI stakeholder relationships are extrapolated from the other stakeholders which interact with them.

## 3.4.6 | RENEWABLE ENERGY COMPANIES

Belize has an energy mix of about 54% RE; one of the highest in the Caribbean region. This is due to 9 utility scale IPPs and not smaller scale distributed generation. This represents a disconnect between written policy and what is supported and practiced in the RE industry. As a result, the RECs are underutilized. There are about 12 registered RECs but not all are functional and not all are registered as certified implementers. This excludes the utility-sized companies; Belize Electricity Company Limited (BECOL) and Belize Co-generation Energy Limited (BELCOGEN).

RECs have on average 7 staff. These RECs have been in business for an average of 10 years, varying from 7 to 11 years of experience. Their scope of operations covers most of the local market needs for the residential and commercial segments. Subcontracted work includes some equipment installations and solar water heaters. Their relationships with the other key stakeholders are depicted in the diagram right

The RECs do not have very beneficial relationships but remain engaged with all stakeholders in the hope of an improved RE industry. Their opportunities are few and restrictive.

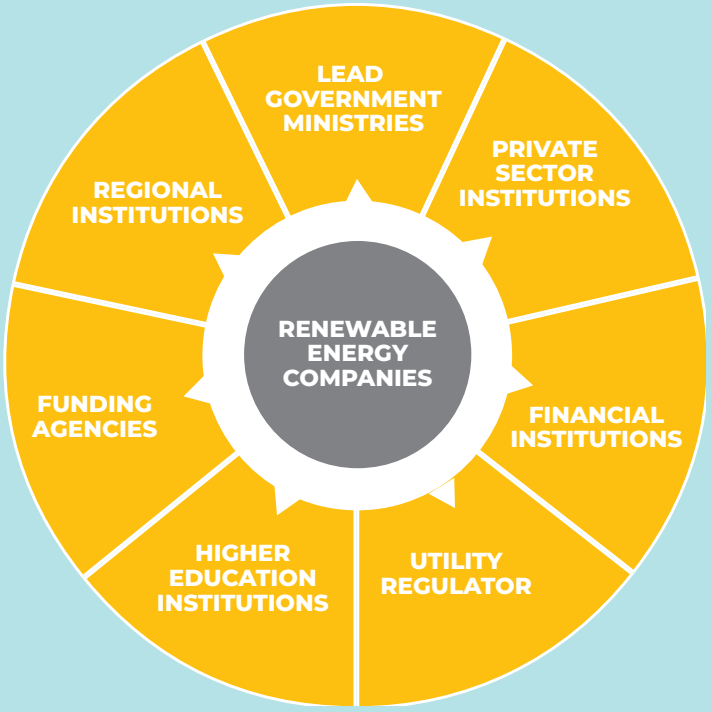



*Figure 3.21 | Relationships of Belize's Renewable Energy Companies*

## 3.5 | DOMINICA

The Commonwealth of Dominica is located southeast of Guadeloupe and northwest of Martinique. The island is 751 square Kilometres and had a population of around 71,625 (WB, 2018). Dominica's economy is primarily agriculture-based and includes eco-tourism. Efforts to promote diversification have included offshore medical education and investments in niche agricultural products.

The electricity utility is privately owned. The country has an installed capacity around 26.7 MW as reported in their energy score card for 2018 including about 6.6 MW capacity of renewables. The Dominica Electricity Service Limited (DOMLEC) is actively involved in RE generation for the grid but not for customers within the competitive RE industry. The utility is responsible for the 6.6MW of hydropower and a small amount of wind.

### 3.5.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of Blue and Green Economies, Agriculture and National Food Security is the lead ministry with responsibility for the energy portfolio. Along with close consultation with the Ministries responsible for Public Works, Planning, Housing and Environment, they execute the policy for the sector. There exists a national energy policy with targets and the required framework and regulations required to facilitate interconnection to the national grid and related feed-in tariffs for non-utility RE generators. The policy is currently awaiting cabinet approval.

Specifically, the energy unit has 8 persons including a project implementation unit with coordinating responsibility for all Geothermal work. One resource has the responsibility for coordinating with all other stakeholders. The energy unit is relatively new to the Ministry and must now build the capacity necessary to develop the RE industry alongside the regulator in order to achieve the national RE targets. Dominica has been actively pursuing geothermal energy to compliment the Hydropower in their RE portfolio. The lead Ministry's relationship with the other external stakeholders is depicted in the diagram on the following page.

The LGM has had the current responsibility of energy for less than a year. Some of its relationships have been ad-hoc, building on what has been achieved through past relationships without having to restart those relationships. Its scope has however been widening and is expected to develop more beneficial relationships.

### 3.5.2 | UTILITIES REGULATOR

The regulator for the energy sector in Dominica is the Independent Regulatory Commission (IRC). It fulfils much of its statutory obligations through regulations, by-laws, orders and policy directives. The IRC promotes competition and efficiency in the generation and supply of electricity, grants licences, and sets rates. This includes the feed-in tariffs for RE systems and this is based on the avoided cost of diesel. It acts as an independent arbiter in all matters relating to the sale of electricity and performs a developmental role in the industry as it seeks to create models and structure which can support the goals of the Government.

There are 8 staff to oversee the utilities. Their relationship with the other key stakeholders is depicted in the diagram right. The nature of the IRC's role does not currently necessitate significant discussions with the financial institutions and the HEI have no capacity to contribute to the RE industry.


*Figure 3.22 | Relationships of Dominica's Lead Government Ministries*

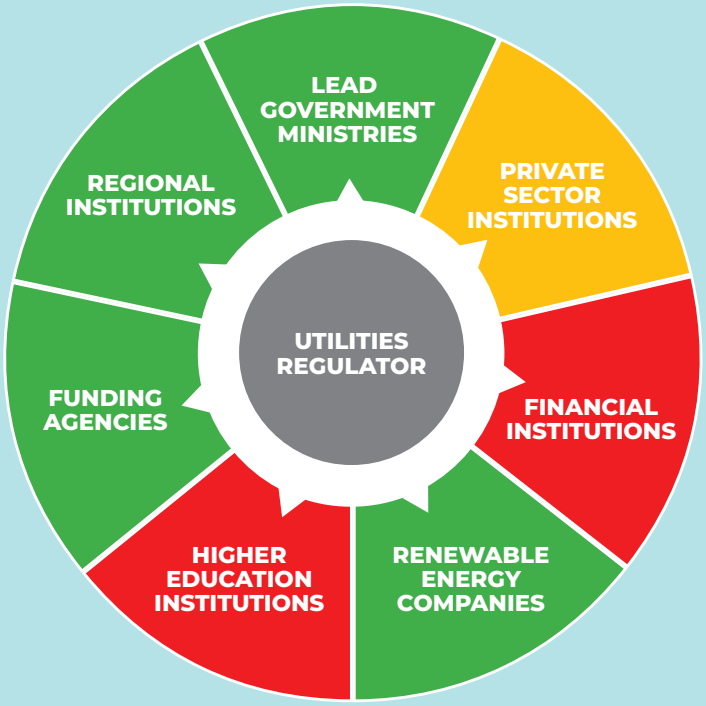



*Figure 3.23 | Relationships of Dominica's Utilities Regulator*

### 3.5.3 | FINANCIAL INSTITUTIONS

The financial institutions in Dominica show varying interests in the RE sector and are not very engaged with the other stakeholders. Commercial banks tend to treat RE requests like any other request showing no preferential treatment. Consequently, they currently play no significant role. In contrast, the National Bank of Dominica and the Agriculture Investment Development Bank (AIDB) offer lower interest loans to the RE industry and is very supportive of applicants. The FI stakeholder relationships are extrapolated from the other stakeholders which interact with them.

### 3.5.4 | PRIVATE SECTOR INSTITUTIONS

The Dominica private sector institutions seek to support the development and increased competitiveness of MSME; especially those in the productive sectors like tourism, manufacturing and agriculture. It also provides training and plays a strong advocacy role on behalf of their clients. Their membership includes an average of 1 REC.

PSI have very few human resources, with on average 2 persons. They are therefore not equipped to adequately execute their mandate on behalf of their members and certainly not as it relates to the RE industry which is young and requires significant public sector support to create a viable RE industry in Dominica. The PSIs would like to see more incentives such as personal and business tax breaks for the sector which would encourage more economic activity.

They are aware of the limited RE initiatives like import duty and tax waivers provided by Government and have limited requests to strive for more support. Their relationship with the other key stakeholders is depicted in the diagram below.

PSIs have focused on delivering their past mandates with limited resources. There have been limited opportunities in the economy and no requests from their membership/clients, to signal any shift in the government's priorities.

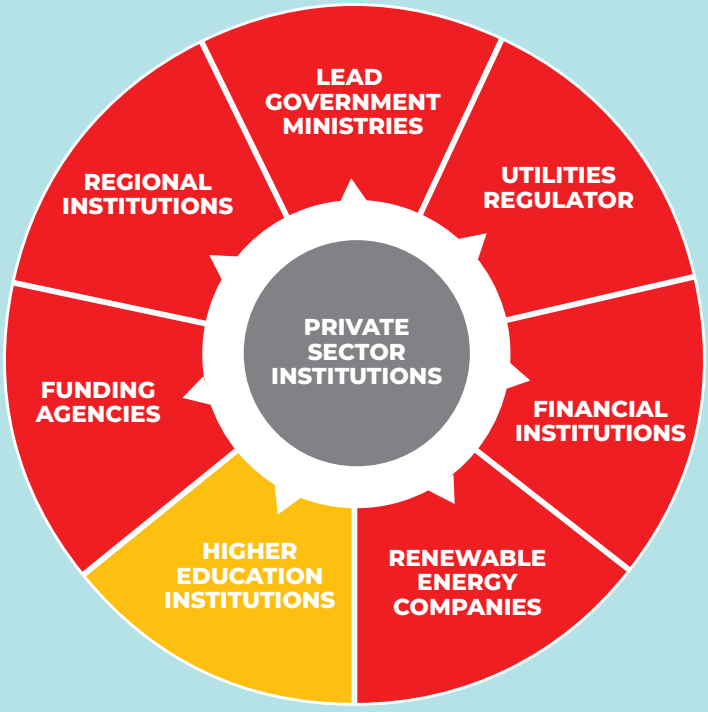



***Figure 3.24 | Relationships of Dominica's Private Sector Institutions***

### 3.5.5 | HIGHER EDUCATION INSTITUTIONS

The tertiary institution in Dominica that could potentially provide teaching and training for RE professionals is the Dominica State College. This college was established by an Act of Parliament in 2002. The college is a merger of the Technical College and the 6th Form College and offers several educational programmes. Unfortunately, there are no renewable energy courses being offered and no specific plans exist to do so. There is some interest but currently do not play any significant role in the RE Industry and have no capacity for research or innovation. The HEI stakeholder relationships are extrapolated from the other stakeholders.

### 3.5.6 | RENEWABLE ENERGY COMPANIES

There have been signals in the RE industry in Dominica that distributed generation is being supported but there is still some delay in the final policy documentation which will provide the needed certainty in the market. Only 3 RECs currently operate in this sector and they only offer design and installation of PV systems along with auditing services and the retailing of some EE equipment. A low level of sub-contracting to the REC does occur on larger utility size projects (5MW+) funded by private foreign investors.

RECs have on average 15 staff ranging from 6 to 25 and have been in business for an average of 10 years, varying from 7 to 13 years. Their scope of operations covers most of the local market needs for the residential and commercial segments. Their relationship with the other key stakeholders is depicted in the diagram right.

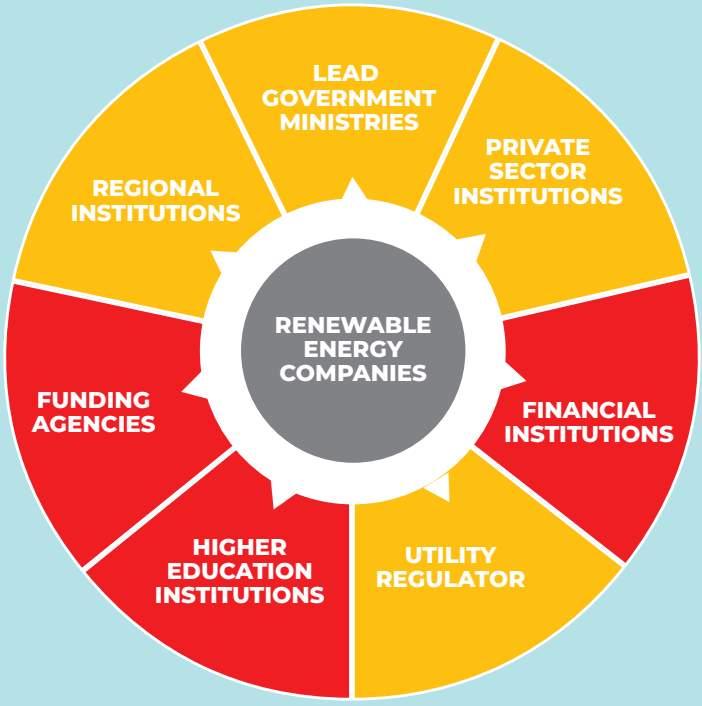



***Figure 3.25 | Relationships of Dominica's Renewable Energy Companies***

## 3.6 | DOMINICAN REPUBLIC

Dominican Republic is an independent territory on the Island of Santo Domingo where it shares a border with Haiti. It spans an area of 48,670 square Kilometres and had a population of around 10.6 million people as of 2019 (UN, 2019). The electricity utilities are Government owned and have an installed capacity of 3,708 MW with 780 MW of RE. 37MW are from wind and 482MW from hydropower.

There are over 13 large scale electricity generators, one of the largest being the privately owned AES Andre with 15.64% of total energy generated, followed by the state-owned Empresa de Generación Hidroeléctrica Dominicana at 13.62% and Empresa Generadora de Electricidad Haina at 12.08%. Due to grid instability, several industries and individuals now generate their own electricity.

### 3.6.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of Energy and Mines is responsible for the development and management of energy policy and national non-metallic mining and metal. It contributes to sustainable development through the formulation and management of public policies that regulate and promote energy security. The National Energy Commission (CNE) which was established in 2001 under the General Electricity Law is located within that ministry and works with other ministries which share some aspects of the energy portfolio. RE deployment is promoted primarily as IPP opportunities and a goal of 25% of electricity generation from RE by 2025 has been set. Direct contact with the lead ministry was not established due to recent changes in government.

### 3.6.2 | UTILITIES REGULATOR

The regulator is the Superintendent of Electricity which has the responsibility of developing national policy in the energy sector and overseeing renewable energy development in the country. The director oversees compliance with the laws and regulations which govern the sector along with the technical standards of electricity generation, distribution, and transmission. Direct contact with the regulator was not established due to recent changes in government.

### 3.6.3 | FINANCIAL INSTITUTIONS

Despite efforts we were unable to contact any financial institutions directly.

### 3.6.4 | PRIVATE SECTOR INSTITUTIONS

Despite efforts we were unable to contact any private sector institutions directly.

### 3.6.5 | HIGHER EDUCATION INSTITUTIONS

There are several Tertiary Education Institutions in the Dominican Republic which could potentially provide teaching and training for RE professionals, such as the Instituto Tecnologico de Santo Domingo, INTEC, Pontificia Universidad Católica Madre y Maestra (PUCMM) and the Dominican University O&M. Only INTEC has related programs in their academic offering.

**a) INTEC** was established in 1972 and has 5 Faculties:

- Engineering
- Basic and Environmental Sciences
- Health Sciences
- Social Sciences and Humanities
- Economy and business

- **Diploma in Management Systems and Energy Audits over a 3-month period**
- **Specialization in RE technologies over a 15 month period**
- **Specialization in RE efficiencies over a 15 month period**
- **Master's Degree in RE Technology over 2 years**
- **Master's Degree in RE Technologies over 2 years**
- **Doctorate in Energy Management for Sustainable Development over 3-years**
- **Almost 100% of the students are local**

The relationship with the other key stakeholders is depicted in the diagram below.

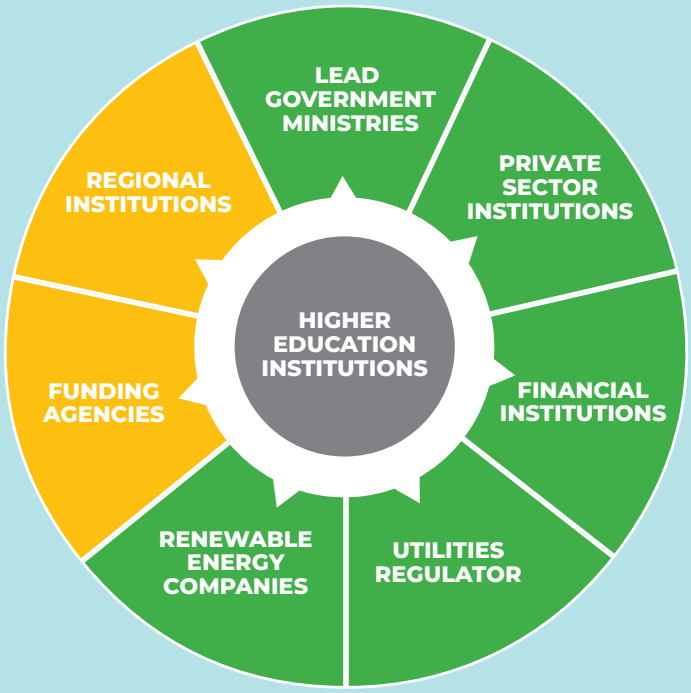



***Figure 3.31 | Relationships of Dominican Republic's Higher Education Institutions***

Academia is very open to collaboration and cooperation with RE stakeholders but their connections with the regional institutions are not well established.

## 3.6.6 | RENEWABLE ENERGY COMPANIES

There have been several pieces of legislation which address electricity services in the Dominican Republic since 2007 with plans to support and encourage RE implementations. Unfortunately, some laws have not been enacted and some plans have not been implemented, thereby negatively impacting the growth of the RE industry. There has been some distributed generation with connections to the grid. Generous tax exemptions on RE generation revenues and between 75% and 100% waivers on import charges on RE and EE equipment has been a source of encouragement. There are over 12 well established RECs currently operating in this market with a similar amount of smaller entities. They offer design and installation of PV systems along with auditing services and RE and EE retail sales.

RECs have on average over 50 staff and have been in business for an average of 20 years. Their scope of operations covers most of the local market needs for the residential and commercial segments, utilities and government. Their relationship with the other key stakeholders is depicted in the diagram below.

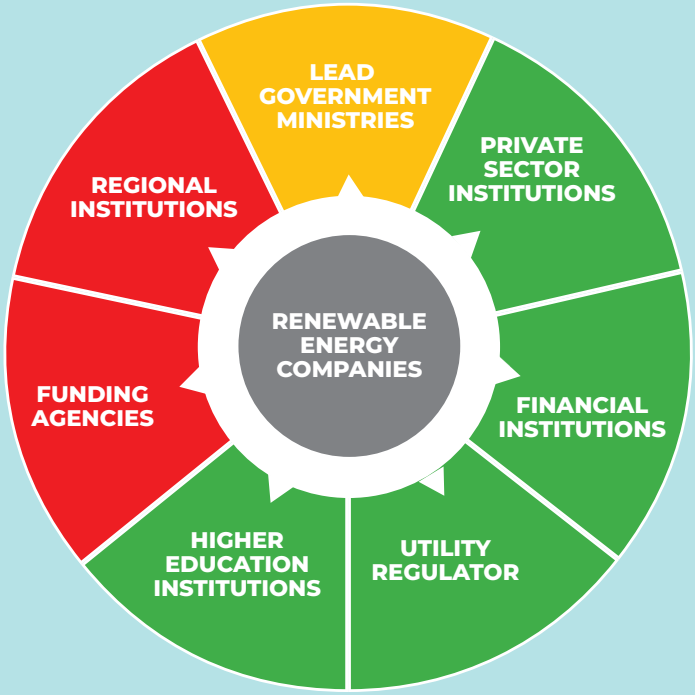



***Figure 3.32 | Relationships of Dominican Republic's Renewable Energy Companies***

## 3.7 | GRENADA

Grenada is an independent Caribbean Island spanning an area of 344 square Kilometres and had a population of 112,003 as of 2019 (UN, 2019). Its main economic sectors are tourism and agriculture.

The Government is currently a minor shareholder in the Electricity Utility but expects to become the sole or major shareholder based on a recent court ruling.

Grenada Electricity Services Limited (GRENLEC) has an installed capacity of 55.57 MW with about 2.5 MW of renewables in their energy generation mix. This is from PV installations by the utility.

### 3.7.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of Infrastructure Development, Public Utilities, Energy, Transport and Implementation is the lead ministry for the energy portfolio, and they consult with 3 other ministries in order to execute their mandate. There is a national energy policy and an interconnection policy in place to guide their activities. However, a road map and specific regulations to allow interconnection and feed-in tariffs for non-utility RE generators are still outstanding, resulting in market uncertainty.

This ministry has 156 persons which are shared across the different responsibilities. This should be adequate capacity to deal with issues in the RE industry. They actively encourage the use of RE. This is seen through their demonstration PV project and a solar PV/battery hybrid project. The lead Ministry's relationship with the other external stakeholders is depicted in the diagram right.

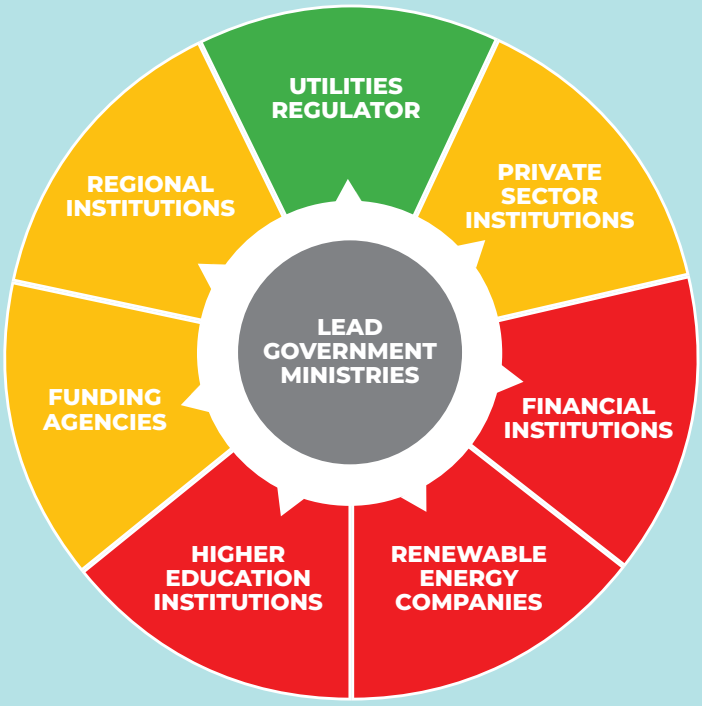



***Figure 3.33 | Relationships of Grenada's Lead Government Ministries***

## 3.7.2 | UTILITIES REGULATOR

The regulator for the RE Industry is the Public Utilities Regulatory Commission (PURC). It was established by the PURC Act, No. 20 of 2016 to regulate the Grenada's public utilities operations. The PURC began its operations in February 2019.

Its functions cover electricity rates, complaints, investigations, licencing and feed-in tariffs as well as ensuring that the environment is one that promotes fairness, sustainability and security in the electricity sector. There are 7 persons in the PURC to perform these functions. Their relationship with the other key stakeholders is depicted in the diagram below.

The regulatory function in relation to RE has only been recently established in 2019 and this department is therefore still learning the industry. They have not yet established all the relationships necessary to develop this sector.

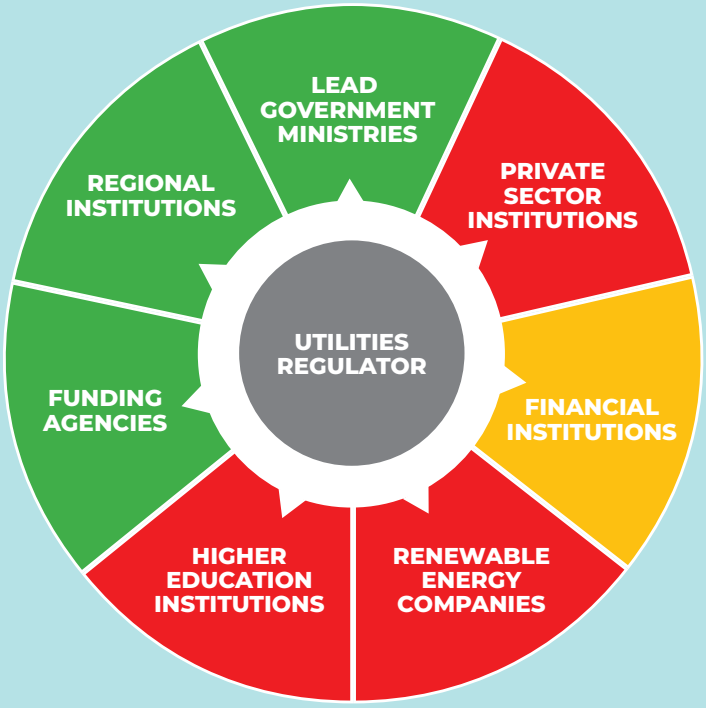



***Figure 3.34 | Relationships of Grenada's Utilities Regulator***

## 3.7.3 | FINANCIAL INSTITUTIONS

The financial institutions in Grenada are not very engaged with the other stakeholders. Commercial banks tend to treat RE requests like any other request and offer no preferential treatment. The RE Industry is also quite small and mostly self-financed. Consequently, the FIs currently play no significant role. In contrast, the Grenada Development Bank is very supporting of RE projects. The bank offers a maximum loan amount of US$150,000 with an interest rate of 4.99% with up to 8 years to repay, with 100% project financing. Their relationship with the other key stakeholders is depicted in the diagram right.

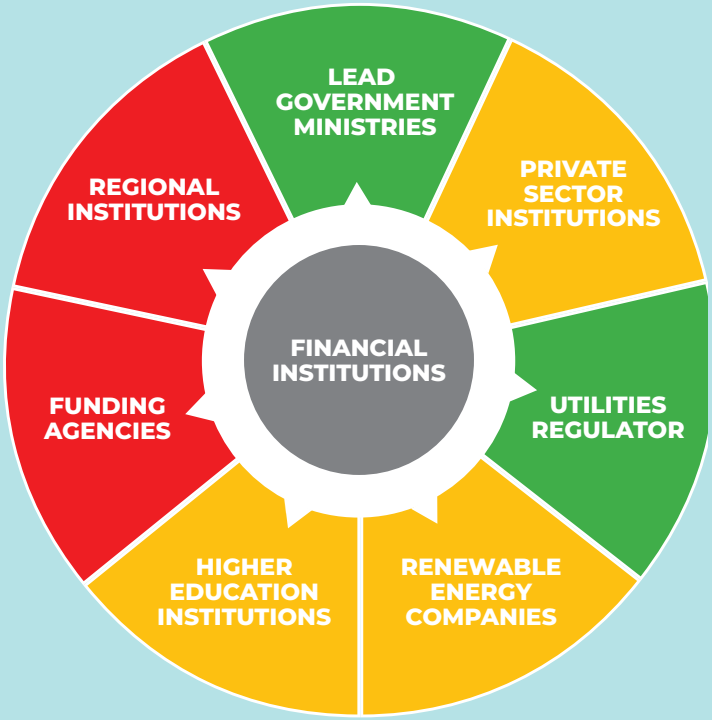



***Figure 3.35 | Relationships of Grenada's Financial Institutions***

### 3.7.4 | PRIVATE SECTOR INSTITUTIONS

The Grenada private sector institutions have overall responsibility to support economic development amongst businesses through advocacy, capacity building and assistance in accessing financing. On average, PSI membership includes 1 REC. They are currently equipped to adequately execute their mandate on behalf of their members but may be challenged to keep up with a developing RE industry which will require significant public sector support in order to become viable.

They recognize the need to provide training for awareness and education within the population so that the benefits of RE may be better understood. PSIs also believe that the government needs to consider the subsidization of the initial investment costs of commercial and utility scale projects to boost foreign direct investment (FDI) and greater local support from commercial banks. Their relationship with the other key stakeholders is depicted in the diagram right.

There have been limited opportunities to invest in RE systems to sell energy to the national grid and little demand from RECs for representation from the PSIs in the form of lobbying, technical or financial assistance to develop their businesses. However, PSIs remain open to stakeholder consultations.

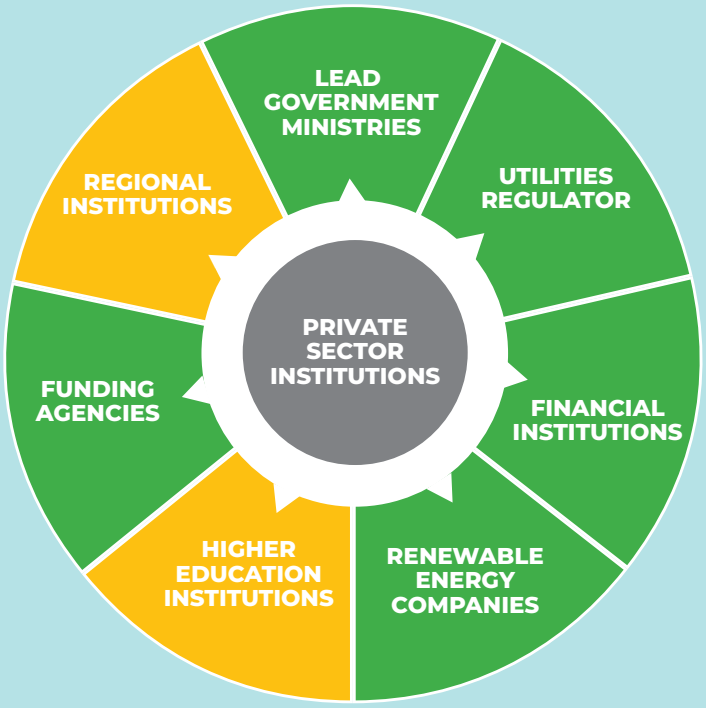



*Figure 3.36 | Relationships of Grenada's Private Sector Institutions*

### 3.7.5 | HIGHER EDUCATION INSTITUTIONS

The main tertiary institutions in Grenada are T. A. Marryshow Community College (TAMCC) and the St. George's University (SGU).

a) **TAMCC** was stablished was established by the Government of Grenada in 1988 by a merger of several educational institutions.

b) **SGU** was founded as an independent School of Medicine in 1976 and opened its doors to students in 1977.

Unfortunately, there are no renewable energy courses being offered in Grenada and no specific plans exist to do so soon. Currently, they play no significant role in the RE Industry and have no research capacity. The HEI stakeholder relationships are extrapolated from the other stakeholders that interact with them.

## 3.7.6 | RENEWABLE ENERGY COMPANIES

There have been clear indications from the Government of Grenada that they support self-generation along with distributed generation by IPPs and other local entities. However, there is still some uncertainty in the industry stemming from delays in establishing the necessary regulatory framework. This may also be contributing to the limited number of RECs currently operating in this sector and their limited product and service offering; namely design and installation of PV systems along with consulting and training services. Some services like energy auditing are sub-contracted.

RECs have on average 8 staff ranging from 1 to 16 and have been in business for an average of 9 years, varying from 3 to 15 years. Their scope of operations covers the current local market needs for the residential and commercial segments and need to enhance their labour by accessing the mobile labour markets when large projects are being undertaken. Their relationship with the other key stakeholders is depicted in the diagram right.

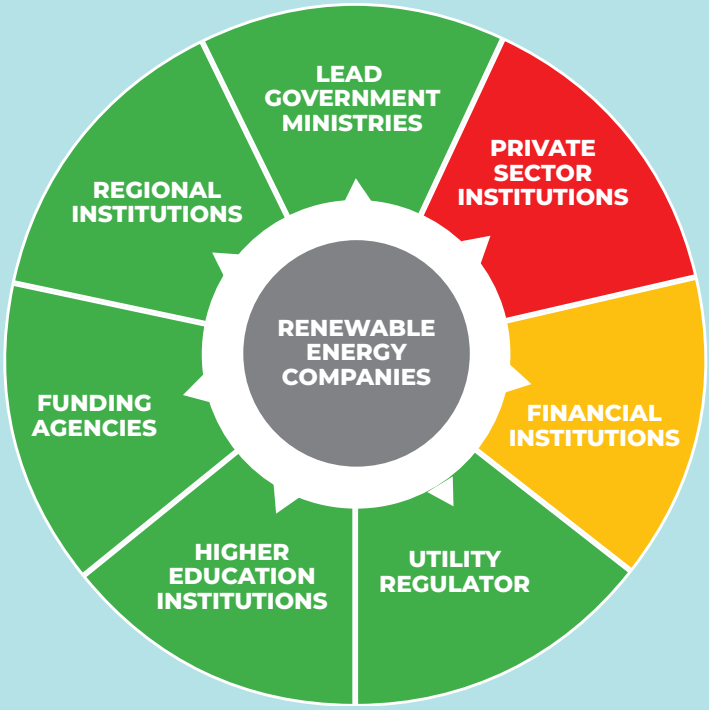



***Figure 3.37 | Relationships of Grenada's Renewable Energy Companies***

The RECs have established relationships with most of the stakeholders in the Grenada RE industry. Their weakest relations are in the private sector and financial institutions where education and awareness remain an issue. With greater policy directives to address the market uncertainties these relationships are likely to improve significantly.

## 3.8 | GUYANA

Guyana is an independent Caribbean territory on the South American continent with an area of 196,850 square Kilometres and had a population of 786,550 as of 2019 (UN, 2019). Its main economic sectors are agriculture and the extractive industries. The electricity utility is owned by the government. Guyana Power and Light Incorporated (GPL) has an installed capacity of about 404 MW with 57.4 MW of RE in their energy generation mix (GUY, 2017). 54.03MW is from Biomass, 2.97MW from Solar PV and 0.4MW from wind.

Given their landscape, there are several off-grid standalone PV systems in the hinterland regions. GPL encourages interconnection with their network subject to compliance with standards and inspection from the Government Electrical Inspectorate (GEI) but do not install systems for customers within the competitive RE industry.

### 3.8.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of the Presidency has responsibility for the Guyana Energy Agency (GEA) which is the lead entity for the energy portfolio. It consults with other ministries in order to execute its functions using energy implementation working groups. There already exists a national energy policy and roadmap to guide their activities. While legislation exists for interconnection to the national grid, specific regulations and feed-in tariffs for non-utility RE generators are still being developed.

The energy unit has 112 employees which is adequate capacity to deal with issues in the RE industry. They actively develop and implement programs to encourage the residential sector in pursuit of significant improvements in EE and their focus on hydropower, PV and wind. The lead Ministry's relationship with the other external stakeholders is depicted in the diagram below.

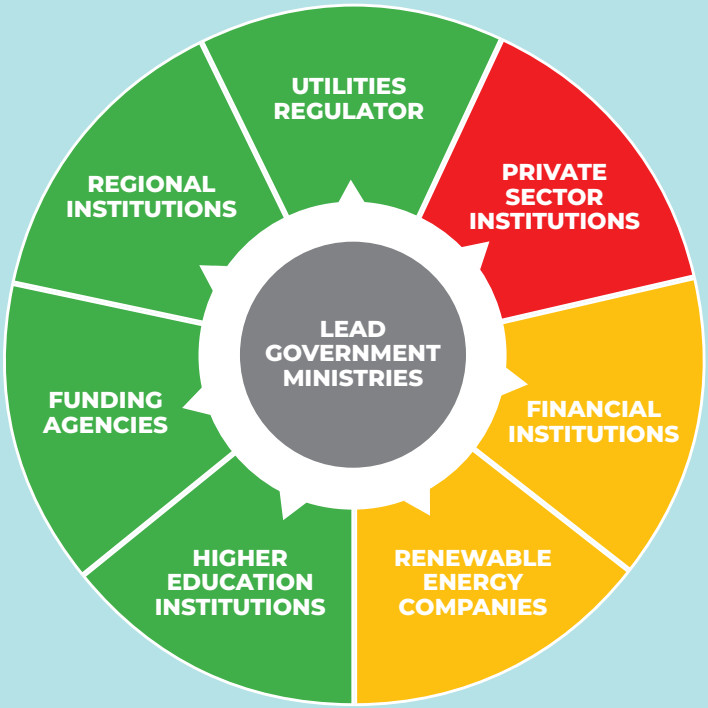



***Figure 3.39 | Relationships of Guyana's Lead Government Ministries***

### 3.8.2 | UTILITIES REGULATOR

The regulator is the Guyana Public Utilities Commission (PUC) Regulation. It has oversight for all utilities including the energy sector and therefore plays an important role in the liberalization of that sector and the emergence of the RE industry. The functions of the Commission include regulation, investigation, enforcement and all other areas defined in the Act including an amendment in 2016. They police the operations and standards of service of the utilities under its purview. Electricity licences are however issued by the Office of the President. The PUC may also act in an advisory capacity to the Minister responsible for energy. The UR's stakeholder relationships are extrapolated from the other stakeholders that interact with them.

### 3.8.3 | FINANCIAL INSTITUTIONS

The financial institutions in Guyana include commercial banks, credit unions and other financial institutions. They have the capacity to finance the private sector even though there is the expectation that Oil and Gas Industry proceeds will finance much of the work planned for the Green Economy including RE and EE. While RE is not a specific focus of the FIs, there is interest in supporting financing in the residential and commercial sectors. They are aware of the national objectives and are committed to providing additional financing for the RE sector and at lower interest rates; thereby aligning with the RE goals.

Their credit due diligence policies remain in place in order to manage their risks; e.g. examining payback, ability to pay, management capacity, etc. Financing thresholds are flexible and may go up to US$10M. Their relationship with the other key stakeholders is depicted in the diagram right.

FIs are not pursuing relationships with stakeholders even though they remain supportive when approached.

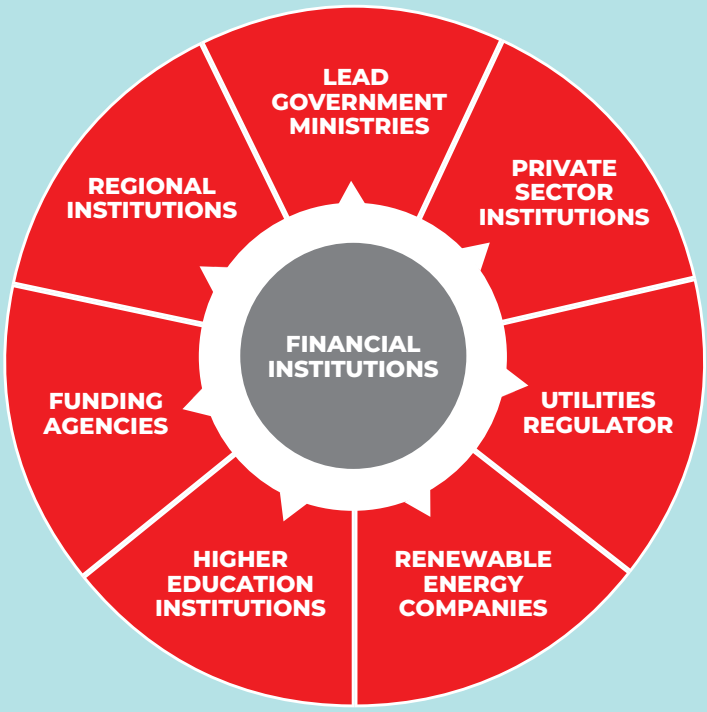



*Figure 3.40 | Relationships of Guyana's Financial Institutions*

### 3.8.4 | PRIVATE SECTOR INSTITUTIONS

The Guyana private sector institutions show interest in the RE sector. Their responsibilities in the private sector include investment promotion and facilitation of government incentives, trade promotion, advocacy, training and export development. Investment in RE and specific work towards enabling clients to develop RE business opportunities has been limited due to the missing regulatory elements and the extremely low number of RECs amongst their membership, averaging between 1 and 2.

PSIs have adequate human resources. They are therefore well equipped to adequately execute their mandate on behalf of their members including any that may come from the RE industry. PSIs believe that access to financing is crucial, along with the completion of key studies like the IDB study on grid connection. There is also the need for more RE/EE promotion and clear financial arrangements for investors with possible guarantees for private self-generation systems. Their relationship with the other key stakeholders is depicted in the diagram below.

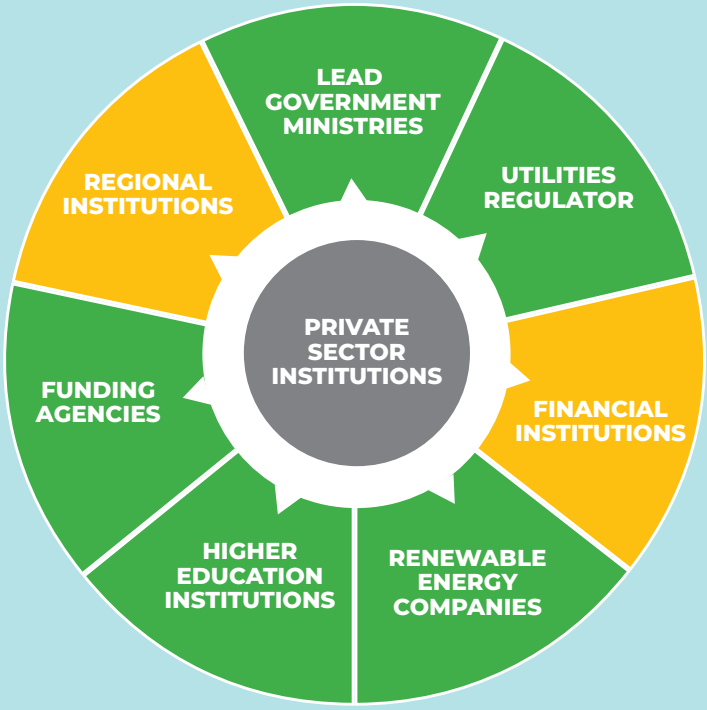



*Figure 3.41 | Relationships of Guyana's Private Sector Institutions*

### 3.8.5 | HIGHER EDUCATION INSTITUTIONS

The two tertiary institutions in Guyana that could potentially provide teaching and training for RE professionals are the University of Guyana (UG) and the Guyana Government Technical Institute (GTI).

**a)** **GTI** was established in 1951 as a public education institution and has no plans to offer RE or EE courses.

**b)** **UG** was formed in 1963 as a public education institution. It does not currently offer renewable energy courses but has plans to start a School of Energy which will focus on the Oil and Gas Industry but also include RE. There is a small Biodiesel plant, but no research is being done. The HEI stakeholder relationships are extrapolated from the other stakeholders that interact with them.

### 3.8.6 | RENEWABLE ENERGY COMPANIES

RE companies are limited in their scope. While there are some legislative elements in place to support the industry, RECs are unable to install systems to connect to the grid because of pending regulations including the feed-in tariff (FIT). There has been a focus on PV systems for remote locations separate from the grid and utility scale deployment for the grid. EE is however widely promoted and supported by retailers of energy saving devices like LEDs. In most cases, RE and EE are not the focus of businesses.

Companies have on average 5 employees and have been in operation for 6 years. There is no significant demand for RE systems in the residential and commercial sectors since there is no opportunity to connect to the grid. Their relationship with the other key stakeholders is depicted in the diagram below.

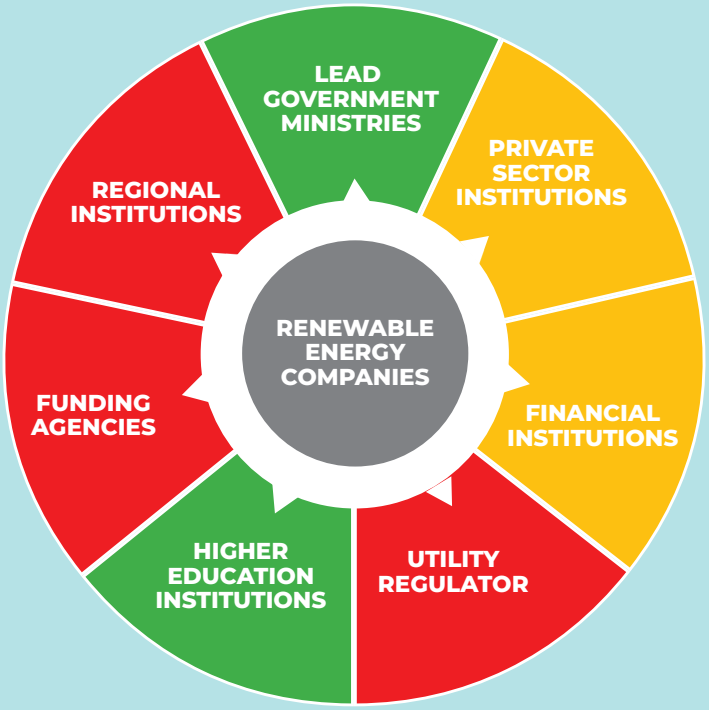



***Figure 3.42 | Relationships of Guyana's Renewable Energy Companies***

## 3.9 | HAITI

Haiti is an independent territory on the Island of Santo Domingo where it shares a border with Dominican Republic. It spans an area of 27,750 square Kilometres and had a population of around 11.3 million people as of 2019 (UN, 2019). The two electricity utilities are Government owned and have an installed capacity of 314.6 MW with 63.35 MW of RE. 62MW is from hydropower and1.35MW is from solar PV, all installed by the utilities. Three major IPPs supply traditional fossil-based energy.

The Electricité d'Haiti (EDH) and Centrale Tripartite PBM (Petion, Bolivar, et Marti) do not provide any RE systems to customers.

### 3.9.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of Public Works, Transportation and Communications has the responsibility for the energy portfolio which is led by the energy cell in that ministry. It consults mainly with the Bureau des Mines et de lénergie d'Haiti in order to execute its functions. There already exists a national energy policy but it does not contain provisions for RE or the related roadmap to guide their RE activities. Government has also granted permission to allow interconnection to the national grid but specific regulations and feed-in tariffs for non-utility RE generators are still outstanding. The lead Ministry's relationship with the other external stakeholders is depicted in the diagram right.


*Figure 3.44 – Relationships of Haiti's Lead Government Ministries*

### 3.9.2 | UTILITIES REGULATOR

The regulator is the National Authority for the Regulation of the Energy Sector (ANARSE) which is in the Ministry of Public Works Transportation and Communication. It is a newly established entity to oversee the energy sector including arrangements between RE generators and the electricity utility. The ANARSE's activities in the RE Sector will be guided by the revised National Energy Policy. The ANARSE stakeholder relationships with the other key stakeholders is depicted in the diagram right.

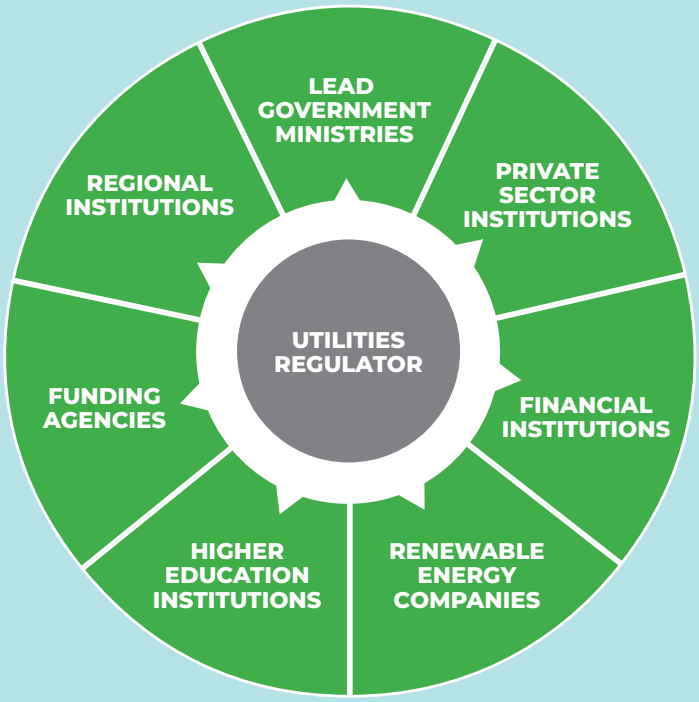



*Figure 3.45 | Relationships of Haiti's Utilities Regulator*

### 3.9.3 | FINANCIAL INSTITUTIONS

The financial institutions in Haiti have not placed any focus on RE nor the targets established by Government. FIs tend to treat RE requests like any other request and offer no preferential treatment. They are confident in their offer of low interest rates and favourable credit terms for all their customers. The RE industry is also quite small since no policies have been put in place to create any momentum in the RE market. Consequently, the FIs currently play no significant role but are quite open to the potential opportunities. Their relationship with the other key stakeholders is depicted in the diagram right.

FIs are not engaged with other stakeholders because there is little need at this time. They are however interested in requests which may arise.

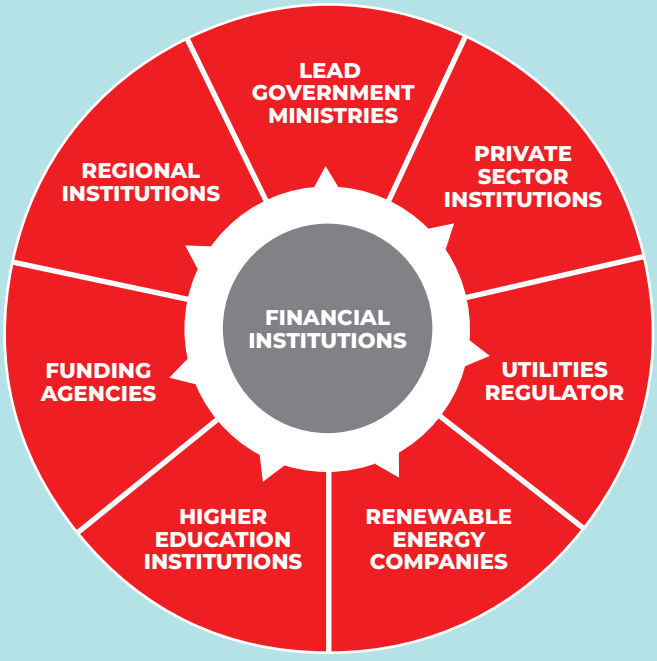



*Figure 3.46 | Relationships of Haiti's Financial Institutions*

## 3.9.4 | PRIVATE SECTOR INSTITUTIONS

The Haiti private sector institutions have overall responsibility to support economic development amongst businesses. On average, PSI membership includes 1 REC. They also average about 12 members per institution and can adequately execute their mandate of advocacy, capacity building and assistance in accessing technologies, on behalf of their members. Their level of engagement is very low because of their limited membership. On average they have 2 RECs as part of their membership. Their relationship with the other key stakeholders is depicted in the diagram right.

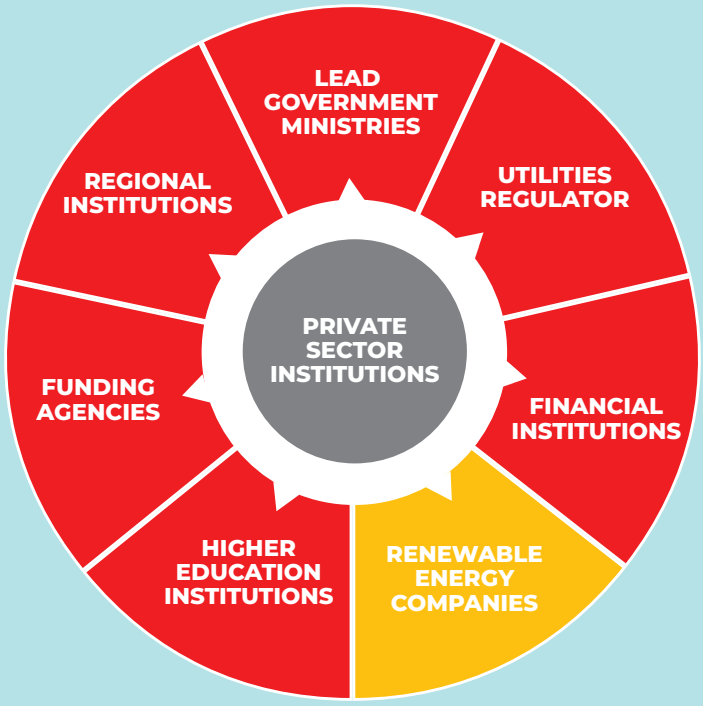



***Figure 3.47 | Relationships of Haiti's Private Sector Institutions***

## 3.9.5 | HIGHER EDUCATION INSTITUTIONS

There are a few Higher Education Institutions in Haiti that could potentially provide teaching and training for RE professionals. Some are not yet involved in providing training in the field. They include Ecole Superieure d'Infotronique d'Haiti (ESIH), Campus Henry Christophe de l'Universite d'Etat d'Haiti a Limonade (CHCL) and Energy and Sustainable Development Fair (ESDF).

**a)** **ESIH** was established in 1995 and has an annual enrolment of between 400 and 450 students. They offer courses in Business, Computer Science and Technologies but no courses in Renewable Energy or Energy Efficiency.

**b)** **CHCL** is a public university with a long history dating back to 1944 with significant changes in 1960 and 1987. CHCL has an average annual enrolment of 3000 students, 60 of which enrol in a RE related course at the undergraduate level.

**c)** **ESDF** is a small private institution which provides professional training to public individuals. Its average annual enrolment is 600 and only offers certificates of completion.

Their relationship with the other key stakeholders is depicted in figure 3.48, right.

HEIs offer no substantial courses in RE or EE for the industry. They have demonstrated some interest and are open to collaboration and cooperation with RE stakeholders if opportunities arise.

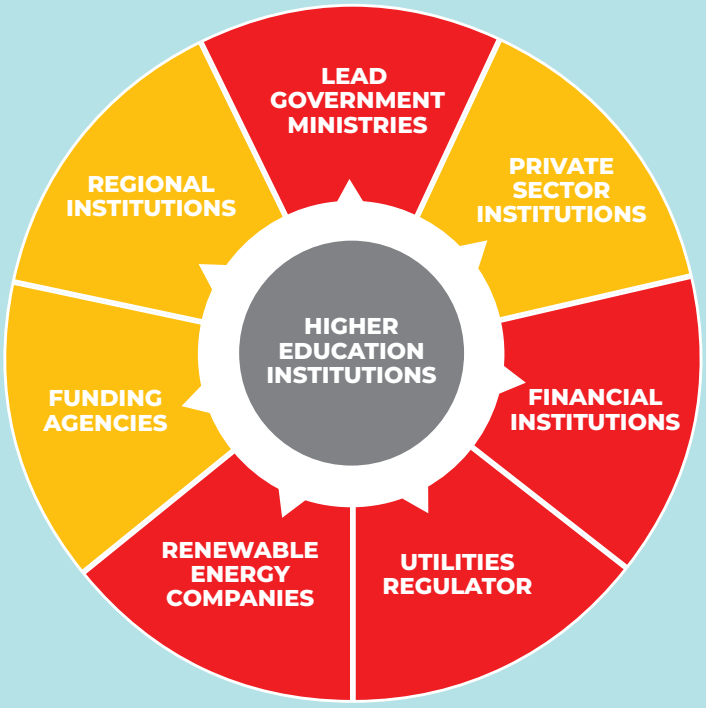



***Figure 3.48 | Relationships of Haiti's Higher Education Institutions***

## 3.9.6 | RENEWABLE ENERGY COMPANIES

Even though the policy and regulatory environment in Haiti is incomplete and uncertain, the RE industry has been moving in a positive way to implement RE systems across communities. 14 RECs currently operate in this sector and they only offer design and installation of PV systems along with auditing services and the retailing of some EE equipment. A low level of sub-contracting to RECs does occur for large implementations.

RECs have on average 17 staff ranging from 5 to 27 and have been in business for an average of 12 years, varying from 2 to 20 years. Their scope of operations covers the residential, commercial, government and utility segments. PV is the dominant technology offered by all RECs with 2/3 having over 75% of their business focused on this one technology. Haiti manufactures PV panels which is the only RE product produced amongst the countries in this study. EE products such as LEDs and SWH are the only additional devices produced. Their relationship with the other key stakeholders is depicted in the diagram 3.49 below.

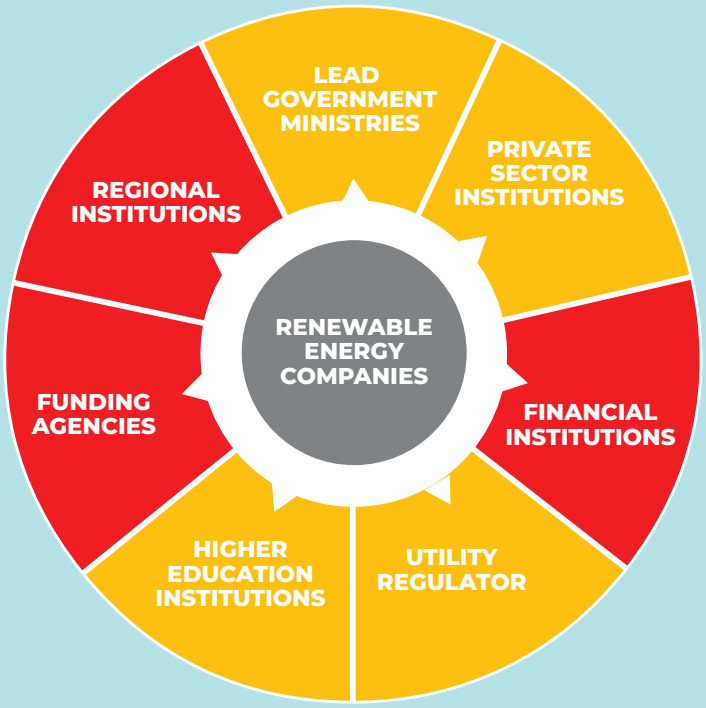



***Figure 3.49 | Relationships of Haiti's Renewable Energy Companies***

## 3.10 | JAMAICA

Jamaica is one of the largest countries in the Caribbean. It spans an area of 10,991 square Kilometres and had a population of 2,948,279 people as of 2019 (UN, 2019). Its main economic activities are in the tourism and financial sectors and to a lesser extent, the mining industry. The electricity utility is owned by the government and participates in the RE Industry, providing RE systems for customers. Jamaica Public Service Company Limited (JPS) has an installed capacity of 1,283 MW with about 151 MW of RE. Wind supplies 102MW, solar PV supplies 20MW and hydropower supplies 29MW. 119MW are provided by IPPs with Wigton wind farm contributing 102MW.

### 3.10.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of Science, Energy & Technology is the lead Government Ministry with responsibility for the energy portfolio. It consults with other ministries including those responsible for Transport and Mining and Local Government Community Development in order to fulfill its mandate. This coordination is facilitated through a cabinet committee. A national energy policy for 2009 to 2030 and a roadmap to guide their activities have been completed. Permission has been granted to allow interconnection to the national grid based on specific regulations and a feed-in tariffs based on the wholesale prices.

The energy unit has 250 staff which is adequate capacity to deal with issues in the RE industry. They actively develop and implement programs to encourage the residential and commercial sectors to implement EE and RE projects. The RE national focus for Jamaica is on Hydropower, PV and Wind. The lead Ministry's relationship with the other external stakeholders is depicted in the diagram below.


*Figure 3.50 | Relationships of Jamaica's Lead Government Ministries*

### 3.10.2 | REGULATOR

The regulator is the Office of Utilities Regulation. It has oversight for the energy sector including arrangements between RE generators and the electricity utility, and as such, plays an important role in the RE industry. Their scope includes JPS and other IPPs as provisioned in the Electricity Act, 2015 and the Electricity Licence, 2016. Subsequent revisions modernised the laws relating to the generation, transmission, distribution, supply, despatch and use of electricity, and interconnection issues like feed-in tariffs. The OUR's activities in the RE Sector are guided by the National Energy Policy. The UR's stakeholder relationships are extrapolated from the other stakeholders.

### 3.10.3 | FINANCIAL INSTITUTIONS

The financial institutions in Jamaica are engaged with the other stakeholders. Commercial banks are open to RE requests for loan financing if applications meet the minimum qualifications set out for all loans. i.e. an examination of risks, payback, ability to pay, borrowing ceilings, etc. Loans are therefore approved in the same manner as for all other sectors. The Jamaica National Bank does provide small grants to communities for EE. The overall FI stakeholder relationships are extrapolated from the other stakeholders which interact with them.

### 3.10.4 | PRIVATE SECTOR INSTITUTIONS

Based on available documentation, the Jamaica private sector institutions seek to support their membership to become drivers of growth and prosperity for Jamaica. It also includes advocacy, capacity building and the promotion of businesses and opportunities for investment in mutually beneficial ventures. They do possess the capacity and do actively participate in the RE Industry on behalf of Jamaica and its members, particularly the RECs who are members/clients. Direct contact was made with 2 of the key institutions but they declined to participate in the study. The overall PSI stakeholder relationships are extrapolated from the other stakeholders that interact with them.

### 3.10.5 | HIGHER EDUCATION INSTITUTIONS

The three Tertiary Education Institutions in Jamaica that could potentially provide teaching and training for RE professionals are the University of the West Indies, Mona campus, (UWIMON), the University of Technology (UTECH) and the Human Employment and Resource Training Trust -National Training Authority (HEART-NTA). They are engaged in some RE activities.

**a)** **UWI Mona Campus** was established in 1948. It has 5 Faculties:

- Faculty of Humanities and Education
- Faculty of Law
- Faculty of Medical Sciences
- Faculty of Science and Technology
- Faculty of Social Sciences

- **BSc in Energy & Environmental Physics over a 3-year period**
- **MSc in Renewable Energy Management over an18-month period**
- **Post Graduate Diploma in Renewable EnergyManagement over a 1-year period**
- **Almost 100% of these students are local**
- **About 21 students enrol in RE programs annually**

**b)** **UTECH** was established in 1958 as the Jamaica Institute of Technology. It has several divisions:

- Business & Management
- Health Sciences
- Education & Liberal Studies
- Engineering & Computing
- Law
- Science & Sport
- Built Environment
- Medicine, Oral Health & Veterinary Sciences

- **Master of Science (M.Sc.) in Sustainable Energy and Climate Change in collaboration with the Caribbean Sustainable Energy and Innovation Institute (CSEII) over a 20-month period**
- **Short course in Energy Auditing designed to teach engineers, technicians and other maintenance professionals in 42 contact hours to complete audits**
- **Collaboration with private sector in biodiesel production and research**
- **Almost 100% of these students are local**

c) **HEART-NTA** is a public institution established in 1982 and operates 28 Technical and Vocational Education and Training locations. Its divisions are arranged around different types of training including:

- Institutional-based training
- On-the-job Learning
- Volunteerism and Mentorship
- Adult Continuing Education
- Professional Development
- Business Development and Entrepreneurship

- **Renewable Energy Level 3 course over a 1-year period**
- **Almost 100% of these students are local**

Their relationship with the other key stakeholders is depicted in the diagram below.

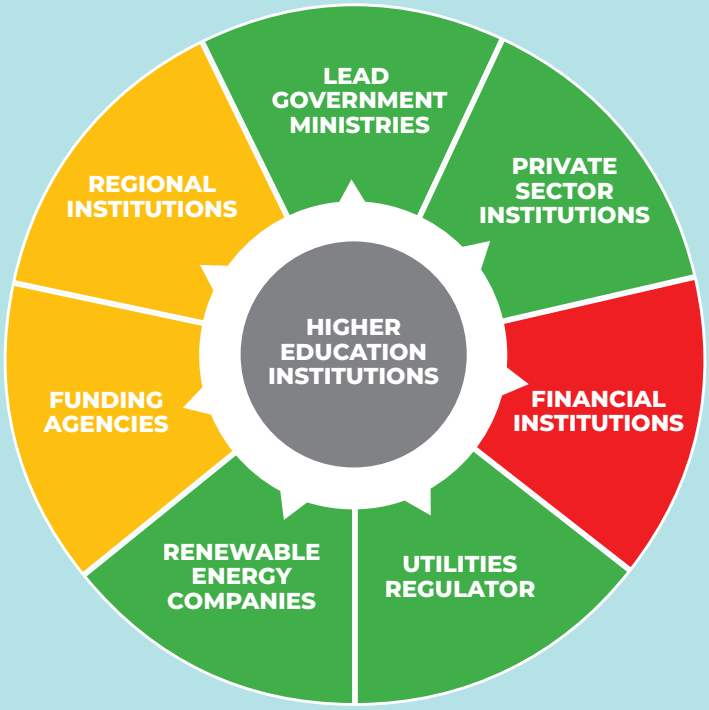



***Figure 3.51 | Relationships of Jamaica's Higher Education Institutions***

## 3.10.6 | RENEWABLE ENERGY COMPANIES

The energy policy and related regulations fully support the implementation of RE in Jamaica. Their 2030 target of 20% to 30% renewable energy production is low compared to most other Caribbean territories, but there is enough capacity to fully occupy the RECs since 150MW of new capacity is expected to be installed during this time, along with significant EE interventions. There is an estimated 850MW of potential RE capacity in Jamaica with over 20 registered RECs. They focus mainly on PV design and installation along with auditing and installation of EE equipment. They have on average approximately 5 staff per REC and do outsource some activities to access additional experienced technical resources in order to fulfil their contractual obligations to clients. These RECs have been in business for an average of 5 years. Their scope of operations covers the residential and commercial segments along with Government, the Utility and industrial sector. Some RECs actively export service in and near the Caribbean region including USA, Mexico and Dominica. One company has an established presence in Cuba.

Their relationship with the other key stakeholders is depicted in the diagram below.

The RECs are not very engaged with the RE industry stakeholders despite a good relationship perception from the HEIs and the LGM. The disparity between the LGM and the RECs perceptions of their relationships may be related to the unfavourable FIT of around $0.11 per KWh set by the regulator who is viewed as part of government and favouring the utility, as well as the perceived inadequate level of support received from government. This impacts the RECs business opportunities negatively since it does not represent an attractive investment environment. There is clearly the need to improve this relationship in order to improve the environment and advance implementation.

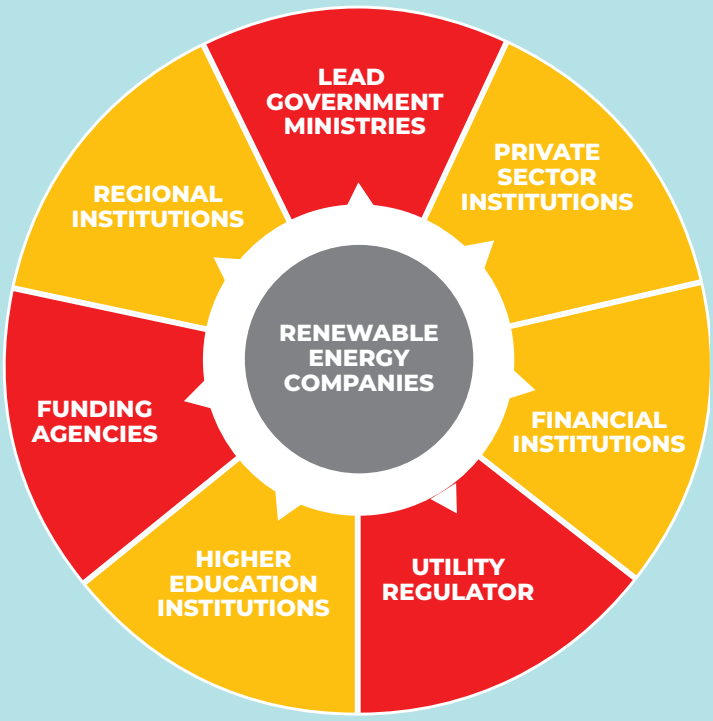



***Figure 3.52 | Relationships of Jamaica's Renewable Energy Companies***

## 3.11 | ST. KITTS & NEVIS

St. Kitts and Nevis is an independent Caribbean twin island state spanning an area of 261 square Kilometres. It had a population of 52,823 people as of 2019 (UN, 2019). Its main economic sectors are tourism, export-oriented manufacturing and offshore banking.

The St. Kitts Electricity Company (SKELEC) is owned by the Government and the Nevis Electricity Company Limited (NEVLEC) is a public–private company. Collectively, they have an installed capacity of 88.8 MW with 4.4 MW of RE capacity. The utilities are actively involved in RE generation for the grid but not for customers within the competitive RE industry. 2.2MW is provided by wind and approximately 2MW by solar PV. One IPP provides close to 50% of this RE and the utilities provide the remainder.

### 3.11.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of Public Works, Housing, Energy & Utilities is the lead ministry with responsibility for the energy portfolio. Along with close consultation with the Ministry of Finance, Sustainable Development and Human Resource Development, they set policy for the sector. There exists a national energy policy and national targets but no road map. Most of the required framework and regulations required to facilitate interconnection to the national grid and related feed-in tariffs for non-utility RE generators are still being developed.

Specifically, the energy unit has 2 persons and must now build the capacity to develop the RE industry. This is necessary if they are to make progress in achieving their RE targets. The St. Kitts government has been actively pursuing geothermal energy over the last few years and have also added PV, waste to energy (WtE) and wind to their RE portfolio. The lead Ministry's relationship with the other external stakeholders is depicted in the diagram right.

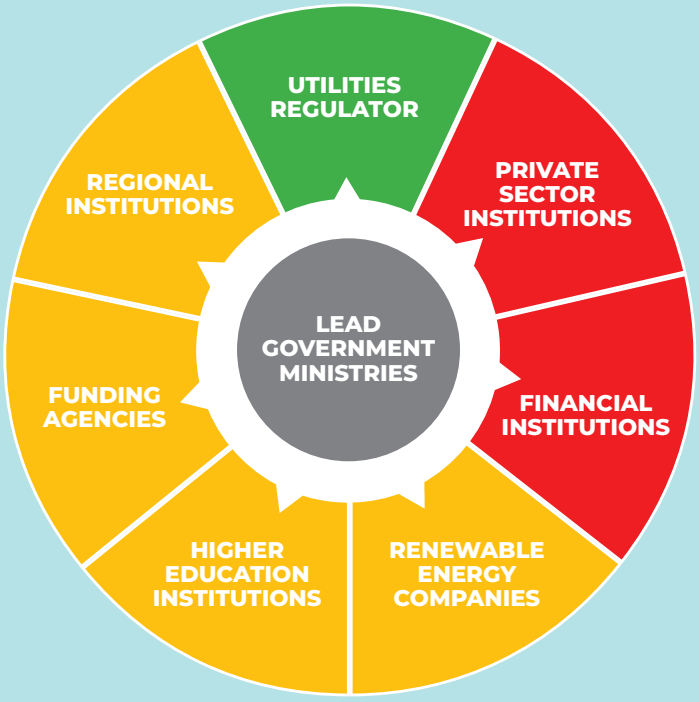



***Figure 3.55 | Relationships of St. Kitts' Lead Government Ministries***

### 3.11.2 | UTILITIES REGULATOR

There is no independent regulatory body in St. Kitts. Only IPPs may connect to the national grid and they are required to apply to the utility and the lead ministry for permission and terms and conditions for connection. Other residential and commercial installations are for self-consumption and not for the national grid.

### 3.11.3 | FINANCIAL INSTITUTIONS

The financial institutions in St. Kitts are not very engaged with the other RE Industry stakeholders. Commercial banks tend to treat RE requests like any other request and offer no preferential treatment. The RE Industry is also quite small and mostly self-financed. Investment opportunities by residential and commercial businesses are limited since no interconnection regime is in place. Consequently, the FIs are not being called upon to play a significant role. The FI stakeholder relationships are extrapolated from the other stakeholders that interact with them.

### 3.11.4 | PRIVATE SECTOR INSTITUTIONS

The St. Kitts private sector institutions show interest in the RE sector. Their responsibilities in the private sector include investment promotion and facilitation of government incentives, trade promotion, advocacy, training and aftercare services. Investment in RE is a primary focus; in line with national strategies. PSIs with a local focus do assist those members who supply EE equipment and a limited amount of RE equipment to the market since there are no dedicated RE companies and little demand for RE services.

PSIs have between 3 and 10 persons to execute their mandate with an average of 6 staff. The investment entities have the higher compliment of persons and this provides adequate human resources to support the Governments strategy to advance their RE implementations. They see access to finance and tax waivers on RE products as two areas that would boost the sector and increase implementation. Their relationship with the other key stakeholders is depicted in the diagram below.

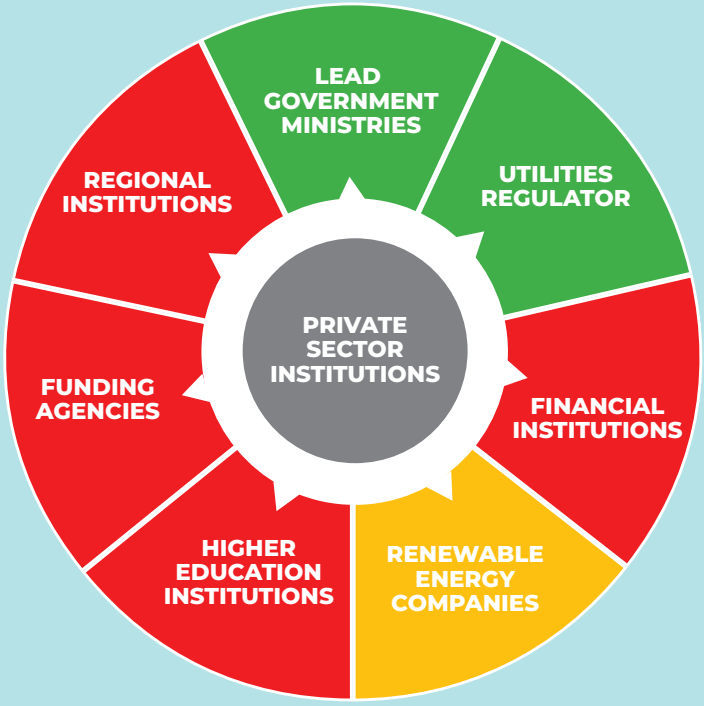



*Figure 3.56 | Relationships of St. Kitts' Private Sector Institutions*

PSIs have remained open to the business needs in St. Kitts whether locally or connected through Government for international financing. Other relationships appear less important because of the current state of the RE Industry.

### 3.11.5 | HIGHER EDUCATION INSTITUTIONS

The institution in St. Kitts and Nevis that could potentially provide teaching and training for RE professionals is the Clarence Fitzroy Bryant College (CFBC). It was founded by Sir Clarence Fitzroy Bryant in 1988 and aims to give students the opportunity to explore a broad range of subjects. Unfortunately, CFBC does not offer renewable energy courses but has indicated an interest in doing so. So far, it has introduced some energy awareness concepts into their green engineering and sustainable agriculture programs. Their relationship with the other key stakeholders is depicted in the diagram left.

While no dedicated RECs operate, the retailing of RE and EE equipment still occurs in a limited way, as well as some ad-hoc RE activity by other businesses. Based on their common interests in the RE industry, some relationships still exist with the hope of future developments in terms of training and opportunities to deploy RE systems for clients.

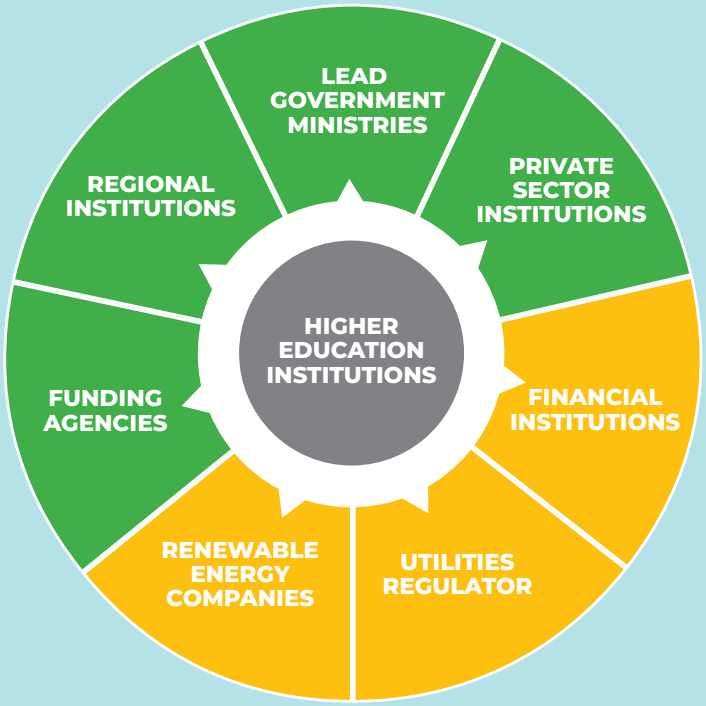



***Figure 3.57 | Relationships of St. Kitts' Higher Education Institutions***

## 3.11.6 | RENEWABLE ENERGY COMPANIES

There has been a focus on developing utility scale IPPs in St. Kitts with less attention being paid to developing RE companies to implement smaller RE systems. The existing wind powered IPP on the island of Nevis was installed by a foreign company. The limited RE activity only exists to support the occasional self-generation project, with no opportunity to export energy to the national grid. Consequently, no dedicated RECs operate but some RE activity still exists. RE and EE equipment are retailed by at least 2 of the larger hardware retailers on the island. Similarly, a few electrical companies do install RE systems for those in the environmentally friendly community with the disposable income to do so. Since no grid connections are in place, tracking of installations does not occur. In all cases, RE is not the focus or main business of any local companies. Their relationship with the other key stakeholders is depicted in the diagram right.

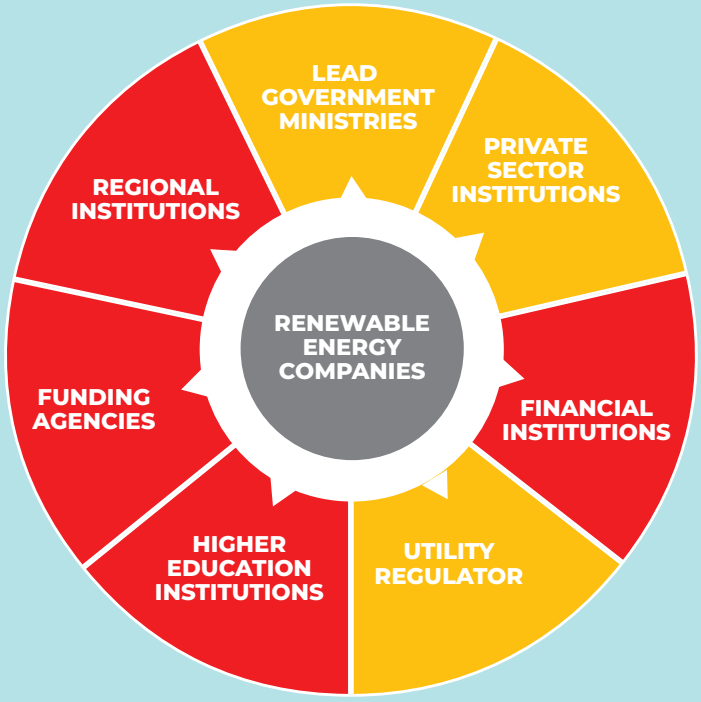



*Figure 3.58 | Relationships of St. Kitts' Renewable Energy Companies*

## 3.12 | SAINT LUCIA

Saint Lucia is an independent territory spanning an area of 616 square Kilometres. It had a population of 182,790 people as of 2019 (UN, 2019). Its main economic sectors are tourism and the banking service.

The Saint Lucia Electricity Company (LUCELEC) is jointly owned by the Government and private sector and has an installed capacity of 91 MW with about 3 MW of RE capacity. They are actively involved in RE generation for the grid but not for customers within the competitive RE industry. The 3MW RE capacity is from solar PV and is installed by the utility.

### 3.12.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of Infrastructure, Ports, Energy and Labour is the lead ministry with responsibility for the energy portfolio. Along with close consultation with Ministry of Finance, planning and development agencies and LUCELC, the lead Government ministry and LUCELEC have developed a National Energy Transition Strategy (NETS) to guide their transition to RE technologies implementation (UNDP,2017). The Government has also developed a national energy policy and national targets to focus its work.

The importance of RE in the transition plan is mentioned as part of their third most important goal (UNDP, 2017). The role of distributed RE is not major and off-grid generation is considered a threat to the primary goal of a least-cost path. Losing customers from the national grid makes a case for spreading the existing cost across fewer subscribers, resulting in increased rates. However, EE is seen as a significant contributing intervention to the national goals. Much of the required framework and regulations required to facilitate interconnection to the national grid and related feed-in tariffs for non-utility RE generators are still being developed.

The energy unit has 7 persons to develop the RE industry. There is an agreed path which focuses on PV, Wind, as well as a significant reliance on geothermal to fulfill most of the future RE energy needs of Saint Lucia. Solar water heating is also encouraged as a good demand side management (DSM) option. The lead Ministry's relationship with the other external stakeholders is depicted in the Figure 3.60 on page 88.

## 3.12.2 | UTILITIES REGULATOR

The regulator for the energy sector in Saint Lucia is the National Utilities Regulatory Commission (NURC) which was established in January 2016. It currently fulfils much of its statutory obligations through Regulations and policy directives based on the amended Electricity Supply Act which now allows the regulator to address RE generation and other IPP issues. The NURC is intended to ensure economic regulation of Saint Lucia's energy and water sectors, setting tariffs, ensuring compliance, and protecting consumers. It is expected to address the feed-in tariffs structures for RE systems, how connections are made and the license requirement for potential distributed supplies.

There are 6 staff to oversee the functions of the NURC. Their relationship with the other key stakeholders is depicted in the Figure 3.61 below, right.

The nature of the NURC's role does not currently require it to focus on the financing of projects which implement energy generation systems. When coupled with a national strategy which is focused on international donors and funders, the resulting relationship with the local financial institutions is weak. All other relationships suggest that the regulator plays a supporting role.

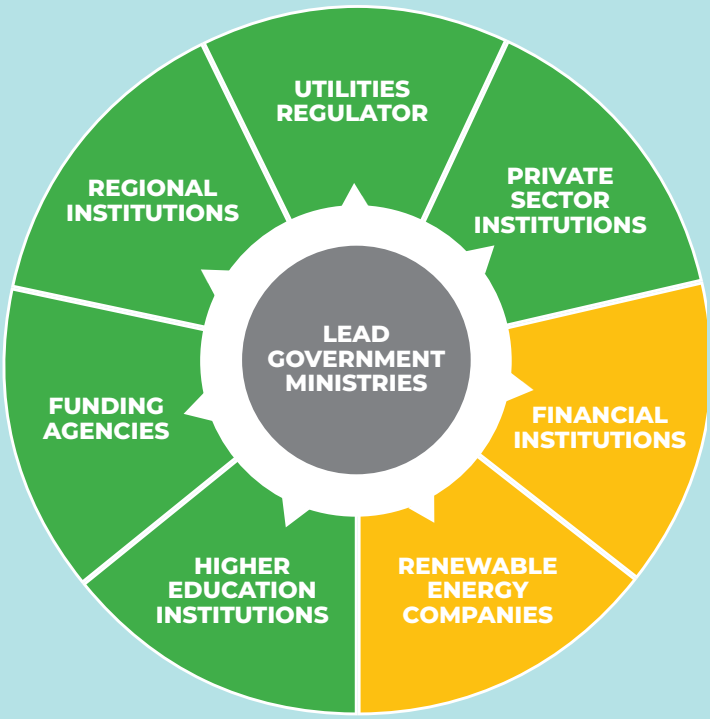



*Figure 3.60 | Relationships of St. Lucia's Lead Government Ministries*

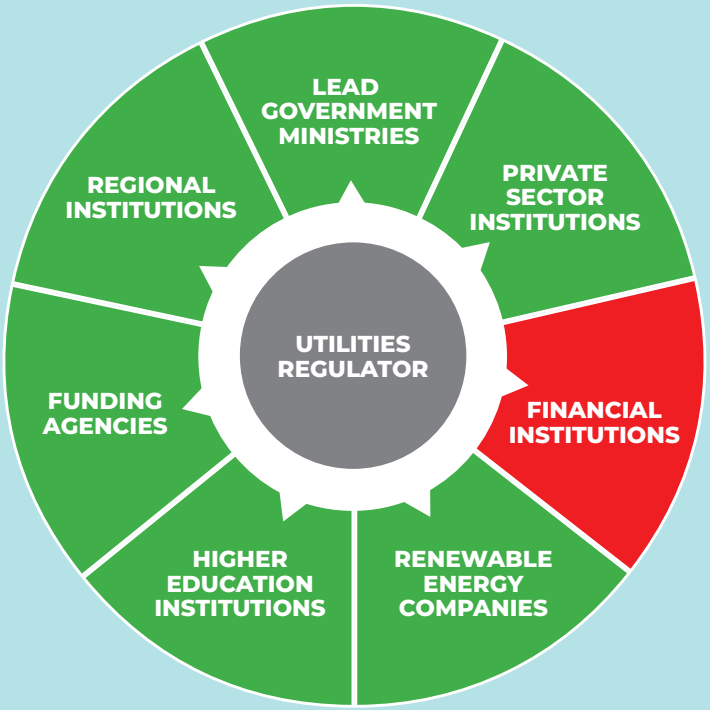



*Figure 3.61 | Relationships of St. Lucia's Utilities Regulator*

### 3.12.3 | FINANCIAL INSTITUTIONS

The financial institutions in Saint Lucia are engaged with the other stakeholders. Commercial banks are open to RE requests for loan financing if applications meet the minimum qualifications set out for such loans. The RE Industry is still also quite small but growing. The Saint Lucia Development Bank operates a Climate Adaptation Finance Facility (CAFF) which is a funding mechanism designed to offer climate change adaptation loans which are affordable for the average citizen and provides incentives for RE deployment. This has assisted the industry significantly, particularly in the Tourism sector. The FI stakeholder relationships are extrapolated from the other stakeholders that interact with them.

### 3.12.4 | PRIVATE SECTOR INSTITUTIONS

The Saint Lucia private sector institutions seek to foster business growth and development by providing capacity building, effective advocacy and relevant services to their membership. They focus on the promotion of businesses and opportunities for investment. They possess adequate capacity to execute their mandate today but may be challenged to keep up with a developing RE industry which is young and requires significant public sector support to creating a viable RE industry in Saint Lucia. The PSI stakeholder relationships are extrapolated from the other stakeholders that interact with them.

### 3.12.5 | HIGHER EDUCATION INSTITUTIONS

The education institution in Saint Lucia that could potentially provide teaching and training for RE professionals is the Sir Arthur Lewis Community College (SALCC). It was established in 1985 and is named after Saint Lucian economist and Nobel laureate Sir Arthur Lewis. Unfortunately, SALCC does not offer renewable energy courses and has no significant relationships with the other key stakeholders in the RE Industry. The HEI stakeholder relationship is extrapolated from the other stakeholders that interact with it.

## 3.12.6 | RENEWABLE ENERGY COMPANIES

The energy policy of the Government of Saint Lucia includes RE as an option in achieving their national goals and their studies have confirmed its cost effectiveness and viability. Only 3 RECs are currently documented as operating in this sector and they only offer design and installation of PV systems along with auditing services and the retailing of some EE equipment. A low level of sub-contracting is provided to RECs for projects funded by foreign investors and the local utility.

RECs have on average 3 staff and have been in business for an average of 4 years. The RECs have confirmed that they are able to meet most of the local market needs for the residential, commercial and Government segments. This is only possible because the residential and commercial demands for RE system in the current regulatory environment are low. Tourism is the most active sector because of hotels' involvement with the Caribbean Hotel Energy Efficiency Action Programme (CHENACT) project created by the Caribbean Tourism Organization (CTO), the Caribbean Hotel & Tourism Association (CHTA), and the Inter-American Development Bank (IDB) to propel the Caribbean hotel sector towards energy efficiency. Their relationship with the other key stakeholders is depicted in the diagram below.

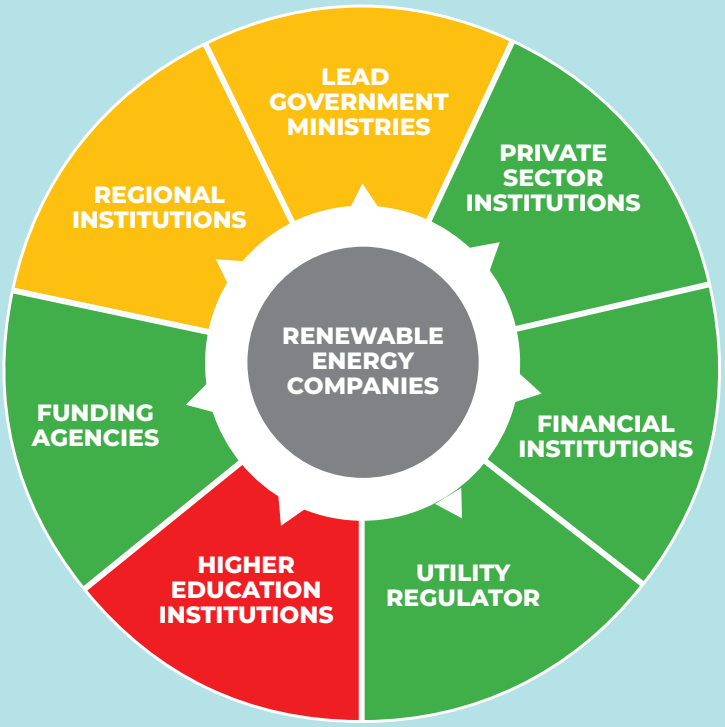



***Figure 3.62 – Relationships of Saint Lucia's Renewable Energy Companies***

## 3.13 | ST. VINCENT AND THE GRENADINES

St. Vincent and the Grenadines is an independent territory spanning an area of 389 square Kilometres. It had a population of 110,589 people as of 2019 (UN, 2019). Its main economic sector is agriculture, dominated by banana production. Its tourism industry is also important and has been growing.

The St. Vincent Electricity Company (VINLEC) is owned by the Government and has an installed capacity of 51.06 MW with about 8.82 MW of RE capacity. The utility has installed 5.6MW of hydropower and 3.2MW of PV. It is actively involved in RE generation for the grid but not for customers within the competitive RE industry.

### 3.13.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of National Security, Air and Sea Port Development is the lead ministry with responsibility for the energy portfolio. There is close consultation with the Ministry of Finance, Economic planning, Sustainable Development and Information Technology, and the Ministry of Transport. The Government has also developed a national energy policy and national targets and much of the supporting framework documentation to focus its work. The regulations which support the interconnection of RE systems to the national grid are still outstanding.

Specifically, the energy unit has 6 persons to develop the RE industry. There is a road map which focuses on utility scale PV with batteries and Geothermal as well as Wind, Hydro and WtE. A national energy committee coordinates the efforts between the other stakeholder ministries and VINLEC. The lead Ministry's relationship with the other external stakeholders is depicted in the diagram below.

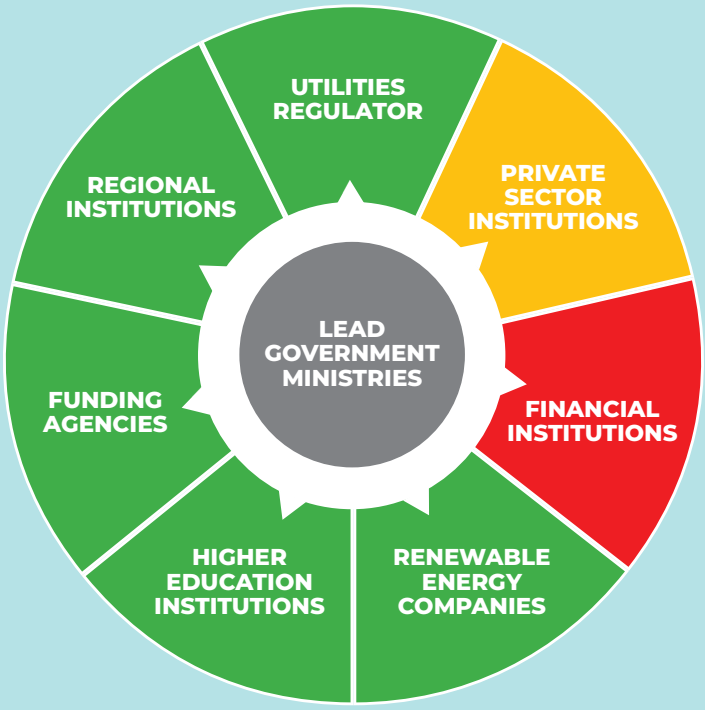



***Figure 3.65 | Relationships of St. Vincent's Lead Government Ministries***

### 3.13.2 | UTILITIES REGULATOR

There is no independent regulatory body in St. Vincent. Only IPPs may connect to the national grid and they are required to apply to the utility and the lead ministry for permission and terms and conditions for connection. The Government therefore sets the feed-in tariffs. Other residential and commercial installations are for self-consumption and not for the national grid.

### 3.13.3 | FINANCIAL INSTITUTIONS

The financial institutions in St. Vincent are not very engaged with the other RE Industry stakeholders. Commercial banks tend to treat RE requests like any other request and offer no preferential treatment. The RE Industry is also quite small and mostly self-financed. Investment opportunities by residential and commercial businesses are limited since there are no established regulations for interconnection. Consequently, the FIs are not being called upon to play a significant role. The FI stakeholder relationships are extrapolated from the other stakeholders that interact with them.

### 3.13.4 | PRIVATE SECTOR INSTITUTIONS

The St. Vincent private sector institutions carry several responsibilities including business support to membership, advocacy, capacity building, networking to develop partnerships and the promotion of government's mandate, including tourism, export development, agri-processing and RE. Investment in key sectors including RE are also of significant importance. On average only 1 REC exists amongst the membership of each PSI.

PSIs have between 2 and 14 persons to execute their mandate with an average of 8 staff per PSI. The investment entities have the higher compliment of persons and this provides adequate human resources to support the Governments strategy to attract investment in the RE Industry. The PSIs have expressed the need to have clear policy on RE in the pending new energy Bill and more fiscal incentives written into law instead of being granted at the discretion of cabinet on an application-by-application basis. Promotion of EVs powered by RE and broad-based training, building retrofits and education are also seen as critical, including key sectors like tourism and agriculture. Their relationship with the other key stakeholders is depicted in Figure 3.66.

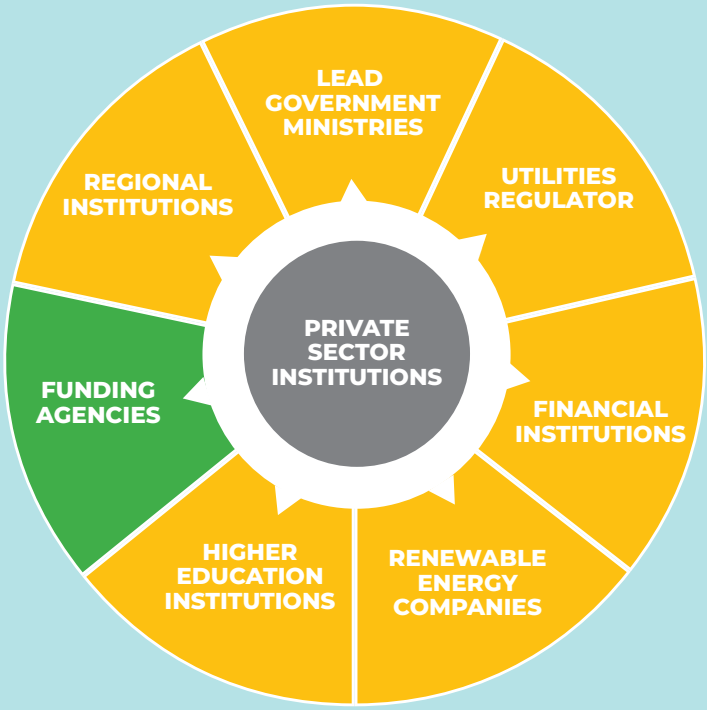



***Figure 3.66 | Relationships of St. Vincent's Private Sector Institutions***

PSIs are more active with Government and external institutions who handle major financing. The other relationships appear less active because of the market uncertainties and lack of clear policies and regulations impacting the RE Industry; e.g. interconnection by residential and commercial properties.

### 3.13.5 | HIGHER EDUCATION INSTITUTIONS

The institution in St. Vincent that could potentially provide teaching and training for RE professionals is the St. Vincent and the Grenadines Community College (SVGCC). It was established in 2005 and does not offer renewable energy courses, has no research capacity and has no significant relationships with the other key stakeholders in the RE Industry. The HEI stakeholder relationships are extrapolated from the other stakeholders that interact with them.

### 3.13.6 | RENEWABLE ENERGY COMPANIES

While the energy policies in St. Vincent are in place for interconnection of distributed small energy generators, the absence of the regulations which govern that connection has created uncertainty and inhibited the growth of the RE industry. This is further compounded by the fact that there is no independent regulation and government controls most of the sector. The few RECs which currently operate in this sector offer design and installation of PV systems along with auditing services. They target all segments of the market

RECs have on average 8 staff ranging from 2 to 20 and have been in business for an average of 20 years, varying from 12 to 32 years. Their scope of operations covers most of the current local market needs and they do outsource equipment installation to the mobile labour market in order to meet their residential and commercial demands. Their relationship with the other key stakeholders is depicted in the diagram below.

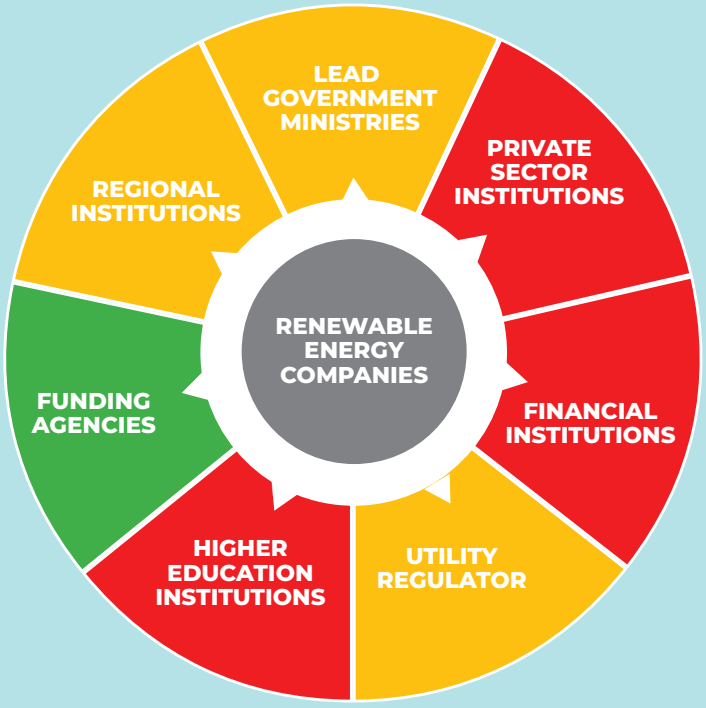



***Figure 3.67 | Relationships of St. Vincent's Renewable Energy Companies***

## 3.14 | SURINAME

Suriname is an independent Caribbean territory bordered by French Guiana and Brazil to the south and the Atlantic Ocean to the north. It spans an area of 163,820 square Kilometres and had a population of 581,372 people as of 2019 (UN, 2019). Its main economic activities are the export of bauxite, gold, petroleum and agricultural products.

The Suriname electricity utility, Energie Bedrijven Suriname (EBS) is owned by the Government and has a total installed capacity of 506.2 MW with about 196.5 MW of RE capacity from hydropower. They are actively involved in RE generation for the grid but not for individual customers within the competitive RE industry.

### 3.14.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of Natural Resources is the lead ministry with responsibility for the energy portfolio in Suriname. The Government is in the process of creating a Suriname Energy Authority (SEA) which will deal with all matters related to energy, including RE and other regulatory responsibilities which will impact the RE Industry. The ministry has a staff of 850 persons, some of which may be transferred to the new Energy Authority to develop that industry. There is a focus on PV, Hydropower and WtE.

While there is an old policy which caters to the connection of utility scale IPPs, there is not yet a completed policy that considers the wider energy sector including RE. Some enhancement work is on-going on the policies and action plans and there is much work still outstanding to facilitate interconnection of RE systems, tariffs for distributed generation and the supporting regulations. The lead Ministry's relationship with the other external stakeholders is depicted in the diagram below.

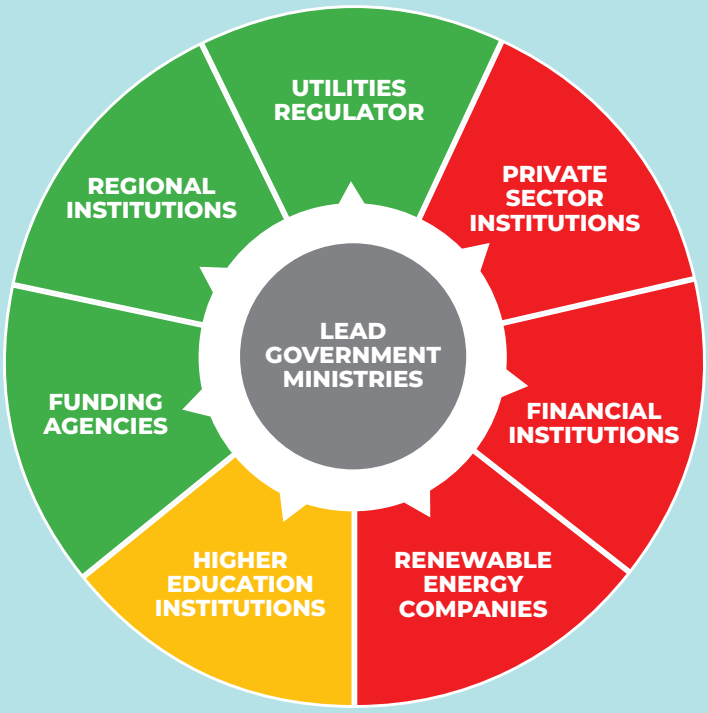



***Figure 3.69 – Relationships of Suriname's Lead Government Ministries***

### 3.14.2 | UTILITIES REGULATOR

There is no independent regulatory body in Suriname, but it is being established. Only IPPs may connect to the national grid and they are required to apply to the utility and the lead ministry for permission and terms and conditions for connection. The Government would set the feed-in tariffs but there are no current IPPs. Other residential and commercial installations are for self-consumption and not for the national grid.

### 3.14.3 | FINANCIAL INSTITUTIONS

The financial institutions in Suriname show very little interest in the RE sector and are not engaged with the other stakeholders. They treat RE request like any other request with no preferential treatment. Based on the current environment, there has been no significant role to be played. This is likely to change once the energy authority is established, and interconnection is legislated with attractive feed in tariffs in place. The FI stakeholder relationships are extrapolated from the other stakeholders that interact with them.

### 3.14.4 | PRIVATE SECTOR INSTITUTIONS

The Suriname private sector institutions perform the usual responsibilities of business support, advocacy, capacity building, networking and promotion but also focus on sustainable and innovative development.

PSIs have on average 3 persons to execute their mandate and only 1 REC in their membership. In addition to needing the required legislation, they have also expressed the need to see more organized promotion of RE and more publication of related activities. Their relationship with the other key stakeholders is depicted in the diagram right. PSIs are not very engaged in the RE Industry. This is related to the market uncertainties and lack of policies and regulations for the RE Industry.

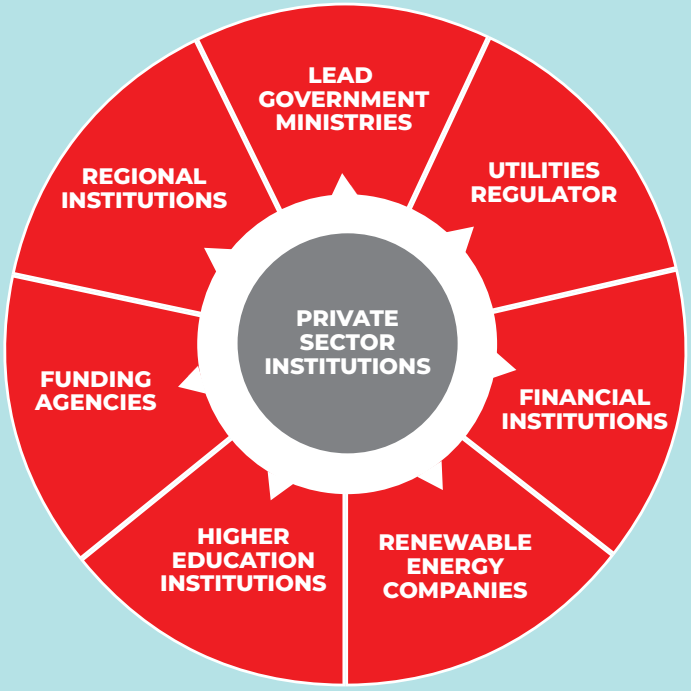



***Figure 3.70 | Relationships of Suriname's Private Sector Institutions***

### 3.14.5 | HIGHER EDUCATION INSTITUTIONS

The three Tertiary Education Institutions in Suriname that could potentially provide teaching and training for RE professionals are the Anton de Kom University of Suriname (AdekUS), the Polytechnic College Suriname (PTC) and the University of Applied Science and Technology Suriname (UNASAT). One institution is currently engaged in RE activities.

**a)** **AdekUS** was established in 1968 and operates under their government's Ministry of Education as a public institution. It is not engaged in any RE research work but has several areas of study:

- Medical Sciences, Medicine and Physiotherapy
- Social Sciences
- Law
- Technological Sciences
- Humanities
- Mathematical and Physical Sciences

- **Energy transformation in Electrical Stations**
- **Project Engineering with RE**
- **Master's in RE Technologies**
- **Almost 100% of these students are local**

**b)** **PTC** was established in 1997 and has many departments but does not offer renewable energy programmes.

**c)** **UNASAT** is a public institution established in 2010 as a public institution to deliver education in three main subject areas but does not offer renewable energy programmes.

The HEI stakeholder relationships are extrapolated from the other stakeholders that interact with them.

## 3.14.6 | RENEWABLE ENERGY COMPANIES

RE companies are limited in their scope. The required framework for RE generation is not in place and the environment is uncertain. Solar water heating is however offered to the public as an EE intervention. Other companies only offer the sales and installation of RE generation products as an additional offer to their main business activity since demand from all sectors is low. Their relationship with the other key stakeholders is depicted in the diagram below.

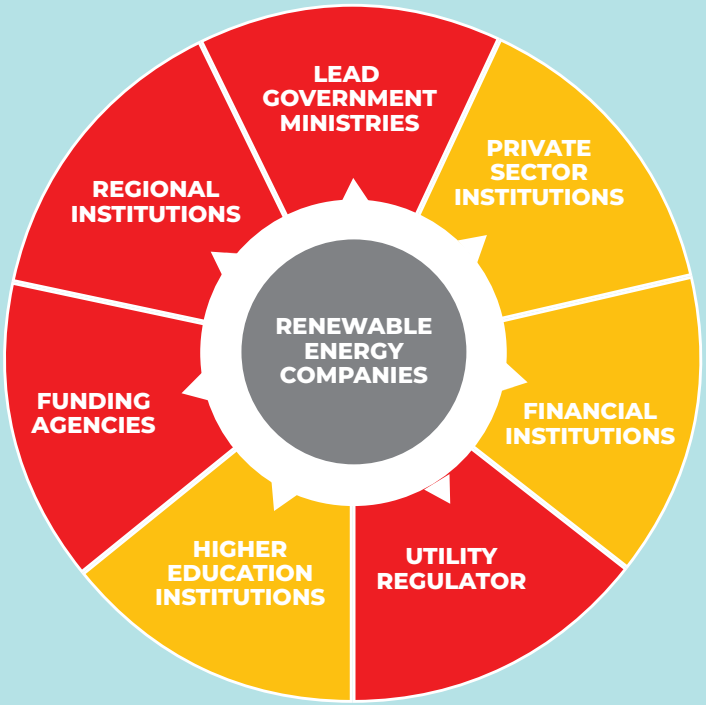



*Figure 3.71 | Relationships of Suriname's Renewable Energy Companies*

## 3.15 | TRINIDAD & TOBAGO

Trinidad and Tobago is an dependent twin island republic spanning an area of 5130 square Kilometres. It had a population of 1,394,973 people as of 2019 (UN, 2019). Its main economic sectors are petroleum products, agriculture and tourism which are concentrated in Tobago. The Trinidad and Tobago Electricity Company (T&TEC) is owned by the Government and has an installed capacity of 2019 MW with a negligible amount of RE capacity. There is an increasing interest in large scale RE generation but no involvement in customer implementations.

### 3.15.1 | LEAD GOVERNMENT MINISTRIES

The Ministry of Energy and Energy Industries is the lead ministry with responsibility for the energy portfolio in Trinidad and Tobago. It works closely with the ministries responsible for planning and development which is responsible for the NDC, the public utilities which is responsible for energy generation, works and transport, Bureau of Standards, education, local government and rural development for small projects to raise awareness. There is coordination between these stakeholders using a steering committee or project appointed committees.

There is an energy policy and an action plan, but they do not address RE specifically. While the existing policy caters for the connection of utility scale IPPs, there is not yet policy which considers the entire energy sector including RE. Some work is on-going to facilitate interconnection of small RE systems, tariffs for interconnection and the supporting regulations.

Targets for EE and RE generation are documented only in their NDC and other political presentations. Some work has commenced in relation to facilitating interconnection between the grid and distributed RE system, but again nothing has been completed and interconnection remains illegal. The ministry

*The Ministry of Energy and Energy Industries is the lead ministry with responsibility for the energy portfolio in Trinidad and Tobago.*

has a staff of 7 persons to execute its RE related functions. There is a focus on utility-scale PV and potential wind.

The lead Ministry's relationship with the other external stakeholders is depicted in the diagram right.

The LGM's relationships are indicative of the RE environment in Trinidad and Tobago. RECs are not a part of the current focus and likewise, neither are the commercial financial institutions. This is expected to evolve as the sector develops and the requisite policies and regulations are established.


***Figure 3.72 | Relationships of Trinidad and Tobago's Lead Government Ministries***

### 3.15.2 | UTILITIES REGULATOR

The regulator is the Regulated Industries Commission (RIC). It is an independent, statutory body established to monitor and ensure a high quality of utility services at fair and reasonable rates. It aims to ensure fairness, transparency and equity in the provision of utility services by regulating the delivery of services including the generation of electricity. These services include licencing, compliance, tariffs, studies of various types and facilitating competition between service providers where competition is possible and desirable. The RIC is also responsible for investigating customer complaints and managing IPAs. The UR's stakeholder relationships are extrapolated from the other stakeholders.

### 3.15.3 | FINANCIAL INSTITUTIONS

The financial institutions in Trinidad and Tobago have not been very engaged by the RE industry stakeholder. This low level of engagement is a result of the policy and regulatory environment along with the challenges of cost effectiveness of small scale RE solutions. Residents of Trinidad and Tobago still enjoy the lowest energy cost in the region. However, for individual use the banks evaluate RE loans as they would any other loan. Unless there is a change in the environment, it is unlikely for there to be any foreseeable significant role for the FIs in the RE Industry. The FI's stakeholder relationships are extrapolated from the other stakeholders which interact with them.

### 3.15.4 | PRIVATE SECTOR INSTITUTIONS

The Trinidad and Tobago private sector institutions have a strong focus on advocacy for their membership. Additionally, they provide general business support and training to build capacity as well as pursuing useful partnerships. They have an average of 20 staff members to execute their mandate. PSIs also have an average of 6 RECs amongst their membership.

They believe that a clear policy on RE, a shift in government's approach to energy rates and the removal of transfers and subsidies to the Oil and Gas sector are vital to the development of the RE sector. PSIs also feel that there is a need to create more policies to mitigate project risks, restructure the tax credit scheme and do more comprehensive resource mapping. Their relationship with the other key stakeholders is depicted in the diagram above.

PSIs have good relationships with most RE stakeholder groups. However, their effectiveness is stifled by insufficient policy and regulation to support the RE Industry.

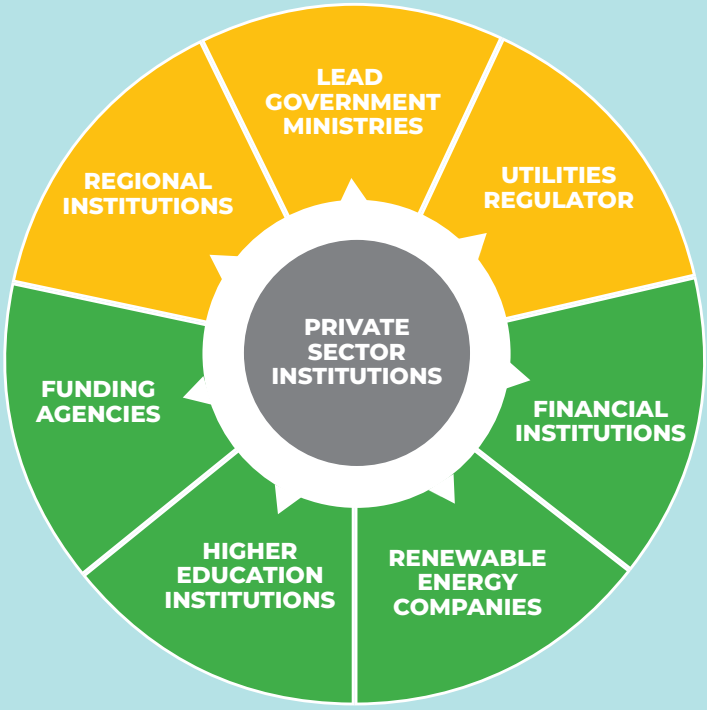



***Figure 3.73 – Relationships of Trinidad and Tobago's Private Sector Institutions***

## 3.15.5 | HIGHER EDUCATION INSTITUTIONS

The two Higher Education Institutions in Trinidad and Tobago that could potentially provide teaching and training for RE professionals are the University of the West Indies, St. Augustine campus, (UWISTA) and the University of Trinidad and Tobago (UTT). They are engaged in RE activities.

**a)** **UWI St. Augustine Campus** was established in 1948 and has research capacity even though not currently focused on RE systems. Their experience in energy and electrical systems provides a good foundation on which to develop some innovation capacity in the RE sector. It has 7 Faculties:

- Faculty of Humanities and Education
- Faculty of Law
- Faculty of Medical Sciences
- Faculty of Science and Technology
- Faculty of Social Sciences
- Engineering
- Food & Agriculture

- **MSc. Programs for Energy Management offered in the Faculty of Science and Technology between 2012 and 2016**
- **M.Sc. in Renewable Energy Technologies which is done over a 3 year period**
- **Over 90% of these students are local**

**b)** The UTT is a public university established in 2004. Its divisions include:

- Process Engineering
- Academy for Performing Arts
- Criminology and Public Safety
- Project Management and Civil Infrastructure Systems
- Bio-Sciences Agriculture and Food Technology
- Academy for Arts Culture and PA,
- Food Science Technology
- The Learning Centre and Information and Communication Technology

- **The Renewable Energy Engineering Technology (REET) Diploma starts in 2020/2021. The course information is presented in Appendix A**
- **The Utilities Engineering Group (Mechanical and Electrical Engineering programmes) also offers a few RE courses at the MEng level**
- **Almost 100% of these students are local**
- **Enrolment is about 60 students annually**

Their relationship with the other key stakeholders is depicted in the diagram right.

HEIs have demonstrated an openness to collaboration and cooperate with RE stakeholders but opportunities are limited. They depend on public sector and private sector funds in order to serve the job market which is primarily for their existence.

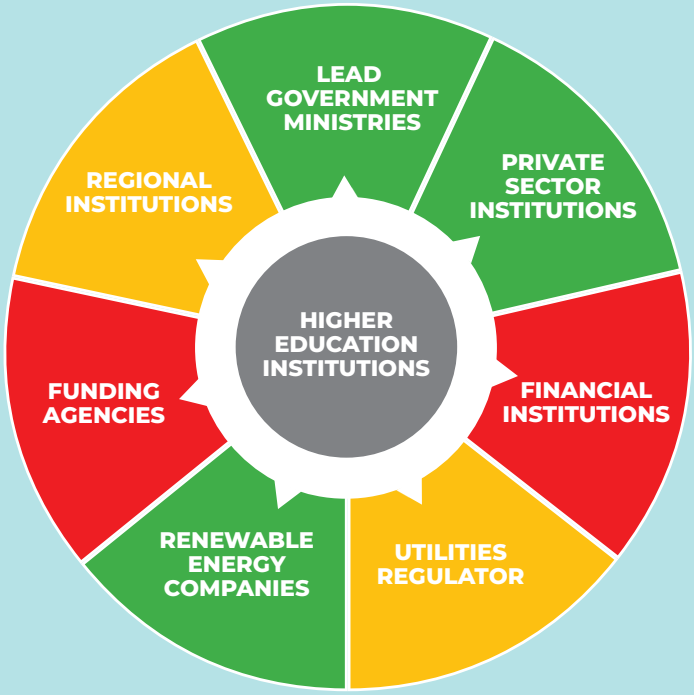



***Figure 3.74 | Relationships of Trinidad and Tobago's Higher Education Institutions***

## 3.15.6 | RENEWABLE ENERGY COMPANIES

The RE market in Trinidad and Tobago is small because of the inadequate legislation and low cost of energy to consumers. This market is likely to remain unchanged unless both situations mentioned above are addressed. As a result, the EE market is more attractive. Given the interest amongst RECs, the correct environment is likely to be the catalyst for the RE Industry. The few RECs which currently operate in this sector offer a full range of RE and EE services. While not excluding the residential sector, the commercial sector is the focus of the REC's activities. PV and SWH are the lowest risk technologies, but the financial returns are unattractive. RECs therefore struggle to generate local business in this sector and 50% of them look to the Caribbean region and South American countries for export business.

RECs have on average 13 staff ranging from 5 to 35 employees and most companies cover a wider range of activities with only 20% focused on PV technology. These companies have been in business for an average of 13 years, varying from 5 to 20 years. Their scope of operations covers the current local market demand and they do outsource some installation and auditing in order to meet their residential and commercial demands. Their relationship with the other key stakeholders is depicted in the diagram on the following page.

Relationships related to financing are not currently beneficial for the RECs, but they continue to be open to the other stakeholder groups which have the power to influence the legislative environment or at a minimum, are interested in seeing the environment changed.

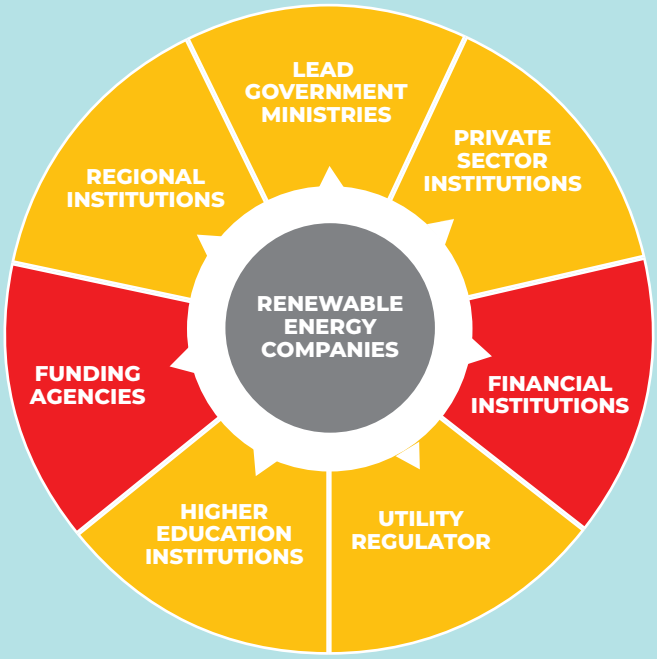



***Figure 3.75 | Relationships of Trinidad and Tobago's Renewable Energy Companies***

## 3.16 | REGIONAL INSTITUTIONS

Institutions which operate regionally are important for several reasons. Apart from Dominican Republic, all the countries included in the study are member states of CARICOM which qualifies them for assistance from all of its agencies. Some of the regional institutions which administer international funds do include the Dominican Republic; like Caribbean Export and the CARICOM Regional Organisation for Standards and Quality (CROSQ). Some important considerations are: -

- As autonomous countries in CARIFORUM, their efforts tend to be fragmented and few opportunities to benefit from synergies are grasped. Interaction with common institutions can often help to identify such opportunities and create the space to benefit from cooperation and collaboration.
- Member states often learn from making their own mistakes but not from the mistakes of their neighbours. Regional institutions provide opportunities for them to share experiences, data and lessons learnt, thus saving each other time, effort and resources.
- Most member states are small and unable to make their positions heard and felt on the global stage. Regional institutions make it easier by combining the collective voices of the region to deliver common messages and concerns globally.
- The RE industries in the region are all relatively young, having only received some urgency following the oil crisis of 2008. Many institutions would already have been established to focus on other priority areas After the oil crisis, given the level of dependence, existing institutions are now asked to integrate the energy needs of the region. This is sometimes easier said than done but remains necessary for regional sustainability.

The Regional Institutions' relationships with the key stakeholders in the countries included in the study are shown below.

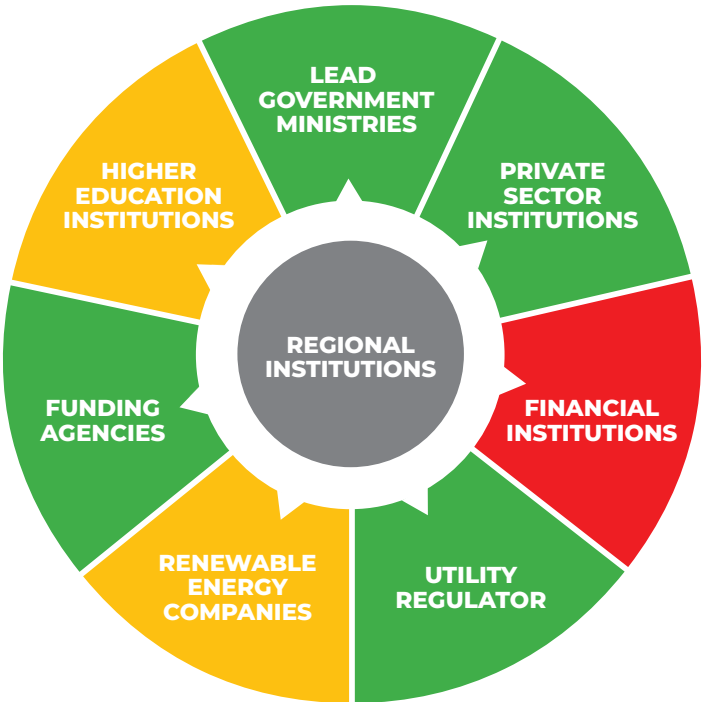



***Figure 3.80 | Relationships of Regional Institutions to Key Stakeholders in the Region***

### 3.16.1 | CARIBBEAN EXPORT

As an inter-governmental organisation, Caribbean Export has a mandate to build the export competitiveness of CARIFORUM private sector businesses including agro-processing, the creative industries of music, fashion, animation and craft. While the RE businesses also fall within their purview, RE products and services may themselves be a key to increasing the competitiveness of most other businesses; much like how Information and Communications Technologies (ICT) have been a key to these businesses in the past. Notwithstanding their full support for this study, they observe other concerns in the RE industry including the need for: -

- Technical development
- Stronger investment in RE by manufacturing and other productive sectors
- Adequate risk management
- Internal capacity building for key stakeholder groups
- Addressing cultural considerations in implementation
- Better support for MSMEs to compete with large firms
- Appropriate financing for project development
- More training for stakeholders and practitioners
- Partnership development amongst MSMEs

In addition to training and capacity building opportunities which are offered to MSMEs, there are also opportunities for companies to benefit from grants to assist them in executing their business plans. This is administered at specific times through a call for proposals.

### 3.16.2 | CROSQ

As an entity under CARICOM, CROSQ has a mandate to develop and harmonize regional quality infrastructure for trade, safety and protection, and the environment amongst other areas. As a result, partnerships exist with the Pan American Health Organization (PAHO), Physikalisch-Technische Bundesanstalt (PTB), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the Caribbean Development Bank (CDB) and the Caribbean Agricultural Research and Development Institute (CARDI). In the past 5 years, CROSQ has become more active in the area of Quality Infrastructure for energy in the region including: -

- Solar Water Heating (SWH)
- Photovoltaic (PV) technology
- Laboratory accreditation
- National policies
- Value chain assessment
- Meteorology
- Energy efficiency building codes
- Appliance Testing
- Labelling standards

CROSQ has indicated the need for more partnership development in the region.

### 3.16.3 | CARIBBEAN CENTRE FOR RENEWABLE ENERGY & ENERGY EFFICIENCY

As the newest entity established by CARICOM 2014, the Caribbean Centre for Renewable Energy & Energy Efficiency (CCREEE) is the most focused regional institution on the RE and EE industry having started its operations formally in 2018. Unlike other institutions, this is its sole focus. It has a mandate to promote renewable energy and energy efficiency investments, markets and industries in the Caribbean. It also seeks to be a knowledge hub for RE and EE in the region. Existing concerns include:

More assistance with integrated resource planning in OECS countries. More support for educational institutions to develop more practical curricula and deliver training to the market practitioners
Its strategic programmes include:

1. Knowledge Management and Transfer
2. Energy Access
3. Sustainable Business and Industry Programme
4. Sustainable Transport
5. Finance and Project
6. Support
7. Climate Resilience
8. Sustainable Buildings Programme

The major funders of the CCREEE programmes are United Nations Industrial Development Organization (UNIDO) and the Government of Austria who also work in partnership with other regional stakeholders listed in section 3.16.

One key partnership is with the Credit Risk Abatement Facility (CRAF) which is a new initiative developed by the CARICOM Development Fund (CDF) with assistance from the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and the CARICOM Energy Unit. One key objective is to incentivise additional lending to MSMEs for renewable energy and energy efficiency projects in the Caribbean.

### 3.16.4 | CARIBBEAN COMMUNITY CLIMATE CHANGE CENTRE

5Cs was approved by CARICOM in 2002 and became fully functional in 2004. It is now a registered accredited entity (AE) for the green climate fund (GCF). Its mandate is to coordinate the Region's response to climate change and help countries to adapt and build resilience. As a regional stakeholder, it aided in the development and implementation of pilot projects which demonstrate the depth of its operations including: -

**a)** The installation of a Saltwater Reverse Osmosis (SWRO) System, using a renewable energy source on the Island of Bequia in Saint Vincent and the Grenadines
**b)** The development of the CARICOM Regional Framework for Achieving Development Resilient to Climate Change (2009 –2015) and its implementation Plan (2011-2021) Using donor funds, it currently invests over 40% of its resources in the area of mitigation, with a focus on actively combining mitigation and adaptation interventions. GCF funding is accessed through country focal points

working with the AE to develop proposals for projects that focus on mitigation and adaptation to combat climate change effects. 5Cs generally work with governments, state owned institutions and NGOs to complete proposals for GCF funding.

Notwithstanding their efforts to date, they still see the need for: -

- Developing Strong public awareness for RE and EE
- Regulation reform in some countries
- More proactive responses in finance mobilization
- More private sector involvement in projects
- Greater emphasis on government buildings
- More fiscal incentives for residential and commercial sectors
- Promotion of green procurement
- Implementation of efficiency building codes and standards
- Development of policy to support national EE interventions
- More consistent RE and EE promotion across all sectors
- Greater focus on RE and EE implementation

### 3.16.5 | CARIBBEAN ELECTRIC UTILITY SERVICES CORPORATION

The Caribbean Electric Utility Services Corporation (CARILEC) is an association of electric energy solutions providers and other stakeholders operating in the electricity industry in the Caribbean region, Central and South Americas and globally. Since its establishment in 1989, it has evolved from just traditional utilities to include RE generators and the wider RE community. It represents 35 utilities in 30 countries and has 66 associate members and 5 affiliates. One third of its membership is involved in RE, including all the countries in this study. CARILEC activities vary from planning with governments to implementing RE systems to supply their grids. They do not supply customers with RE systems.

CARILEC's mandate is to provide knowledge sharing, networking, capacity building and training. It also hosts conferences, undertakes advocacy, conducts research and does benchmarking in order to help the energy sector to be more self-sufficient. The current sector needs as expressed by CARILEC include:

- Completion of national integrated resource plans (IRP)
- Development of sustainable energy action plans

### 3.16.6 | CARICOM

The Caribbean Community (CARICOM) is a grouping of twenty countries; fifteen member states and five associate members. It was established initially on 4 July 1973 with the signing of the Treaty of Chaguaramas and later revised in 2002 to allow for the eventual establishment of the Caribbean Single Market and Economy (CSME). This group of countries plus Dominican Republic constitutes CARIFORUM. CARICOM rests on four main pillars: economic integration, foreign policy coordination, human and social development and security. The economic integration pillar in the context of the CSME has positive implications for the RE industry since this allows for easier access to this market by RE firms, equipment manufacturing and assembly companies. The Energy Unit in the Secretariat plays an important role within this regional institution along with several other institutions, some of which function directly or indirectly in the RE industry. They play a key role in two key regional programmes including:

- The C-SERMS as mentioned previously in the sections on the regional approach and the literature review.
- The Technical Assistance Programme for Sustainable Energy in the Caribbean (TAPSEC) which supports the Region's transition to a low-carbon, sustainable and a climate compatible development pathway. It seeks to increase and improve access to modern, affordable and sustainable energy services for Caribbean citizens.

## 3.17 | FUNDING AGENCIES

There are several agencies indicated right, which provide some type of financing to the countries included in the study. This may include grants, low interest loans, equity financing, blended financing and other variations. While many are multilateral institutions, there are also regional and local development banks which vary in scope.

The funding agencies' relationships with the key stakeholders in the countries included in the study is shown right. Not all institutions cover the Dominican Republic.

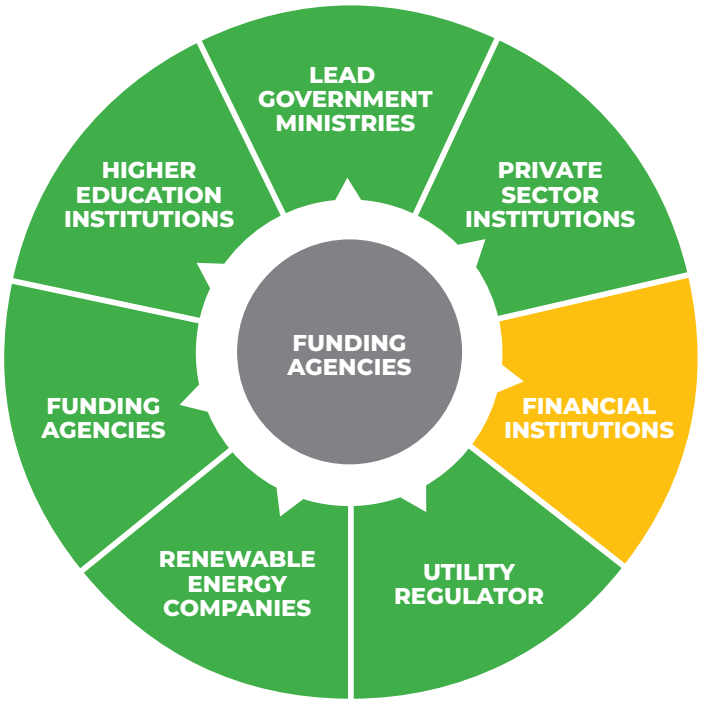



***Figure 3.81 | Relationships of Funding Agencies to Key Stakeholders in the Region***

### 3.17.1 | INTER-AMERICAN DEVELOPMENT BANK

The Inter-American Development Bank (IDB) was established in 1959 to support the process of economic and social development in Latin America and the Caribbean. It has been the main source of multilateral financing to this region for several years. The IDB Group provides solutions to development challenges by partnering with governments, companies and civil society organizations, thus reaching its clients ranging from central governments to businesses. The IDB lends money and provides grants using established financial mechanisms that play an important role in mobilizing additional resources required for RE and EE actions including but not limited to:

- Sustainable Energy and Climate Change Funds
- Climate Investment Funds (CIF)
- Global Environment Facility (GEF)
- Resources under the Kyoto Protocol (CDM)
- Social Entrepreneurship Program (SEP)
- Voluntary markets
- A range of lending and technical assistance programs

IDB is actively involved in the region in technical corporation, co-financing, procurement and related processes. They have expressed the desire to see more financing done for pilot projects which they believe would encourage more widespread RE implementation. They do primarily low interest financing and a limited amount of grants. They also encourage the support of horizontal linkages to the RE/EE sector with tourism as a major sector. One initiative was the CHENACT project which included EE in hotels across the region.

Funding for projects and businesses is usually up to $750,000 with the access criteria being applied by the implementing institution. National support is provided on a demand basis and IDB's normal mode is to work with governments to support their energy plans and to not engage businesses directly. They are usually very involved in developing the projects and programmes they plan to support.

IDB has recognized that traditional risk assessment by the bank will require more creativity since many economies have been setback during the COVID-19 pandemic. They have committed between $200M and $300M to the region annually until 2030. Since the funded areas depend on each country's request, there is a measure of control for each qualifying government.

### 3.17.2 | UNITED NATIONS DEVELOPMENT PROGRAM

The United Nations Development Program (UNDP) was established in 1965 by the General Assembly of the United Nations. It is guided by the United Nations Development Group's common approach to implementing the SDGs; Mainstreaming, Acceleration, and Policy Support (MAPS). UNDP's mandate includes helping countries to meet their SDGs. The UNDP also administers a Capital Development Fund, which helps developing countries grow their economies by supplementing existing sources of capital assistance by means of grants and loans. It also supports governments in securing increasingly diverse sources of innovative financing for development and ensures that such financing is risk informed. The most relevant goal for this study is SDG-7: Affordable and clean energy.
In 1992, as part of their strategy a UNDP Small Grants Facility (UNDP-SGF) was established globally, and in 1994, for all independent Caribbean countries. Administrative offices exist in 16 countries to serve the region. As implied, only small grants are provided, and it excludes private enterprises.

On a country-by-country basis, assistance transfers are provided based on biodiversity, context, vulnerability and per capita income. Country assistance varies from $5M to $10M annually. RE companies would have to organize themselves under an umbrella private sector institution or NGO in order to access the funds. Funding for qualifying projects is usually up to $50,000 with the access criteria being predefined and evaluated by a committee to determine eligibility. Strategic projects may however go up to $150,000. Projects must be within the Global Environment Facility (GEF) focal areas and may include capacity building in organizations; project management, proposal writing, event hosting and showcasing expertise. Standard proposal templates exist to facilitate applications for funding assistance.

### 3.17.3 | GLOBAL ENVIRONMENT FACILITY

The Global Environment Facility (GEF) is a global partnership among 178 countries, international institutions, non-governmental organizations (NGOs), and the private sector to address global environmental issues while supporting national sustainable development initiatives. It provides grants for projects related to specific focal areas:

- Biodiversity
- Climate change
- International waters
- Land degradation
- The ozone layer
- Persistent organic pollutants

The GEF is also the designated financial mechanism for several multilateral environmental agreements or conventions. As such the GEF assists countries in meeting their obligations under the conventions they signed and ratified. These conventions and agreements provide guidance to the two governing bodies of the GEF; the GEF Council and the GEF Assembly.

The GEF helps fund initiatives to assist developing countries in meeting the objectives of the international environmental conventions. Today the GEF is the largest funder of projects to improve the global environment. GEF requests are submitted by countries through one of its affiliate institutions like UNEP, UNDP, etc.

### 3.17.4 | UNITED NATIONS DEVELOPMENT ORGANIZATION

The United Nations Industrial Development Organization (UNIDO) was established in 1966 to promote industrial development for poverty reduction, inclusive globalization and environmental sustainability. In 2013, it was reformed to be a specialized agency of the United Nations to promote and accelerate inclusive and sustainable industrial development in Member States. They currently provide:

- Technical cooperation
- Analytical and research functions and policy advisory services
- Normative functions and standards and quality-relatedactivities
- Convening and partnerships for knowledge transfer, networking and industrial cooperation.

Its recent work in Barbados, St. Vincent and Dominican Republic was in the areas of RE clusters, agri-businesses and bioenergy respectively. Specific assistance includes:

- Policy development for countries
- Promotion of RE companies
- Capacity building
- Technical assistance
- Market studies
- Seminars
- Matchmaking

Startup RE companies may receive up to 50% grant financing for their project; up to $10,000 each. Criteria include excellence of idea and product, novelty, value added, impact, scalability, quality of implementation team members, experience and work plans. Because of the normal risk associated with startups, grants are used instead of loans, but the full fund is only $220,000. This may however be useful for those countries which need to enhance their RE capacity and can attract the UNIDO cluster program.

Grant funding is provided to a country for a specific project or programme. Depending on the structure of the country programme, businesses may then request funds to support their business plans using mechanisms setup under the programme.

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### 3.17.5 | EUROPEAN UNION

The Delegation of the European Union (EU) to Barbados, the Eastern Caribbean States, the OECS and CARICOM/CARIFORUM has long worked with the Caribbean. One popular landmark is the European Partnership Agreement (EPA). The role of the Delegation is to promote the values and policies of the EU in an open and equal partnership with the Governments and people of the region. They seek to:

- Implement development and trade policies focusing on poverty alleviation, democracy, etc. and the smooth and gradual integration of the countries into the world economy
- Deepen the political dialogue on all issues of mutual interest and to strengthen the partnership
- Support CARICOM regional integration as well as the planned development of regional policies, programmes and institutions

The Delegation has an energy officer who focuses on the EU's energy work in the Region. It routinely works with other international funding institutions (e.g. IDB/CDB and the European Investment Bank (EIB)) who manage country projects in order to finance proposed projects. Funding may go up to $12M for multi-country projects depending on the project while the Caribbean Investment Facility (CIF) has been financed up to $130M. Preferential support is extended to projects which are innovative, high risk or utilize mature technologies. For government programs the EU seeks to minimize risks by checking for enough capacity and expertise in the department of energy, observing regular communication, ongoing training and utilizing proven partner procedures (e.g. IDB's). Assistance comes in the form of:

- Bilateral support directly to government for budget support
- Regional support negotiated with CARICOM
- Program support for specific national programs
- Caribbean Investment Facility (CIF) for projects
- Concessionary Loans

Bilateral allocations are much smaller than regional allocation with the largest in recent time being $18M. Other areas of interest include climate change, disaster risk reduction and capacity building but these are not allocated directly into the normal EDF cycle and should therefore be requested early to receive consideration. Requests are normally made by governments and not businesses directly, even if the disbursement eventually reach businesses.

### 3.17.6 | GIZ

GIZ is an international service provider in the field of international cooperation for sustainable development and international education work, including economic development and employment promotion, energy and the environment. It has worked with the CARIFORUM office to support the institutional structures for the promotion of renewable Energy and Energy Efficiency. One key project has been the Renewable Energy and Energy Efficiency Technical Assistance (REETA) which sought to develop a regional energy strategy, create regional expertise and promote networks between actors. At the national level, GIZ helped countries to improve their regional policy framework for renewable energy and energy efficiency and strengthen the ability of the energy units of the CARICOM Secretariat to carry out their coordinating roles. While not a provider of cash, it contributes by way of:

- Technical assistance
- Training courses in renewable energy and energy efficiency
- Development of curricula at educational institutions
- Promoting and implementing pilot projects

Businesses benefit when the above assistance is being offered and not from any specific request on their part. This assistance is normally aligned with the regional C-SERMS implementation. The TAPSEC is being implemented by GIZ.

### 3.17.7 | CARIBBEAN DEVELOPMENT BANK

The CDB was established in October 1969 and entered into force in January 1970. The Bank was created to contribute to the economic growth and development of member countries in the Caribbean, and to promote economic cooperation and regional integration, with special focus on the needs of the less developed countries in CARICOM. It also has a renewed commitment to climate resilience and the adoption and use of clean energy, RE and EE technologies, and has signalled the need for special measures of assistance for member states. The department for Renewable Energy and Energy Efficiency has been established to manage this portfolio. CDB provides funding to member states via:

- Grants
- Low interest loans
- Technical assistance

Ensuring that projects are bankable is important to the bank given its small size. Where gaps exist in good projects, technical assistance may be provided to bridge the gap. Other measures to reduce and mitigate risks are being explored. Keen support is extended to RE and EE projects linked to agriculture which provides some synergies for several member states. Requests for support are made by government and not individual businesses.

### 3.17.8 | GREEN CLIMATE FUND

The Green Climate Fund (GCF) was established by the 194 countries which are signatories to the United Nations Framework Convention on Climate Change (UNFCCC) in 2010. The GCF is a global facility designed to respond to climate change needs by financing projects which target low-emission and climate-resilient development. Its scope includes:

- Mitigation projects which seek to limit or reduce greenhouse gas (GHG) emissions
- Adaptation projects which seek to cope with the impacts of climate change. Particular attention is focused on the Least
- Developed Countries (LDCs), Small Island Developing States (SIDS), and African States.

A significant financial investment is required to fund the RE work that is necessary. Traditional modalities used by some banking institutions do not allow some projects to qualify and so in these cases the GCF is both an attractive and a relevant option for the Caribbean region. The GCF provides financing for projects and programs in the form of:

- Grants
- Concessionary loans
- Blended finance
- Equity schemes
- Guarantees

It implements projects through Accredited Entities (AE) which meet the standards of the Fund. AEs execute various activities including the development of funding proposals, management and monitoring of projects.

The GCF promotes shared financing and normally without caps on the amounts. However, caps may be applied for grant financing components for the private sector. Other considerations include the number of beneficiary countries and the number of years over which the project is implemented. Projects must also be aligned with the GCF's 6 investment criteria.

- Continuity
- Effectiveness
- Ownership
- Paradigm shift
- Financial risk and policies
- How project is funded, including other resources and environmental footprint

In order to reduce risks and assist applicants, the GCF encourages discussion, submission of concept notes, technical support to assist with document preparation, use of feasibility studies, and evidence gathering. Experts are made available to assist further as required. All requests must be made to the GCF through an AE using standard proposal templates. The AEs work with the private and public sectors to develop projects for submission, as well as provide technical support in completing such applications.

### 3.17.9 | INTERNATIONAL RENEWABLE ENERGY AGENCY

The International Renewable Energy Agency (IRENA) is an intergovernmental organization that supports countries in their transition to a sustainable energy future and serves as the principal platform for international cooperation. It promotes the widespread adoption and sustainable use of all forms of renewable energy in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity. With a mandate from countries around the world, IRENA encourages governments to:

- Adopt enabling policies for renewable energy investments
- Provide practical tools and policy advice to accelerate renewable energy deployment
- Facilitate knowledge sharing and technology transfer to provide clean, sustainable energy

IRENA assists the Caribbean region with a wide range of products and services, including:

- Renewable energy capacity statistics
- Renewable energy cost studies
- Renewables Readiness Assessments, conducted in partnership with governments and regional organizations
- The Global Atlas, which maps resource potential by source and by location
- Renewable energy benefits studies
- Facilitation of renewable energy planning
- Integrated resource planning

All requests for assistance are made by governments.

### 3.17.10 | ROCKY MOUNTAIN INSTITUTE

The Rocky Mountain Institute (RMI) is a non-profit independent organization that supports countries in their transition from fossil-based energy to clean energy sources. One major focus is energy planning. RMI assists the Caribbean region with:

- Implementing clean energy projects
- Energy Planning
- Renewable energy benefits studies

RMI primarily uses grant funds to support the region. These are new grant funds which were not previously earmarked for the region. Sources include the EU and the governments of other developed countries. They currently have $1B in projects in the pipeline and estimates that their work will save the region $9B annually and create 75,000 new jobs by 2030. They implement projects in countries which meet some basic criteria including:

- Funds provided by a donor may only be used in countries from that donor's qualifying list of countries
- Strong political will to implement changes exists
- Government and electricity utilities agree on interventions

Since RMI operates at the national level, all requests are filtered using the criteria above. They execute their own projects and may therefore perform some local procurement at their discretion.

# 4.0 | COUNTRY INDICATOR ANALYSIS

## 4.1 | RE INDUSTRY CHARACTERISTICS

### 4.1.1 | DEFINITION

One functional definition of the Renewable Energy Industry is the collection of activities and relationships that contribute to the development, generation, sale, purchase and management of renewable products and services which are utilized to support a cleaner energy environment. This includes renewable energy and energy efficiency. The regional energy policy along with the C-SERMS references these two areas extensively and while separate targets are set, they are treated with the same urgency and always together. The C-SERMS document specifically points out that we, "need to find synergies across renewables and to integrate them with energy efficiency efforts". There is no plan on renewable energy that excludes energy efficiency. Rather, existing energy plans make every effort to marry the two; RE and EE, as observed in the formation of the CCREEE. Given that these two interventions are inextricably linked and strategically approached together, this study has elected to stick with international, regional and national approaches to addressing regional energy and cost concerns.

These relationships drive the activities between stakeholders and influence the sustainability of the RE Industry. Based on the relationships presented for each country included in the scope of this study, it is possible to show the active parts of the RE Industries. The quality of the relationships is depicted using the colour coding system from Section 3.0, with the number rating also shown for the stakeholder groups in the RE Industry. While the relationships in Section 3.0 only reflected one side of the relationship (outwards from a single stakeholder to the others), the table on the following pages now also includes the relationships from each of the other stakeholders to a single stakeholder (inward). By combining both the inward and the outward sides of the relationship, we can obtain a more comprehensive rating of the stakeholder relationships. As a reminder green represents a good relationship, magenta represents a fair relationship and red represents a poor relationship.

| COUNTRY | LGM | UR | FI | PSI | HEI | REC | FA | RI | INDUSTRY |
|---|---|---|---|---|---|---|---|---|---|
| Antigua & Barbuda | 2.55 | 2.93 | 4.46 | 3.92 | 4.28 | 3.16 | 2.54 | 2.61 | 3.30 |
| Bahamas | 4.15 | 4.15 | 4.49 | 2.93 | 4.31 | 3.44 | 2.41 | 2.50 | 3.55 |
| Barbados | 2.00 | 2.51 | 3.52 | 2.36 | 2.34 | 2.70 | 2.01 | 2.24 | 2.46 |
| Belize | 2.63 | 2.55 | 3.46 | 2.46 | 4.28 | 3.10 | 2.08 | 2.33 | 2.86 |
| Dominica | 2.93 | 2.64 | 4.49 | 3.21 | 4.08 | 3.70 | 2.58 | 2.44 | 3.26 |
| Dominican Republic | 3.92 | 3.92 | 4.13 | 3.77 | 1.81 | 2.49 | 2.14 | 2.23 | 3.05 |
| Grenada | 2.59 | 2.47 | 3.19 | 2.31 | 4.08 | 2.46 | 2.19 | 2.49 | 2.72 |
| Guyana | 2.18 | 3.78 | 4.12 | 2.34 | 3.82 | 3.08 | 2.37 | 2.61 | 3.04 |
| Haiti | 2.52 | 2.24 | 3.73 | 3.42 | 3.01 | 3.35 | 2.54 | 2.47 | 2.91 |
| Jamaica | 2.13 | 3.90 | 4.37 | 3.71 | 2.40 | 2.93 | 2.22 | 2.30 | 3.00 |
| St. Kitts & Nevis | 2.60 | 2.55 | 4.58 | 3.00 | 2.65 | 4.04 | 2.13 | 2.26 | 2.98 |
| St. Lucia | 2.01 | 1.83 | 4.37 | 3.63 | 4.09 | 2.45 | 1.68 | 2.21 | 2.78 |
| St. Vincent & Grenadines | 2.19 | 2.18 | 4.62 | 2.77 | 4.12 | 3.15 | 1.86 | 2.30 | 2.90 |
| Suriname | 3.10 | 3.26 | 4.54 | 3.59 | 4.17 | 3.81 | 2.27 | 2.53 | 3.41 |
| Trinidad & Tobago | 2.30 | 3.78 | 4.46 | 2.13 | 2.66 | 2.89 | 2.27 | 2.36 | 2.86 |

***Table 4.1 | Actual Relationships Status in each Local RE Industry***

The resulting RE industry in each country is in many cases a response to the energy policies and plans of government or the lack thereof. It is important to note that where no supporting regulations exist for a policy, there is no policy effect experienced. Table 4.2 below provides a summary of the targets, active policy and preferred technologies. It also contributes to the sizing estimates for the RE markets in each country in section 4.1.2.

| COUNTRY | RE TARGETS & EE TARGETS | PREFERRED TECHNOLOGIES | **GRID CONNECTION & FOCUS |
|---|---|---|---|
| **Antigua & Barbuda** | **15% RE by 2030**<br>**33% EE by 2027*** | Wind, PV, EE Retrofits, SWH | **Yes**<br>**All scale generation** |
| **Bahamas** | **30% by 2030**<br>**33% by 2027*** | PV, Wind, WtE, SWH | **No**<br>**No policy focus** |
| **Barbados** | **100% RE by 2030**<br>**20% EE by 2030** | PV, Wind, WtE, Biomass, Biofuels, SWH, EE Retrofits | **Yes**<br>**All scale generation** |
| **Belize** | **85% RE by 2030**<br>**30% EE by 2027*** | PV, Biomass, Biofuels, SWH EE Retrofits | **No**<br>**Large scale generation** |
| **Dominica** | **100% RE by 2030**<br>**33% EE by 2027** | Hydro, Geothermal, PV, SWH | **Yes**<br>**All scale generation** |
| **Dominican Republic** | **25% by 2025**<br>**33% EE by 2027** | PV, SWH | **No**<br>**Large scale generation** |
| **Grenada** | **100% RE by 2030**<br>**33% EE by 2027** | Geothermal, PV, SWH, Wind | **Yes**<br>**All scale generation** |
| **Guyana** | **100% RE by 2030**<br>**33% EE by 2030*** | Hydro, PV, Wind, Biomass Biofuel, EV, LED lights | **No**<br>**All scale generation** |
| **Haiti** | **50% RE by 2020**<br>**33% EE by 2027*** | PV, Hydro, Wind, Biomass | **No**<br>**No policy focus** |
| **Jamaica** | **30% RE by 2030**<br>**33% EE by 2030*** | Wind, PV, Hydro, Biomass SWH | **Yes**<br>**All scale generation** |
| **St. Kitts & Nevis** | **100% RE by 2020**<br>**33% EE by 2027*** | Geothermal, Wind, PV, WtE | **No**<br>**Large scale generation** |
| **St. Lucia** | **35% RE by 2025**<br>**50% RE by 2030**<br>**33% EE by 2027*** | PV, Wind, Geothermal, SWH EE Retrofits | **No**<br>**All scale generation** |
| **St. Vincent & the Grenadines** | **59% RE by 2027**<br>**33% EE by 2027*** | Geothermal, Wind, WtE PV, SWH, EE Retrofits | **Yes**<br>**All scale generation** |
| **Suriname** | **52% RE by 2017***<br>**33% EE by 2027*** | PV, Hydro, WtE | **No**<br>**No policy focus** |
| **Trinidad & Tobago** | **10% RE by 2021**<br>**33% EE by 2027*** | PV, Wind | **No**<br>**No policy focus** |

***Table 4.2 | Targets, Technologies and Active Policy***

*** C-SERMS EE value**
**** Not including IPP connections**

A combination of the active policy and the existing relationships allow for a reasonable definition of the RE Industry. Where the active policy is clear, whatever it indicates, the required actors are also clear. And where active policy is unclear, the actors are unclear and by extension the definition of the RE Industry in any country. These are local considerations which are not determined by any regional policy or actors. Table 4.3 below provides a summary for each country.

| COUNTRY | RE INDUSTRY DEFINITION AND NEEDS |
|---|---|
| **ANTIGUA AND BARBUDA** | All stakeholders are important in this policy model which has encouraged MSMEs and residents to implement RE systems with connections to the grid. All relationships require strengthening with a focus on FIs, HEIs and PSIs. Government policies also need to be better articulated to the PSIs.<br>• PSIs need to assist FIs and RECs in becoming more aligned to policy.<br>• HEIs need to be actively involved in building technical capacity.<br>• FIs need to revisit lending policies in order to align with RE project requirements. |
| **BAHAMAS** | It is unclear which stakeholders are the most important in this local RE Industry. Only the FA relationships are functional. Those stakeholder relationships which will require strengthening regardless of the policy decisions are those for the HEIs, the lead Government Ministry and the Regulator. Government policies and regulations need to be established<br>and articulated |
| **BARBADOS** | All stakeholders are important in this policy model which has encouraged MSMEs and residents to implement RE systems with connections to the grid. Further outreach is required to the financial sector.<br>• The Regulator and RECs relationships require strengthening.<br>• FIs need to revisit lending policies in order to align with RE project requirements. |
| **BELIZE** | While there is written policy, the active policy does not support inter connection and therefore impacts the state of the local RE industry. Large implementations appear to be the priority and the state-owned development bank is quite active in the residential and business sectors, resulting in little involvement from the FIs. All other stakeholders are important. All relationships except PSIs require strengthening with a focus on FIs and HEIs.<br>• HEIs need to be actively involved in building technical capacity.<br>• If regulations are developed for interconnection, the FIs will need to revisit lending policies in order to align with RE\project requirements. |

***Table 4.3 | RE Industry Definition and Needs***

| COUNTRY | RE INDUSTRY DEFINITION AND NEEDS |
|---|---|
| **DOMINICA** | All stakeholders are important in this policy model which has encouraged MSMEs and residents to implement RE systems with connections to the grid. All relationships require strengthening with a focus on FIs, HEIs and RECS.<br>• HEIs need to be actively involved in building technical capacity.<br>• FIs need to revisit lending policies in order to align with RE project requirements.<br>• RECS need to engage more with Government and HEI to gain inclusion into the planning processes. |
| **DOMINICAN REPUBLIC** | There is written policy supporting inter-connection, but this is not seen in the market since only IPPs have been participating. The policy has not impacted the status of the local RE Industry. Large implementations appear to be the priority and the RE target of 25% is relatively low. Many of the key relationships require strengthening with a focus on FIs and PSIs. The government needs to better articulate their policies and increase their engagement with the private sector.<br>• PSIs need to assist FIs and RECs in becoming more aligned to policy<br>• FIs need to revisit lending policies in order to align with RE project requirements |
| **GRENADA** | While there is written policy, the regulations to support inter-connection are not in place. This impacts the status of the local RE Industry. All stakeholders are important in this policy model which has encouraged MSMEs and residents to implement RE systems with connections to the grid. In particular, the relationships of the HEIs require strengthening.<br>• HEIs need to be more actively involved in building technical capacity.<br>• With Regulations in place, FIs would need to revisit lending policies in order to align with RE project requirements. |
| **GUYANA** | While there is written policy, the regulations to support inter-connection are not in place. This impacts the status of the local RE Industry. All stakeholders are important in this policy model which has encouraged MSMEs and residents to implement RE systems with connections to the grid.<br>All relationships except PSIs and the responsible ministry require strengthening with a focus on HEIs, FIs and the utilities regulator.<br>• HEIs need to be more actively involved in building technical capacity.<br>• With regulations in place, FIs would need to revisit lending policies in order to align with RE project requirements.<br>• Regulations need to be better articulated to the PSIs and other stakeholders. |

***Table 4.3 | RE Industry Definition and Needs***

| COUNTRY | RE INDUSTRY DEFINITION AND NEEDS |
|---|---|
| **HAITI** | It is unclear which stakeholders are the most important in this local RE Industry, but some stakeholders exhibit signs of weak relationships, especially the FIs and PSIs. Government policies and regulations need to be set and articulated so that the required stakeholders may respond. |
| **JAMAICA** | All stakeholders are important in this policy model which has encouraged MSMEs and residents to implement RE systems with connections to the grid. All relationships except HEIs and the responsible ministry require strengthening with a focus on PSIs, FIs and the utilities regulator.<br>Regulations need to be better articulated to the PSIs and other stakeholders.<br>• PSIs need to assist FIs and RECs in becoming more aligned to policy.<br>• FIs would need to revisit lending policies in order to align with RE project requirements. |
| **ST. KITTS AND NEVIS** | While there is written policy, there are no regulations to support interconnection and therefore impacts the status of the local RE industry. Large implementations appear to be the priority, requiring little involvement from the FIs. All other stakeholders are important. All relationships require strengthening with focus RECs, and FIs.<br>• Government policies need to be better articulated to the PSIs.<br>• RECs need to engage more with Government and HEI to gain capacity building and have input into the planning processes.<br>• If regulations are developed for interconnection, the FIs will need to revisit lending policies in order to align with RE project requirements. |
| **ST. LUCIA** | While there is written policy, the regulations to support interconnection are not in place. This impacts the status of the local RE industry. All stakeholders are important in this policy model which has encouraged MSMEs and residents to implement RE systems with connections to the grid. |
| **ST. VINCENT AND THE GRENADINES** | All stakeholders are important in this policy model which has encouraged MSMEs and residents to implement RE systems with connections to the grid. Further outreach is required to the FIs and HEIs.<br>• The PSIs and RECs relationships require strengthening.<br>• HEIs need to be more actively involved in building technical capacity.<br>• FIs need to revisit lending policies in order to align with RE project requirements. |

***Table 4.3 | RE Industry Definition and Needs***

| COUNTRY | RE INDUSTRY DEFINITION AND NEEDS |
|---|---|
| SURINAME | It is unclear which stakeholders are the most important in this local RE industry, but all stakeholders already exhibit signs of weak relationships, particularly the FIs, HEIs, RECs and PSIs. Government policies and regulations need to be set and articulated so that the required stakeholders may respond. |
| TRINIDAD AND TOBAGO | It is unclear which stakeholders are the most important in this local RE Industry, but some stakeholders already exhibit signs of weak relationships while the FA and RI relationships appear functional Government policies and regulations need to be set and articulated so that the required stakeholders may respond. |

*Table 4.3 | RE Industry Definition and Needs*

## 4.1.2 | MARKET SIZE

Countries are at different stages on their RE roadmap for different reasons. Their timing has been affected by:

- The recognition of the RE industry as a national priority area.
- The availability of resources to commence the transformation.
- The level of innovation and entrepreneurship.
- The cost of energy locally.

**Electricity consumption** has been prioritized by all countries in this study. They see RE and EE as priority areas and have committed resources to support their NDC and targets to transition their energy sectors. Except for Trinidad and Tobago, all territories are dependent on foreign oil. Their energy mixes vary between 0% and 60% renewable, the remainder being fossil-based. Installed national capacity varies

| COUNTRY | INSTALLED MW CAPACITY | INSTALLED RE MW CAPACITY | PERCENTAGE RE INSTALLED | MINIMUM MW FOR CONVERSION TO RE |
|---|---|---|---|---|
| Antigua & Barbuda | 81.00 | 10.50 | 12.96% | 70.50 |
| Bahamas | 536.00 | 1.20 | 0.22% | 534.80 |
| Barbados | 286.60 | 37.00 | 12.91% | 249.60 |
| Belize | 153.56 | 83.00 | 54.05% | 70.56 |
| Dominica | 26.70 | 6.60 | 24.72% | 20.10 |
| Dominican Republic | 3,708.00 | 780.00 | 21.04% | 2,928.00 |
| Grenada | 55.57 | 2.50 | 4.50% | 53.07 |
| Guyana | 404.00 | 57.40 | 14.21% | 346.60 |
| Haiti | 314.60 | 63.35 | 20.14% | 251.25 |
| Jamaica | 1,283.00 | 151.00 | 11.77% | 1,132.00 |
| St. Kitts & Nevis | 88.80 | 4.40 | 4.95% | 84.40 |
| St. Lucia | 91.00 | 3.00 | 3.30% | 88.00 |
| St. Vincent & Grenadines | 51.06 | 8.82 | 17.27% | 42.24 |
| Suriname | 506.20 | 196.50 | 38.82% | 309.70 |
| Trinidad & Tobago | 2,019.00 | 0.01 | 0.00% | 2,018.00 |
| | 9,605.09 | 1,405.28 | 14.63% | 8,199.81 |

*Table 4.4 | Country Installed Capacity Statistics*

between 40 MW and 4,000 MW. Table 4.4 on previous page, shows the approximate installed capacity statistics for each country in the study. It will be used in our estimation of the investment required and the size of the RE market locally.

With a regional capacity of almost 10GW, there is potentially over 8GW of capacity to be substituted with renewables. The actual required replacement capacity will be much more than 8GW because of the nature of renewable technologies being considered. PV capacity may only be available 6 hours during the 24-hour day leaving 18 hours unserved. Wind may be available between 0 and 24 hours in any day. Hydropower may be available between 6 and 12 months of the year. As a result, utilities will have to adequately model their supply of renewable energy and invest in additional storage capacity to fill the gaps.

The implementation timelines differ for each country and in some cases a 100% renewable target has not been set. It must also be noted that this target may change if there is a change in demand stemming from changes in consumption patterns or primary productive sectors. Just as a shift from agriculture to tourism caused a shift in many countries, a shift to financial services or away from industries which are energy intensive will also cause a change.

There has been no comprehensive analysis on the cost of transitioning from fossil-based sources to RE sources for electricity generation in the region.

- The CARICOM Energy Policy reported an estimated of US$5.7 trillion over the period 2010 to \ 2035. This is an old estimate which was not substantiated in the document.
- A second rough estimate has been done by a Funding Agency (FA1) which suggests that a mixture of RE technologies, along with the soft costs and storage, would cost about US$7M per MW. Using this estimate and 2030 as the 10-year target period for the countries and EE interventions of 10%, we can estimate the annual market for RE and EE in each country. Based on FA, it would require a total of US$63.1 Billion.
- A further estimate has also been done by another Funding Agency (FA2) which now allows the estimated investment to be based on Gross Domestic Product (GDP). It also considers EE interventions at close to 25% of the RE replacement cost for a period up to 2023. Based on FA2, it would require a total of US$50.7 Billion over a 10-year period. Belize, Haiti and Trinidad and Tobago were not included in FA2 study. Consequently, estimated percentage of GDP values were used in Table 4.5, on the following page, to estimate their costs.

| COUNTRY | POTENTIAL MW CONVERTED | FA1 COST OF TRANSITION TO 100% RE ($M) | ANNUAL* POTENTIAL RE MARKET ($M) | FA1A TOTAL ANNUAL MARKET ($M) | NATIONAL GDP ($M) | % OF GDP | FA2 4-YEAR COST ($M) | FA2B TOTAL ANNUAL MARKET ($M) |
|---|---|---|---|---|---|---|---|---|
| Antigua & Barbuda | 70.50 | $493.50 | $49.35 | $54.29 | $1,611.00 | 3.7 | $59.61 | $18.63 |
| Bahamas | 534.80 | $3,743.60 | $374.36 | $411.80 | $12,425.00 | 5.8 | $720.65 | $225.20 |
| Barbados | 249.60 | $1,747.20 | $174.72 | $192.19 | $5,087.00 | 9.9 | $503.61 | $157.38 |
| Belize | 70.56 | $493.92 | $49.39 | $54.33 | $1,925.00 | 10.6 | $204.05 | $63.77 |
| Dominica | 20.10 | $140.70 | $14.07 | $15.48 | $551.00 | 10.6 | $58.41 | $18.25 |
| Dominican Republic | 2,928.00 | $20,496.00 | $2,049.60 | $2,254.56 | $88,940.00 | 10 | $8,894.00 | $2,779.38 |
| Grenada | 53.07 | $371.49 | $37.15 | $40.86 | $1,185.00 | 9.7 | $114.95 | $35.92 |
| Guyana | 346.60 | $2,426.20 | $2 | $266.88 | $3,879.00 | 8.4 | $325.84 | $101.82 |
| Haiti | 251.25 | $1,758.75 | $175.88 | $193.46 | $9,658.00 | 10 | $965.80 | $301.81 |
| Jamaica | 1,132.00 | $7,924.00 | $792.40 | $871.64 | $15,461.00 | 6.2 | $958.58 | $299.56 |
| St. Kitts and Nevis | 84.40 | $590.80 | $59.08 | $64.99 | $980.00 | 10.3 | $100.94 | $31.54 |
| Saint Lucia | 88.00 | $616.00 | $61.60 | $67.76 | $1,922.00 | 4.9 | $94.18 | $29.43 |
| St. Vincent and the Grenadines | 42.24 | $295.68 | $29.57 | $32.52 | $811.00 | 12 | $97.32 | $30.41 |
| Suriname | 309.70 | $2,167.90 | $216.79 | $238.47 | $3,591.00 | 7.5 | $269.33 | $84.16 |
| Trinidad & Tobago | 2,018.99 | $14,132.93 | $1,413.29 | $1,554.62 | $23,808.00 | 12 | $2,856.96 | $892.80 |
| Total | 8,199.81 | $57,398.67 | $5,739.87 | $6,313.85 | $171,834.00 | 8.8 | $16,224.21 | $5,070.07 |

***Table 4.5 | Annual Potential RE & EE Market***

** Normal EE retrofits excluding Solar Water Heating.*
*FA1 and FA2 are two independent Funding Agencies*
*a - FA1's calculation includes 10% cost for EE*
*b - FA2's calculation includes 25% cost for EE*
*%GDP was estimated for countries with inaccurate or missing data in the FA2 study*

The table on the opposite page, calculated the annual market value using the latter two methods which indicated a difference of 20% for the region with country level variations from 6% to 65%. This variation resulted primarily because the two approaches did not treat the proposed RE technologies in the same way. One approach based the estimate on a percentage of GDP while the other used a fixed MW replacement cost. It is therefore still necessary to conduct a detailed investment assessment of the market per country. Like all other currency references, Table 4.5 uses USD.

**Water heating,** even though not a significant cost consideration for most MSMEs, it represents significant national energy consumption and a noticeable demand for the utility in the mornings and the evenings. The energy source may be electricity or some type of gas. The cost to users is acutely evident for countries with high energy rates and high water-service penetration. One previous study (USAID, 2008) presented a picture of a very attractive market for Solar Water Heating. Estimates from that study indicate a residential market of US$689M for 17 million people in 4.5M households across the Caribbean including BVI, Cuba and Turks and Caicos which are not a part of this study. The hotel industry was estimated at US$45.5M for 103,000 rooms.

The countries not included in this study were excluded and the countries not included in the SWH were estimated. The data was also extrapolated to reflect a growing population. The estimated residential market breakdown is shown right. Using this estimate and 2030 as the 10-year target period for the countries, we can estimate the annual market for SWH in each country. Assumptions made are: -

**1)** Approximately US$2,000 per thermosiphon system (traditional)
**2)** 60% SWH penetration for Barbados
**3)** 0% SWH penetration for Trinidad and Tobago
**4)** 10% SWH penetrations for all other countries
**5)** 4 persons per household
**6)** Commercial SWH market is 2% of residential market for Belize, Dominica, Guyana, Haiti, Suriname and Trinidad and Tobago
**7)** Commercial SWH market is 5% of residential market for all other countries

While Barbados has a thriving market with approximately 60% penetration with the help of duty-free equipment imports and tax incentives, some countries struggle to gain any significant progress because of low energy prices or a lack of awareness and education in the market. Any movement towards realizing this market should learn from past lessons. Since SWH can offer as much as 20% savings on a household electricity bills, it would be beneficial to both householders and SWH firms to accelerate implementation. The export capacity is addressed later.

| COUNTRY | POPULATION | HOMES | POTENTIAL RESIDENTIAL SWH MARKET ($M) | ANNUAL RESIDENTIAL SWH MARKET ($M) | ANNUAL COMMERCIAL SWH MARKET ($M) | TOTAL ANNUAL SWH MARKET ($M) |
|---|---|---|---|---|---|---|
| Antigua & Barbuda | 97,118 | 24,280 | $43.7 | $4.4 | $0.2 | $4.6 |
| Bahamas | 393,482 | 98,371 | $177.1 | $17.7 | $0.9 | $18.6 |
| Barbados | 274,465 | 68,616 | $54.9 | $5.5 | $0.3 | $5.8 |
| Belize | 398,050 | 99,513 | $179.1 | $17.9 | $0.4 | $18.3 |
| Dominica | 71,625 | 17,906 | $32.2 | $3.2 | $0.1 | $3.3 |
| Dominican Republic | 10,600,000 | 2,650,000 | $4,770.0 | $477.0 | $23.9 | $500.9 |
| Grenada | 112,003 | 28,001 | $50.4 | $5.0 | $0.3 | $5.3 |
| Guyana | 786,550 | 196,638 | $353.9 | $35.4 | $0.7 | $36.1 |
| Haiti | 11,300,000 | 2,825,000 | $5,085.0 | $508.5 | $10.2 | $518.7 |
| Jamaica | 52,823 | 13,206 | $23.8 | $2.4 | $0.1 | $2.5 |
| St. Kitts and Nevis | 182,790 | 45,698 | $82.3 | $8.2 | $0.4 | $8.6 |
| Saint Lucia | 182,790 | 45,698 | $82.3 | $8.2 | $0.4 | $8.6 |
| St. Vincent and the Grenadines | 110,589 | 27,647 | $49.8 | $5.0 | $0.2 | $5.2 |
| Suriname | 581,372 | 145,343 | $261.6 | $26.2 | $0.5 | $26.7 |
| Trinidad and Tobago | 1,394,973 | 348,743 | $697.5 | $69.7 | $1.4 | $71.1 |
| Total | 29,304,119 | 7,326,030 | $13,188 | $1,319 | $46 | $1,365 |

*Table 4.6 | Annual Potential SWH Market*

## 4.2 | RE INDUSTRY STAKEHOLDER ACTIVITIES

Observations of the stakeholders reveal 4 functional groups based on roles and responsibilities. These are depicted in the diagram below.

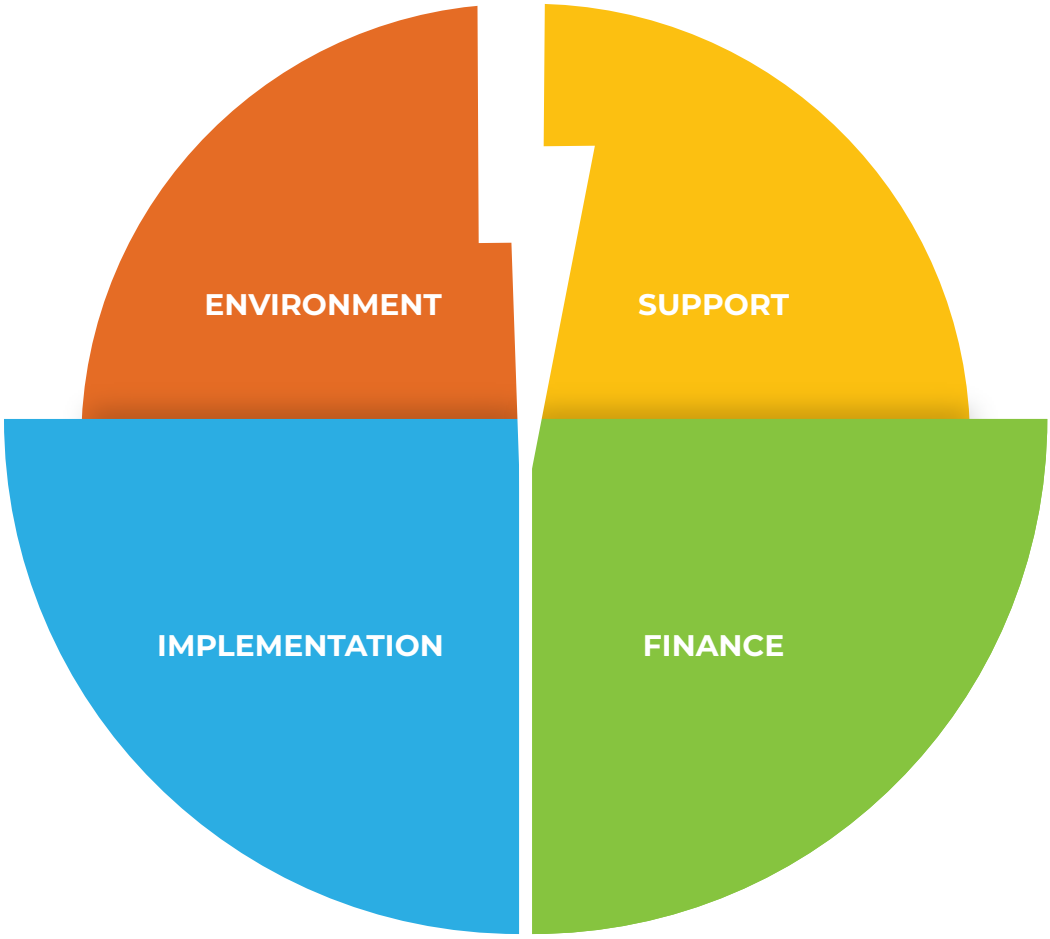



***Figure 4.2 | Renewable Energy Industry Functional Stakeholder Groups***

While stakeholder group activities are influenced by the relationships within and outside that grouping, it may also be affected by external shocks that can negatively or positively affect their operations. The following section will refer to any clear predictable shocks that may impact the stakeholder group, but additional shocks may also occur. Unpredictable shock cannot be planned for and would pose a challenge for any country.

## 4.2.1 | ENVIRONMENTAL STAKEHOLDERS

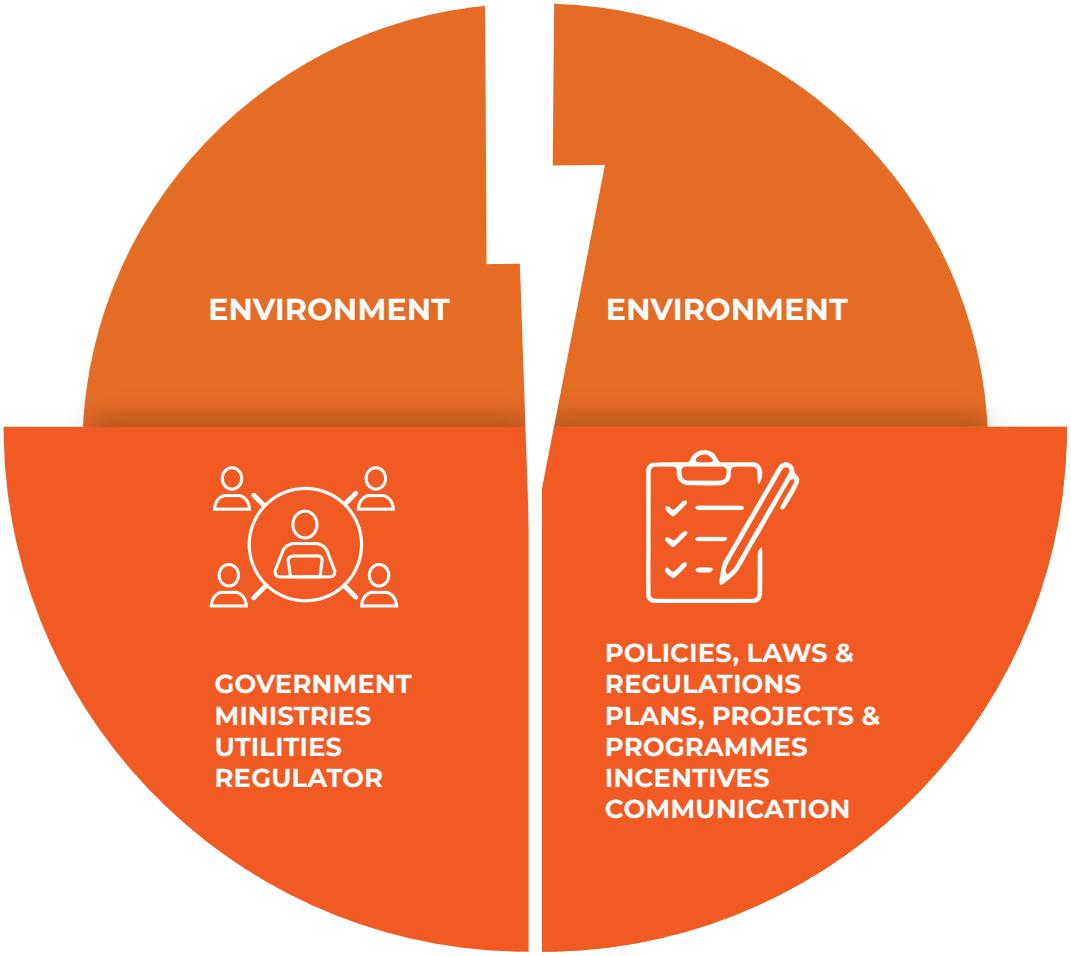



***Figure 4.3 | Environment Stakeholders Functions***

The environmental stakeholders establish the RE environment for the sector. Their work is represented in the sector by the policies, laws, regulations, plans, projects and programmes. These must be well documented, effectively communicated to all stakeholders, monitored and managed for compliance and supported with incentives for some period. This function is required for all countries but is currently established to different degrees in each.

The environment stakeholder group may be impacted by economic shocks; both unpredicted and planned. One planned shock would be a result of any restructuring economic plan. Some of the countries within the scope are in structured IMF plans that may impact how these stakeholders operate. Unpredictable shocks by nature bring scenarios which are not necessarily planned for and must be addressed by these stakeholders if they occur.

### 4.2.2 | SUPPORT STAKEHOLDERS

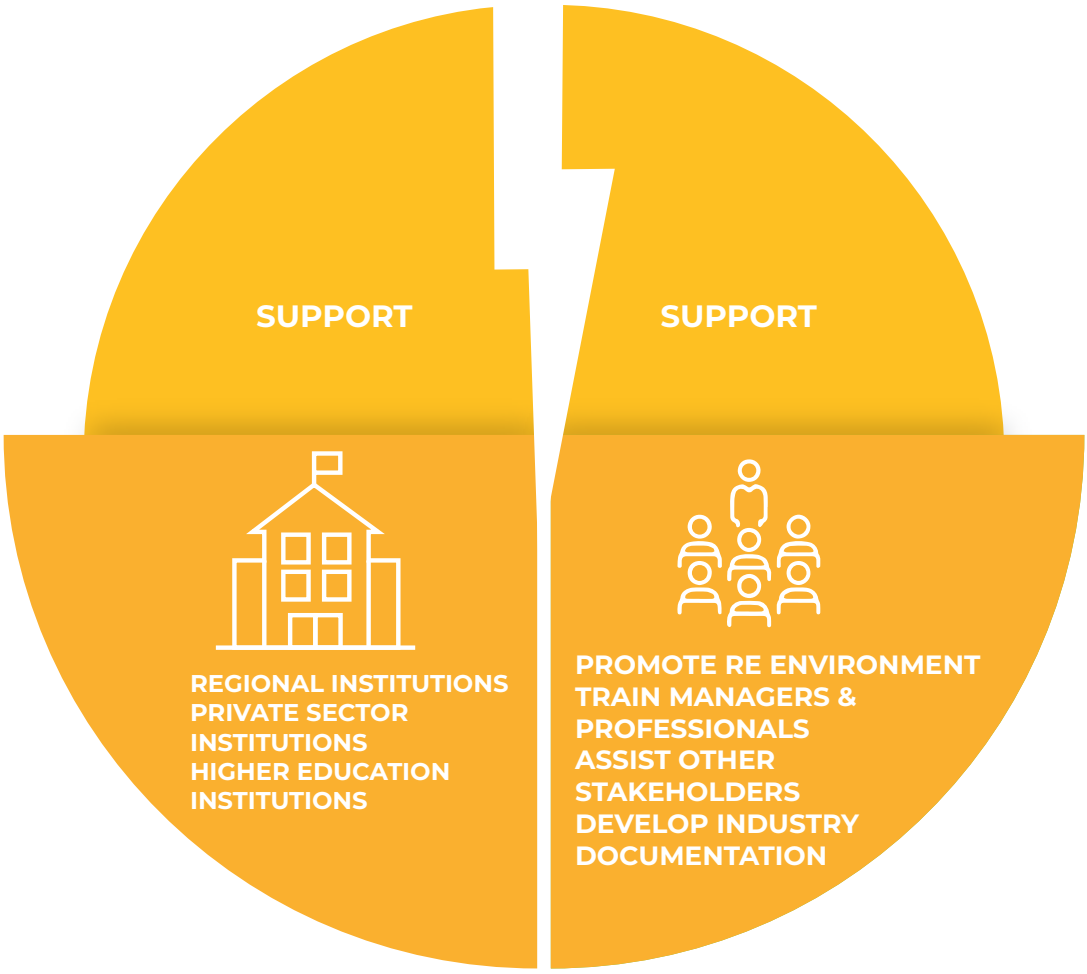



***Figure 4.4 | Support Stakeholders Functions***

The Support stakeholders utilize the communicated positions of the environment stakeholders to ensure all other stakeholders are fully informed. Consultation with other groups is of primary importance in order to conduct any supplementary work required to fully realize market goals and build the necessary capacity amongst all actors to pursue targets. This may include training, studies and quality standards. A significant portion of this work may be conducted for the entire region (e.g. standards), but other work will be localized.

The support stakeholder group may also be impacted by shocks related to policy changes within PSIs or RIs. After many years of support, some government funded PSIs have been asked to mobilize their own funding to support daily operation. Both PSIs and RIs are also being asked to support more sectors or reprioritize their work. These realities trigger policy changes that eventually impact support at the local and regional levels respectively.

## 4.2.3 | FINANCE STAKEHOLDERS

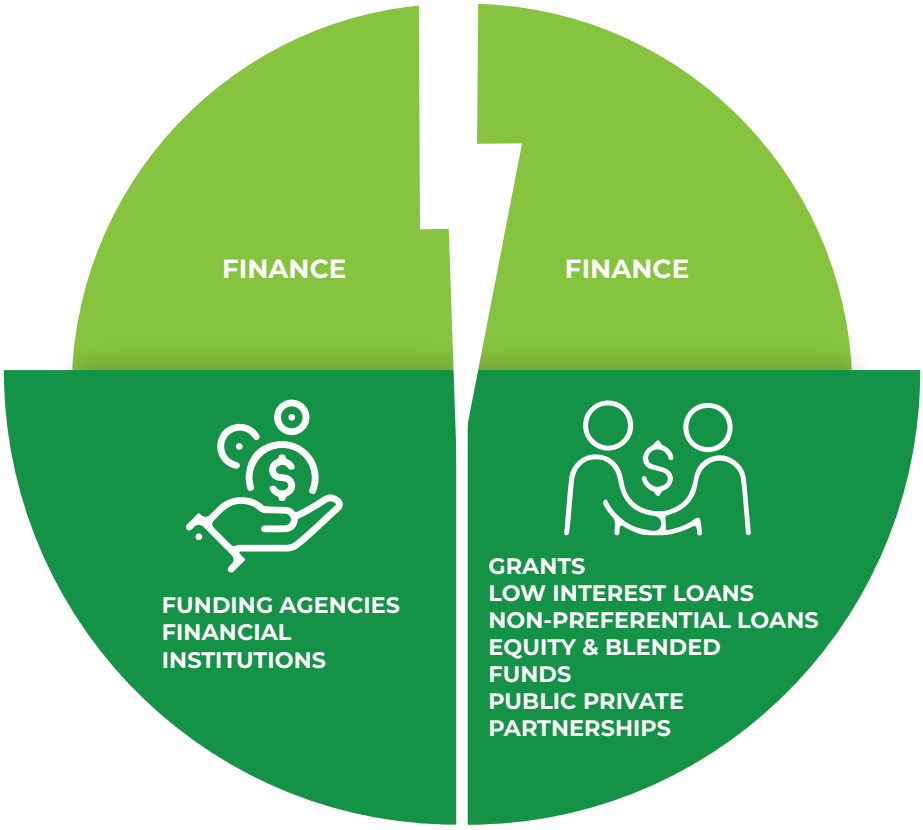



***Figure 4.5 | Finance Stakeholders Functions***

The Finance stakeholders utilize the communicated positions of the environment stakeholders and the supplemental information from support stakeholders to respond to the needs of the clients of the implementation stakeholders. The needs of the clients are linked to the RE environment set by government and the regulator and are based on the market requirements. This varies significantly in practice since some countries have documented policies which remain unimplemented. E.g. tax incentives that would exceed the government's expectations and policies with no regulations to make them actionable.

Financial support to implement projects is provided through this group as a financial investment or in response to physical environment benefits related to mitigation or adaptation. Without the requisite financing, targets cannot be met, and goals cannot be realized. Even low-cost EE interventions with great payback indicators require some level of financing.

Since funding agencies often depend on government funding in and out of the Region, they may be impacted by changes in policy. Governments who back away from agreements related to climate change or some other environmental cause can reduce the amount of available funds to execute regional projects. Changes in countries' developmental status can also disqualify individual countries from receiving funding which may be directed to specific countries.

## 4.2.4 | IMPLEMENTER STAKEHOLDERS

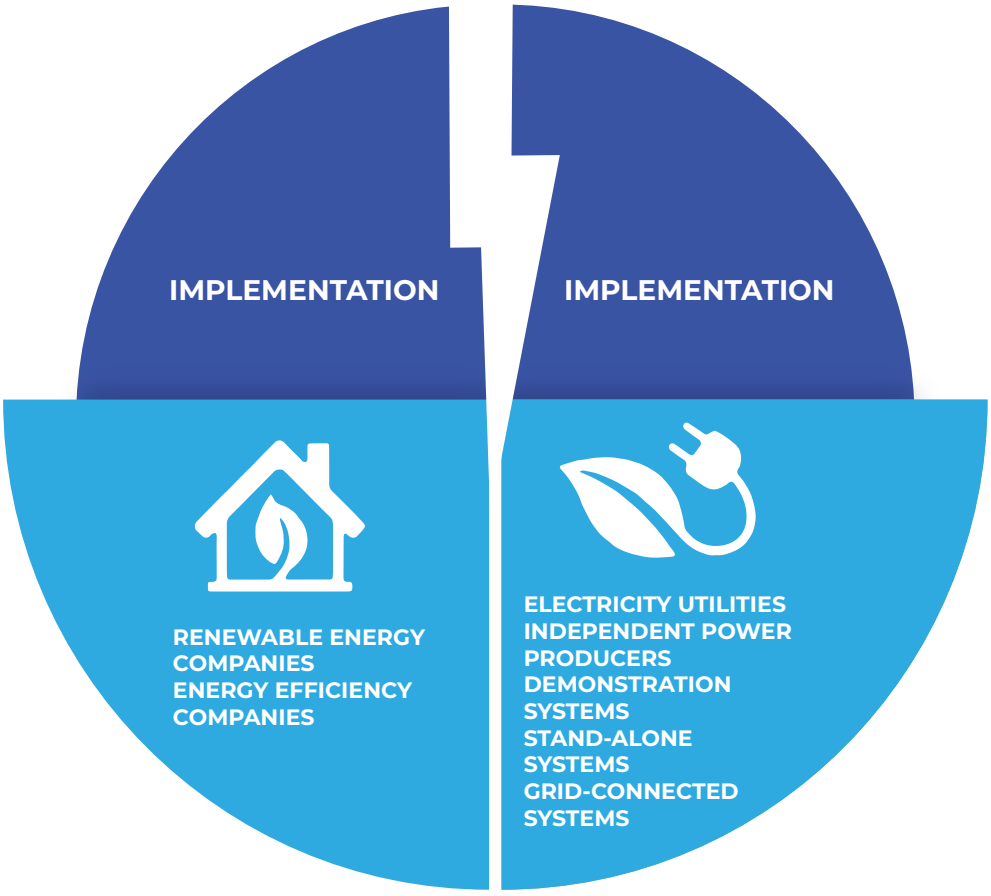



***Figure 4.6 | Implementation Stakeholders Functions***

The Implementation stakeholders utilize all the resources provided by the other three stakeholder groups to push their products and services. Total failure of any group would significantly hamper RE and EE firm's ability to work, where that work is shaped by the policies and regulations of the country. Potential work is determined by whether the utility can integrate RE into their network, or IPP are allowed, or grid-connection is allowed. Stand-alone systems are limited in number outside of those countries with remote communities. Fully stand-alone systems are doubly expensive since they must be totally self-sufficient apart from the national grid under all conditions.

Implementers deploy RE systems and EE interventions for clients who are mostly required to secure financing. Some types of Energy Service Companies (ESCO) do provide financing and receive their payments from customer savings, but these are not widely found amongst regional firms.

One positive shock is the injection of direct investment into the industry. This would be the creation of new equity in an IPP or the utility and would create opportunities for work locally even if the project is directed by an investor; local or foreign.

## 4.2.5 | FUNCTIONAL STAKEHOLDER GROUP POTENTIAL

Based on the analysis of the relationships in the RE industries for each country, the following pictorial representation was created to show the potential for each group to deliver their expected responsibilities as laid out in section 4.2 on page 140. The potential is based on the effectiveness of relationships and functional group experiences in the RE Industry and is shown in figure 4.7. The RE industry is currently still a developing space and depends heavily on the networking and collaborative relationships of actors. The figure below shows a clear need for capacity building in general, and specifically in energy matters. Any rating below 50% suggests the need for resource enhancement.

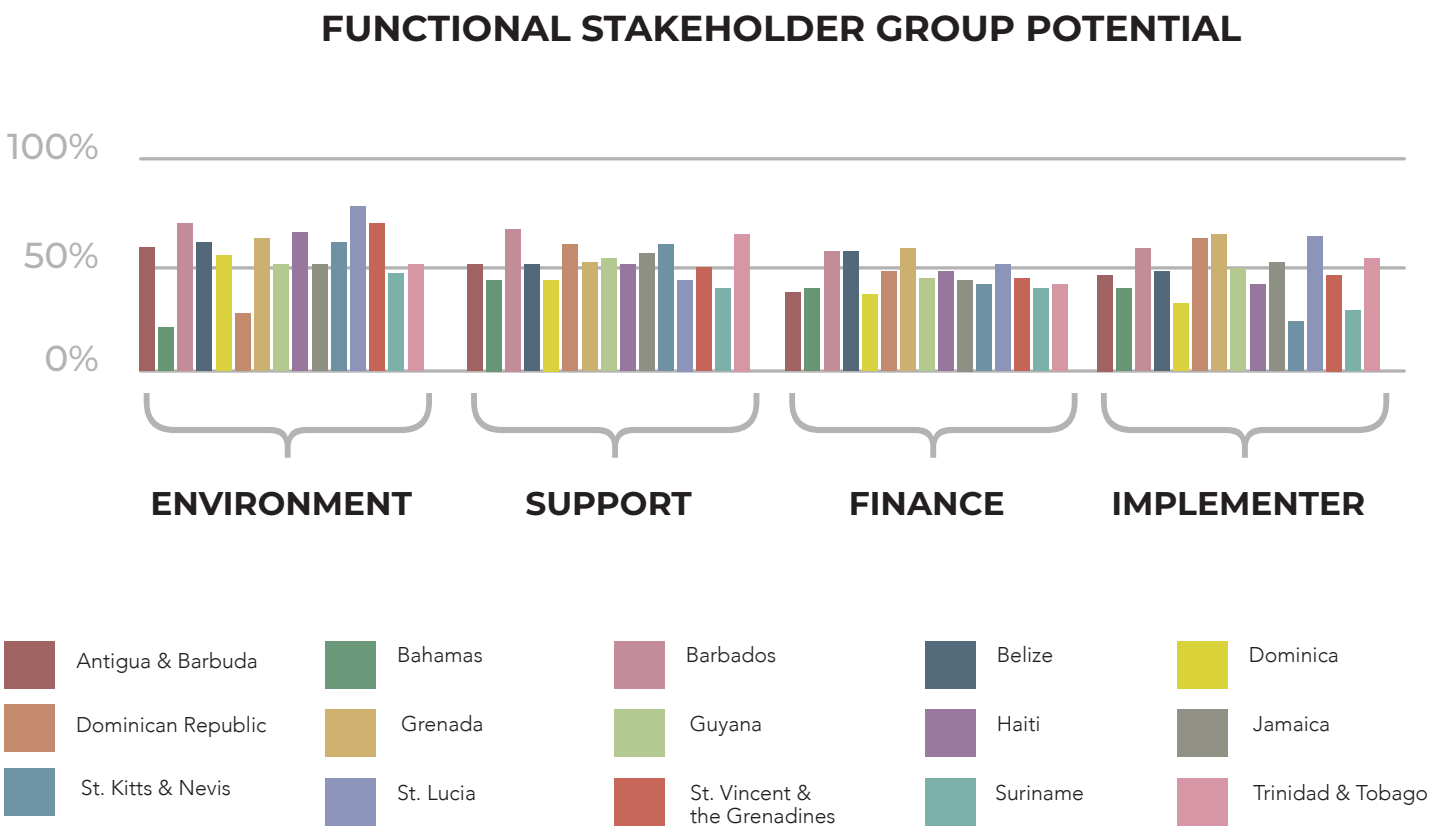



***Figure 4.7 | Functional Stakeholder Group Potential by Country***

## 4.2.6 | FUNCTIONAL STAKEHOLDER GROUP PERFORMANCE

Unfortunately, while good relationships within the RE Industry are a good recipe for success, they are not the only factor and therefore do not necessarily translate in a proportionate performance.

The expected outputs are presented in figure 4.3 to figure 4.6 and the actual performance in delivering those outputs is shown in figure 4.8 below. This shows how well each group has delivered on their outputs for the RE Industry. Performance is determined independently from potential and is determined by examining what was achieved by the stakeholder group.

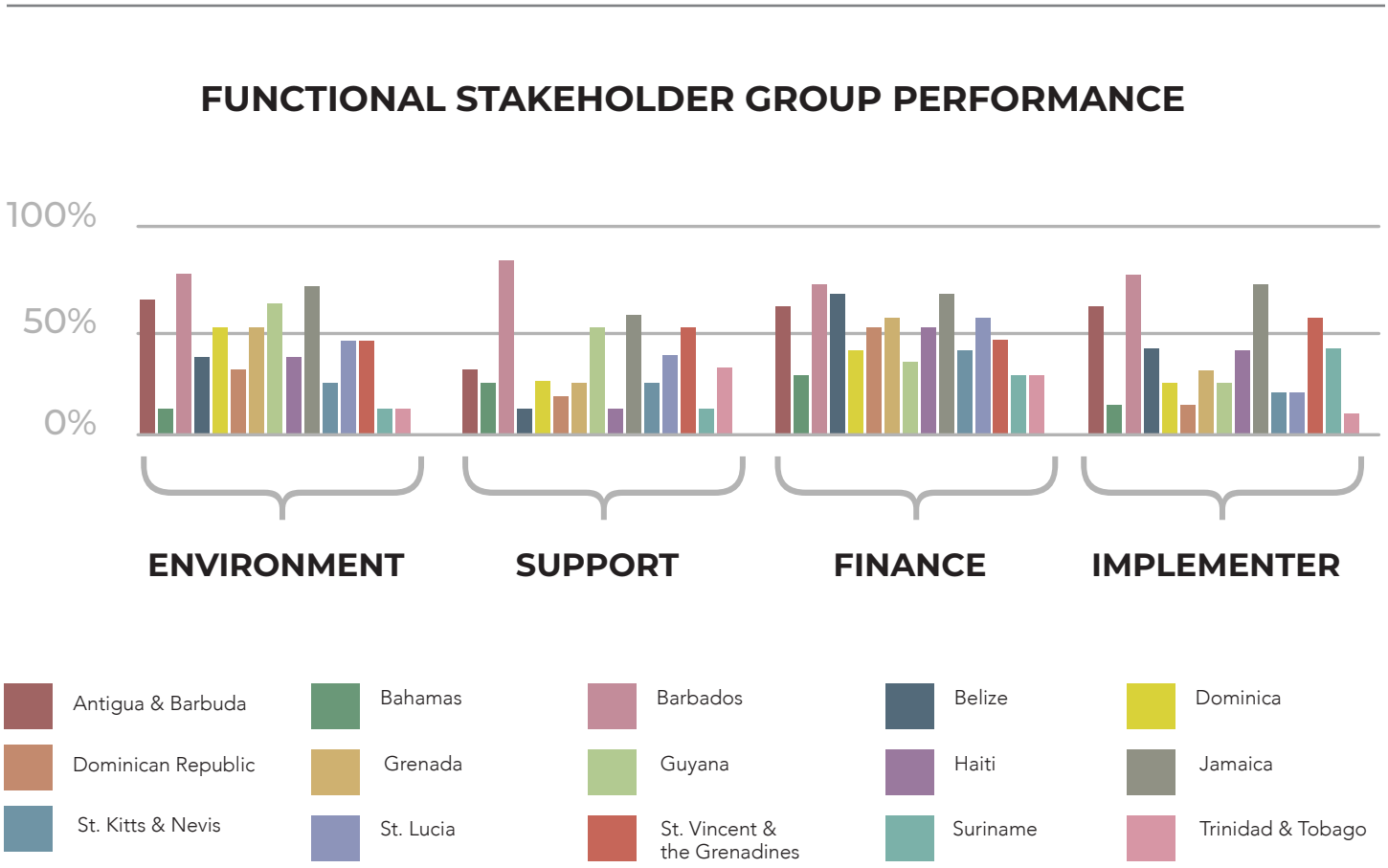



***Figure 4.8 | Country Functional Stakeholder Groups Performance***

## 4.2.7 | COUNTRY PERFORMANCE COMPARED TO POTENTIAL

Antigua and Barbuda, Barbados and Jamaica are the only countries whose RE industries are delivering the majority of what is expected of the industry overall. The Bahamas, Suriname and Trinidad and Tobago are currently delivering the least, with the others ranging from 28% to 48%. As expected, the late starters and those with few committed resources have delivered the least while the first movers have delivered the most. Jamaica, Antigua and Barbuda and Barbados are the only countries which appear to over-perform. A comparison of potential and performance is shown in figure 4.9 and table 4.7 below.

| COUNTRY | POTENTIAL | PERFORMANCE | VARIANCE |
|---|---|---|---|
| Antigua & Barbuda | 44% | 53% | 10% |
| Bahamas | 36% | 21% | -15% |
| Barbados | 62% | 75% | 13% |
| Belize | 53% | 39% | -14% |
| Dominica | 42% | 35% | -7% |
| Dominican Republic | 49% | 29% | - 20% |
| Grenada | 59% | 40% | -19% |
| Guyana | 49% | 43% | -5% |
| Haiti | 51% | 35% | -16% |
| Jamaica | 50% | 65% | 15% |
| St. Kitts & Nevis | 46% | 28% | -19% |
| St. Lucia | 58% | 39% | -19% |
| St. Vincent & Grenadines | 52% | 48% | - 4% |
| Suriname | 39% | 24% | -15% |
| Trinidad & Tobago | 52% | 21% | - 31% |

***Table 4.7 | Country Potential Vs Performance***

The data shows that countries generally performed in line with their potential, except for Trinidad and Tobago which is a late starter. It underperformed significantly compared to other countries. In general, all the countries would benefit from training and capacity building in order to deliver the RE mandate.

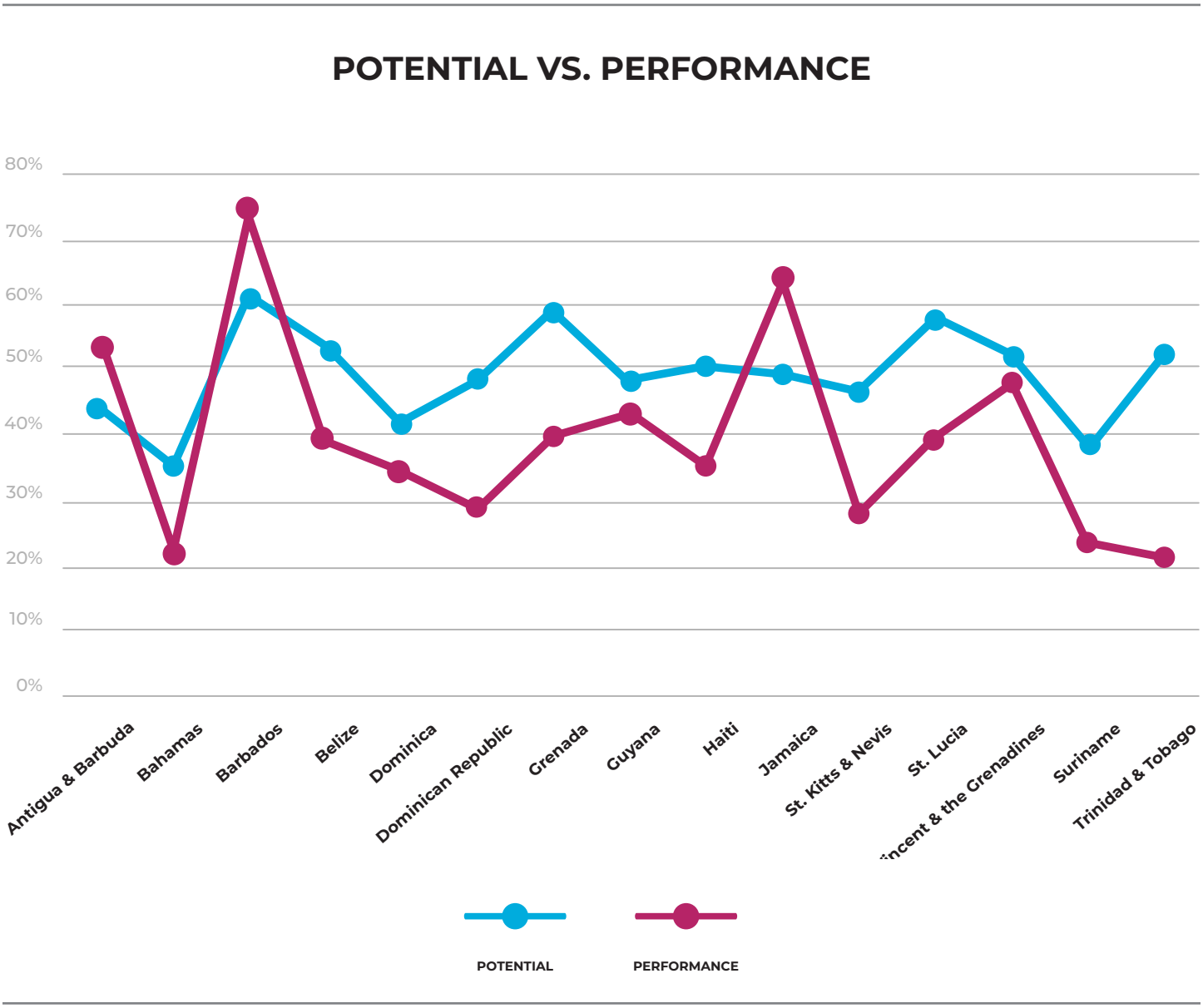



***Figure 4.9 | Country Potential Vs Performance***

## 4.2.8 | FOREIGN IMPACTS

**a)** Outside of IPP, the influence of foreign firms on the regional RE installation market is minimal. The limited activity has been generally focused on those countries which exhibit favourable regulatory environments. To date, there have been 1 to 2 registered companies per country which install PV systems in Barbados, Bahamas, Saint Lucia, Antigua, Jamaica and Dominica. These companies do not bring any special expertise or new technologies since the local RECs have the requisite skills to service the market needs based on the national technology preferences. It is not common for international companies which are not registered locally to pursue residential work. Despite The Bahamas' unfavourable regulatory environment, there is one foreign REC established there with a sister company in Jamaica. Competition in the domestic markets therefore remains fair with no competitive advantage for these foreign companies. If any advantage exists, it would be towards local companies with a sustained presence.

**b)** Larger energy companies not registered in the region tend to pursue RE and EE services for governments, regional and multilateral institutions; consultancies and studies. This happens because such contracts are advertised internationally and are often funded by the countries, regions of some of the same foreign firms. E.g. Canada, USA and Europe. The tender processes are generally open but a large percentage of this work is normally contracted to the foreign companies. Some local companies complain of nepotism but there is no way to substantiate this claim. Foreign companies appear to have a competitive edge. Admittedly, they often have more qualified resources and more experience. However, the need for capacity building in the region makes a case for those RECs which are qualified to have greater access to opportunities, particularly in their own countries. This may be negotiated with donor agencies and could include engagement or regional partnerships in the bidding process to help to develop regional capabilities.

**c)** Haiti is the only country included in this study which manufactures RE equipment; PV panels. All other countries must import all their RE products. Except for Dominican Republic which shares a border with Haiti, all other countries import their PV panels from an international supplier since regional maritime connections are inadequate to facilitate regional trade; assuming prices are competitive. In the case of SWHs, none of the countries truly manufacture. Barbados, Suriname and Dominica lead in the assembly of these products and import all the major required components. E.g. tanks, glass, copper and Alu-Zinc.

**d)** Some EE products are commonly sold in hardware retail stores. Exact ownership was not confirmed during this study but there is a combination of local and international ownership. Since no manufacturing occurs locally, they all import their goods and operate under the same retail framework.

**e)** A minimum amount of RE and EE equipment is retailed since RECs import their own supplies to implement their contracts and not to supply the local market.

**f)** Excluding any impacts of foreign investment on countries, foreign firms who make investments in RE generally mobilize their own technical resources, particularly when utilizing technologies other than PV.

The region is lacking in skills for less popular technologies like geothermal, wind, hydropower and waste to-energy (WtE). As a result, local RECs are not able to benefit from these opportunities. All countries included in the study, which have developed or updated their energy policies in the last 10 years, have made provision for the interconnection of utility scale IPPs. This has created opportunities which are advertised internationally, especially given the need for large investments to pursue local RE targets. As expected, IPP projects are spread across the technologies. However, PV is the only preferred technology common to all 15 countries. This would suggest that there are significantopportunities for local RECs to install PV systems on behalf of foreign investors and local investors as well. There is no way to accurately predict the volume of expected work from PV installations since most governments have not specified these types of details (e.g. percentages per technology). The financial reality is that whichever technology from the list of preferred options attracts the required investment, will most likely be implemented. It may be fair to conclude that significant opportunity exists for RECs who offer these services in the future.

On average only about 2 of these subcontracting assignments have occurred in about half the territories. Unfortunately, there has been some negative feedback about being offered very unfavourable terms and conditions.

Foreign Direct Investment (FDI) remains relevant to all territories since they all encourage the presence of utility scale IPP regardless of whether smaller distributed systems are promoted or not. The major portion of the investment is in equipment, which is sourced internationally, resulting in a minor monetary investment. These foreign developers dominate the design, engineering and procurement stages of the value chain for IPP projects. Ongoing economic activity post implementation (maintenance, operations) represents an offset to the local revenues generated from energy sales to the utility. While these investments will help the region to achieve its energy transformation goals, there is a long-term negative net flow of foreign currency via repatriation if saving from fuel imports are excluded. An in-depth impact assessment may be useful.

**g)** The PSI group in two other countries have reported courting foreign firms which were interested in their local market, but no progress has been made. In some cases, the foreign firms have unrealistic expectations about the role of the PSI in securing business for them. Those countries with unfavourable regulatory environments are generally ignored by foreign entities.

## 4.3 | CLASSIFICATION OF RE COMPANIES

### 4.3.1 | RE COMPANY CAPABILITY

The conversation on RE has outstripped the reality on the ground for all countries in this study. The numbers and types of RE companies who practice the use of RE and EE technologies tend to be less than the companies registered in most cases. In some cases, the function of the registered firm is replaced by individuals who meet a prescribed qualification in the specific country. E.g. Antigua and Barbuda. Regionally, the professional certifications include the North American Board of Certified Energy Practitioners (NABCEP), and the Caribbean Energy Manager (CEM). These certifications offer the public some degree of protection and assurance that practitioners have passed an examination which is based on acceptable minimum standards when performing tasks. It provides a way to distinguish practitioners from their competition and improve quality and public perception. In some case, installations must be done by an authorized installer in order to gain permission to connect to the national grid.

#### One-time Training

The NABCEP PV Installation Professional Certification process follows professional credentialing guidelines. Between 2015 and 2016, the IDB Bridge programs trained 72 persons across Barbados, Trinidad and Jamaica using NABCEP guidelines. Over 90% of the participants took the exam and were successful. In 2018, CDB and USAID sponsored the CEM in Barbados for about 10 of the countries in this study. Between 25 and 30 persons attended the course and 16 persons completed the CEM successfully

#### On-going Training

The training institutions identified in Section 3.0 provide their courses every year. However, most of them do not provide the depth and level of practical training that is necessary to deploy RE systems across the region. These courses therefore require extensive on-the-job training. This is a major weakness in some HEI who need to enhance their offering to meet market needs.

#### Resources

There are around 150 registered RECs across the 15 countries in this study. Additionally, the staff complement for RECs is also generally low. On average RECs are about 12 years old and have an average staff complement of 12. This represents a lack of capacity nationally. Small RECs will be able to do residential installations if supported by policy but lack the capacity to execute larger commercial or utility-scale projects. In the latter segment of the market, RECs can at best function as sub-contractors. The level of collaboration reported amongst RECs also site their inability to come together to execute larger projects. Dominican Republic and Barbados have the larger staff compliment due to their market size and the SWH industry.

Only three countries have private sector-based institutions which focus solely on RE and EE, those being Barbados, Jamaica and Dominican Republic. If these types of associations can be proliferated across the region, RECs may be able to combine their resources under an umbrella organization to become more

competitive. Not only would this boost their capacity but also enhance their skills. Sub-contracting from foreign firms can also be managed considering that smaller RECs have reported experiencing pressure from larger international firms with local assignments to fulfil.

| COUNTRY | POTENTIAL | PERFORMANCE |
|---|---|---|
| Antigua & Barbuda | 5 | 8 |
| Bahamas | 5 | 10 |
| Barbados | 22 | 20 |
| Belize | 7 | 10 |
| Dominica | 15 | 10 |
| Dominican Republic | 50 | 20 |
| Grenada | 8 | 10 |
| Guyana | 5 | 6 |
| Haiti | 12 | 10 |
| Jamaica | 5 | 5 |
| St. Kitts & Nevis | 5 | 10 |
| St. Lucia | 3 | 4 |
| St. Vincent & Grenadines | 8 | 10 |
| Suriname | 10 | 30 |
| Trinidad & Tobago | 13 | 20 |
| Regional Average | 12 | 12 |

*Table 4.8 | REC Capacity By Country*

## 4.3.2 | TYPES OF RE COMPANIES

The range of products and services being offered by RECs are limited in some countries. They deliver their services and products to residents, businesses, government and the utility. As expected, the market needs and demands have dictated the prevalence of products and services being offered.

| COUNTRY | Renewable Energy Systems Design and Installation | Energy Auditing Services | Energy Service Companies (Escos) | Renewable Energy Consulting Services | Renewable Energy & EE Product Manufacturing | Solar Water Heating (Assembly, sales & installation) | Energy Equipment and Efficient Appliances Retailing |
|---|---|---|---|---|---|---|---|
| Antigua & Barbuda | x | x | | x | | x | x |
| Bahamas | x | x | | x | x | x | x |
| Barbados | x | x | | x | x | x | x |
| Belize | x | x | | x | | x | x |
| Dominica | x | | | | | x | x |
| Dominican Republic | x | | | x | | x | x |
| Grenada | x | | | x | | | x |
| Guyana | x | x | x | | x | | x |
| Haiti | x | x | x | | x | | x |
| Jamaica | x | x | x | | | x | x |
| St. Kitts & Nevis | | | | | | | x |
| St. Lucia | x | x | | x | | | x |
| St. Vincent & The Grenadines | x | x | | | | x | x |
| Suriname | x | | | | | x | x |
| Trinidad & Tobago | x | x | x | x | | x | x |

*Table 4.9 | RE and EE Services By Country*

The RECs are positioned in the value chain according to the product(s) and service(s) they offer in the RE market. The single exception to the model below is Haiti, which does manufacture PV panels.

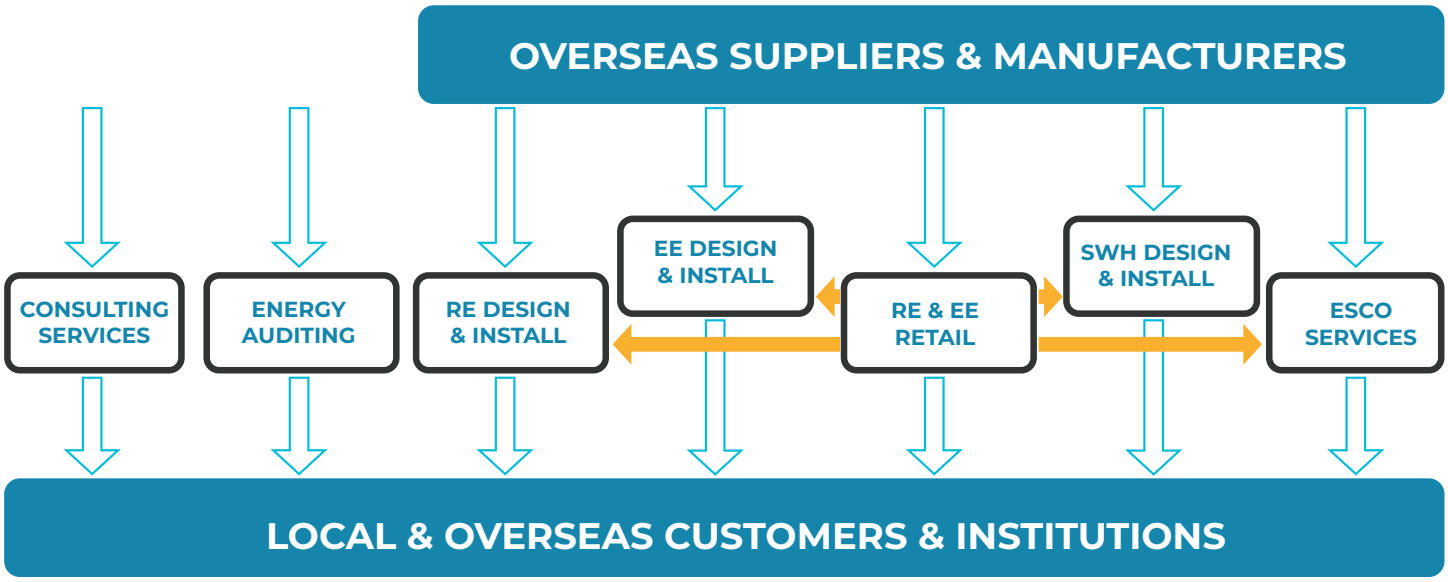



***Figure 4.10 | RE & EE Value Chain in the Region***

Most RECs function in multiple areas in the RE industry. However, it is important to understand a few key dynamics about the operations of these firms.

**a)** Firms which function in the RE space do not normally function in the EE space. The reverse is also true, with few exceptions.

**b)** Firms which offer consulting services and/or energy audits only, do not depend on any suppliers or manufacturers in order to deliver their services to their local or overseas clients.

**c)** Firms which deliver RE and EE installation services depend on the importation of products and other materials in order to complete the job for their local clients.

**d)** For SWH company exports, most of their assembly occurs locally before shipping to the overseas client where the installation is completed.

**e)** For other RE and EE exports, full assembly and installation takes place at the overseas client.

RECs generally order equipment on demand. Consequently, there is limited inventory locally. This may stem from limited local demand linked to the RE industry environment and the limited financial capacity of firms due to their relatively small size (12 on average). Consequently, clients may experience some delays in their installation. Where demand is extremely low, relationships with overseas suppliers tend to be less established, creating a small market for retailers who may act as local suppliers. This opportunity is untapped now but represents a real opportunity pending improvements in the RE industries in those countries where low demand exists. These retailers are normally established companies with established supply chains for other products and should therefore have the infrastructure

and capacity to ramp up their operations to service new demands. With this competitive edge, the requisite market education and targeted promotion, these companies may also become driving factors in the development of their local RE industry.

Despite the unfavourable RE environment in some countries where existing policy and regulatory environments have led to low demand and limited capacity in RECs, there still exists the possibility to explore the self-generation RE market if local research can confirm its existence.

## 4.4 | RE MARKET STRUCTURES

All the countries in this study have set goals and targets which communicate their desire for some degrees of liberalization in their electricity markets. Some are more eager than others, often linked to the relationship between the electricity utility and the government. The table right shows the ownership status of the utilities in each country.

The decision to liberalize the electricity sector is ultimately owned by government but never becomes effective by a simple signature. The process takes time and relies on the cooperation of the utility, which is in most cases, the sole distributor of electricity in the country. In fact, the sector comprises of generation, transmission and distribution. The general liberalization conversation is one about generation and this has been the focus of governments so far. There has been little attempt to liberalize the other two (2) components in the Region, i.e., transmission and distribution. The utilities own the transmission and distribution infrastructure much like the monopoly telecommunications utilities of the past. All new entrants to the telecommunications sector depended on the incumbent to deliver most customer phone calls. Similarly, all electricity generation for the general public depends on the utility to receive and distribute it. This excludes standalone mini grids which are community-based. These off-grid systems

| COUNTRY | OWNERSHIP STATUS |
|---|---|
| Antigua & Barbuda | State owned |
| Bahamas | State owned |
| Barbados | Privately owned (Foreign) |
| Belize | State owned |
| Dominica | Privately owned (Foreign) |
| Dominican Republic | State owned |
| Grenada | In transition to State ownership |
| Guyana | State owned |
| Haiti | State owned |
| Jamaica | Privately owned (Foreign) |
| St. Kitts & Nevis | State owned |
| St. Lucia | Public-Private (Foreign) owned |
| St. Vincent & Grenadines | State owned |
| Suriname | State owned |
| Trinidad & Tobago | State owned |

*Table 4.10 | Electricity Utility Ownership*

are most popular in countries with very remote rural communities like Guyana, Suriname and Belize or in countries where grid connections are still not permitted or not implementable. The need for RE on and off the grid requires a different treatment.

### 4.4.1 | OFF-GRID GENERATION

All off-grid generation represents a direct opportunity for RECs. Generally, this supplies the community's needs in the case of mini-grids and micro-grids, and the homeowners in the case of individual systems. There have been projects which sought to deploy enough capacity to provide for the community health, social and economic needs, e.g., OLADE in Guyana hinterlands in 2015. This represents some impact on community MSMEs but on a micro scale with no implication for exportation of electricity to the national grid. Such projects are usually funded by Government or other regional or multilateral partners and installed by RECs.

Mini grids offer no threat to utilities by way of increased grid unit cost since they were never connected to the grid. However, RE off-grid systems for residents and businesses are perceived as a risk to grid unit costs and ultimately customer rates.

### 4.4.2 | ON-GRID GENERATION

The grid connection requirements impact the utility and are shaped by the active policies of the government. While governments have set targets related to the amount of RE they hope to generate for the grid, and they have indicated the preferred technologies, they have not signalled how it would be generated in terms of KW from IPPs, businesses or homes. A few countries have leaned towards IPPs but the mix has not been specified. These IPPs are governed by power purchase agreements (PPA) negotiated by the utility, regulator and government. However, small residential and business generators depend on the terms and conditions of the liberalization process and the regulatory framework. In every scenario, there are opportunities for local RECs depending on their technical capabilities.

### 4.4.3 | IPP GENERATION

In the current environments, large RECs may take on utility scale implementations for the utilities or investors in IPPs, or function as sub-contractors for international RECs. This IPP approach will minimize the need for individual generators, smaller RECs, and a Typical RE Industry. It will however still achieve the national objectives for cleaner, indigenous energy, possibly at a lower cost to MSMEs to contribute positively towards their competitiveness.

### 4.4.4 | DISTRIBUTED GENERATION

The delivery of RE systems to businesses and residents presents an opportunity for large and small RECs but depend on the liberalization environment. This provides more opportunities for RECs to deploy RE systems as well as an opportunity for the MSMEs to make relatively small investments and see positive returns on their investment based on the normal customer rate (NCR) and the feed in tariff (FIT) as set by the regulator or the assigned government department. The interconnection environment in which RECs must operate is described in Table 4.11 on the following page.

| COUNTRY | LIBERALIZATION STATUS (ON-GRID) * | BILLING ARRANGEMENT |
|---|---|---|
| **ANTIGUA & BARBUDA** | • IPP negotiate selling rate with utility and regulator.<br>• Installations of less that 5KW may sell excess energy to the grid.<br>• Installations of 5KW and over must sell all electricity to the utility and purchase all eletricity they need from the grid. | **Under 5KW**<br>For Used KWh >= Generated KWh<br>• Bill = (Used KWh – Generated KWh) * NCR<br>For Used KWh < Generated KWh<br>• Credit = (Generated KWh – Used KWh) * FIT<br>**5KW and Over**<br>• Bill = Used KWh * NCR<br>• Credit = Generated KWh * FIT<br>FIT is $0.2250 per KWh |
| **BAHAMAS** | • IPP negotiate selling rate with utility and regulator for systems.<br>• Net billing is proposed up to 5KW using the standard customer rate and the FIT<br>• No FIT has been set by the regulator | **Under 5KW**<br>For Used KWh >= Generated KWh<br>• Bill = (Used KWh – Generated KWh) * NCR<br>For Used KWh < Generated KWh<br>• Credit = (Generated KWh – Used KWh) * FIT<br>**5KW and Over**<br>• Bill = Used KWh * NCR<br>• Credit = Generated KWh * FIT |
| **BARBADOS** | • IPP negotiate selling rate with utility and regulator for systems above 1MW<br>• FITs are established for sytems under 1MW<br>• Installations of less that 3KW may sell excess energy to the grid<br>• Installations of 3KW and over must sell all electricity to the utility and purchase all electricity they need from the grid<br>• Tariff vary by technology and MW size<br>• 32.7 MW of capacity was set in 2019<br>• Community projects get a 10% premium<br>• 20-year utility contract with a 1-3 years review period | **Under 3KW**<br>For Used KWh >= Generated KWh<br>• Bill = (Used KWh – Generated KWh) * NCR<br>For Used KWh < Generated KWh<br>• Credit = (Generated KWh – Used KWh) * FIT<br>**3KW and Over**<br>• Bill = Used KWh * NCR<br>• Credit = Generated KWh * FIT<br><br>**FIT**<br>• PV up to 10 KW $21.75<br>• PV above 10 kW to 100 KW $0.2238<br>• PV above 100 kW to 250 KW $0.2088 |

***Table 4.11 | Liberalization Environment***

| COUNTRY | LIBERALIZATION STATUS (ON-GRID) * | BILLING ARRANGEMENT |
|---|---|---|
| **BARBADOS CTND.** | | • PV above 250 kW to 500 KW $0.1913<br>• PV above 500 kW to 1 MW $0.1813<br>• Land-Based Wind up to 10 KW $0.1988<br>• Land-Based Wind 10 kW to 1 MW $0.1913<br>• Anaerobic Digestion up to 1 MW $0.2213<br>• Solid Biomass up to 1 MW $0.2613<br><br>• PV between 1MW and 5MW $0.1175<br>• Land-Based Wind between 1MW and 5MW $0.1113<br>• PV between 5MW and 10MW $0.1088<br>• Land-Based Wind between 5MW and 10MW $0.1013<br><br>**Other fees paid to the government: -**<br><br>• For domestic systems -$125<br>• Other systems 25 KW – 100KW -$300<br>• 100KW–150KW -$575 plus $4,250 annually<br>• 150KW–500KW -$600 plus $10,000 annually<br>• 500KW–1MW -$625 plus $14,000 annually<br>• 1MW–20MW -$725 plus $70,000 annually<br>• Over 20MW -$750 plus $77,500 annually<br>• Utility -$3,000 plus $750,000 annually |
| **BELIZE** | • IPP negotiate selling rate with utility and regulator<br>• No rate structure has been established | None |

| COUNTRY | LIBERALIZATION STATUS (ON-GRID) * | BILLING ARRANGEMENT |
|---|---|---|
| **DOMINICA** | • IPP negotiate selling rate with utility and regulator for systems<br>• Net billing is utilized using the standard customer rate and the FIT to be set by the regulator and based on the avoided cost of fuel | For Used KWh >= Generated KWh<br>• Bill = (Used KWh – Generated KWh) * NCR<br>For Used KWh < Generated KWh<br>• Credit = (Generated KWh – Used KWh) * FIT<br><br>FIT varies around $0.15 per KWh |
| **DOMINICAN REPUBLIC** | • IPP negotiate selling rate with utility and regulator<br>• Net metering was developed for residential wind or solar installations smaller than 25 kW and commercial facilities under 1 MW<br>• Customers receive credits for excess power exported to the grid | **Under 25KW for residential and under 1MW for commercial**<br>For Used KWh >= Generated KWh<br>• Bill = (Used KWh – Generated KWh) * NCR<br>For Used KWh < Generated KWh<br>• Credit = (Generated KWh – Used KWh) * FIT<br><br>The FIT for solar power generation lies between $0.53 and $0.60/kWh |
| **GRENADA** | • IPP negotiate selling rate with utility and regulator<br>• No rate structure has been established | None |
| **GUYANA** | • IPP negotiate selling rate with utility and regulator<br>• Rate structure has not been approved<br>• No FIT has been set by the regulator | None |
| **HAITI** | • IPP negotiate selling rate with utility and regulator<br>• No rate structure has been established | None |

| COUNTRY | LIBERALIZATION STATUS (ON-GRID) * | BILLING ARRANGEMENT |
|---|---|---|
| **JAMAICA** | • IPP negotiate selling rate with utility and regulator<br>• Net billing is utilized using the standard customer rate and the FIT to be set by the regulator and based on the avoided cost of fuel | For Used KWh >= Generated KWh<br>• Bill = (Used KWh – Generated KWh) * NCR<br><br>For Used KWh < Generated KWh<br>• Credit = (Generated KWh- Used KWh) * FIT<br><br>FIT varies around $0.11 per KWh |
| **ST. KITTS & NEVIS** | • IPP negotiate selling rate with utility and regulator<br>• No rate structure has been established | None |
| **ST. LUCIA** | • IPP negotiate selling rate with utility and regulator for systems<br>• It is proposed that prosumers sell all generated electricity to the utility and purchase all electricity they need from the grid<br>• No FIT has been set by the regulator | • Bill = Used KWh * NCR<br>• Credit = Generated KWh * FIT |
| **ST. VINCENT & THE GRENADINES** | • IPP negotiate selling rate with utility and regulator for systems<br>• Prosumers must sell all generated electricity to the utility and purchase all electricity they need from the grid | • Bill = Used KWh * NCR<br>• Credit = Generated KWh * FIT |
| **SURINAME** | • No liberalization has occurred yet | None |
| **TRINIDAD & TOBAGO** | • No liberalization has occurred yet | None |

* ***Generation for own use with no connection to the grid is not subject to the liberalization terms and conditions***
* ***IPP refer to utility scale generators governed by a PPA***


## 4.5 | ECONOMIC LINKAGES OF THE RE INDUSTRY

The development of a sustainable energy sector necessitates the enabling of the entire environment that supports and depends on it. The energy product underpins every sector of the economy whether in the form of electricity, transportation or other business and personal activities. During this period when countries are seeking to transform their energy sectors, the RE industry has gained some prominence. Transformation reaches beyond utilities, IPPs and prosumers and touches all sectors of the economy. However, the greatest impacts will occur across key sectors. Consequently, planning is performed with these key sectors in mind so that resources are maximized while pursuing national objectives in multiple sectors. For this reason, a multi-criteria analysis is normally applied to all major projects being performed by government and more and more in the private sector entities.

It is also hoped that this transformation will build new capacity and bring more RE and EE jobs to the economies in the region as well as lower energy costs that will allow MSMEs to provide goods and services more competitively and in a cleaner environment. While this offers hope to the challenged export sectors, it will also provide opportunities within the local energy sector and the wider economy, depending on the national strategy of each country. For those investing in a vibrant local RE industry, the RE transformation ensures the long-term sustainability of the industry as well as the spreading of economic benefits across the business community.

All the documented national energy policies acknowledge the broad-based impact of energy transformation and point to the economic linkages between the RE industry and the key economic sectors. This has facilitated a more coherent and harmonized approach to achieving their country's energy goals along with other sectoral goals. Those sectors with the most potential for economic benefits for the region are shown in the figure below.

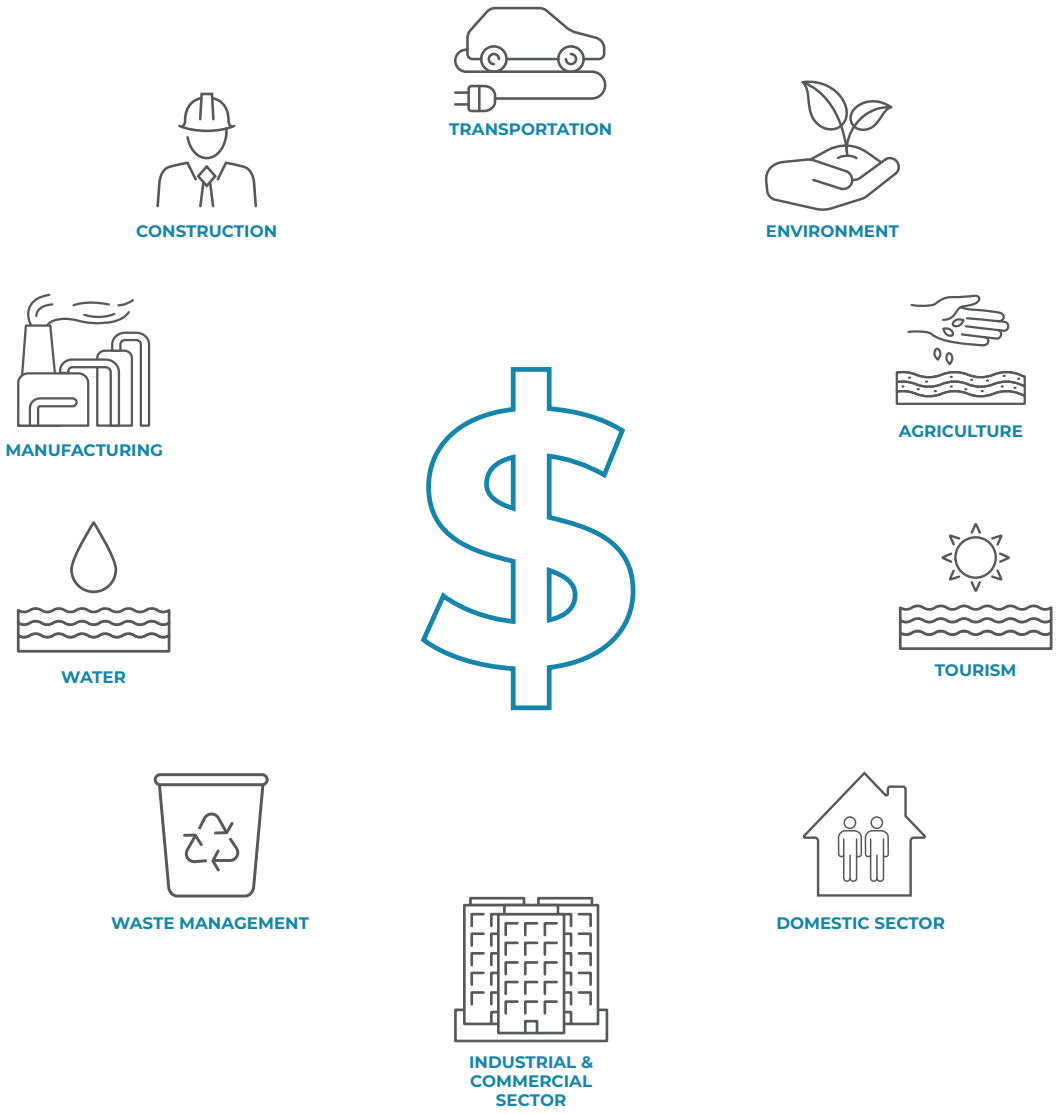



***Figure 4.11 | Renewable Energy Sector with Economic Linkages***

These economic linkages are all understandable and obvious in several of the countries included in this study. Some countries have articulated specific goals of connecting other sectors to the RE industry, while other have not yet identified these linkages, nor have they synchronized their plans to develop other sectors in tandem with renewable energy. Some linkages may also be more critical to one country that another. The following sections explore these linkages and how they may benefit the RECs and MSMEs. It must be noted that while some regional institutions and funding agencies like to see projects that explore the cross linkages with RE and EE, this does not prequalify or establish any preferential treatment for projects outside of their set criteria. For example, 5Cs and GCF focus on actions related to climate change but do not favour a sector. Other funders like the European Delegation look for an alignment between projects and governments' strategic plans. Overall, there is support for the cross linkages without discrimination.

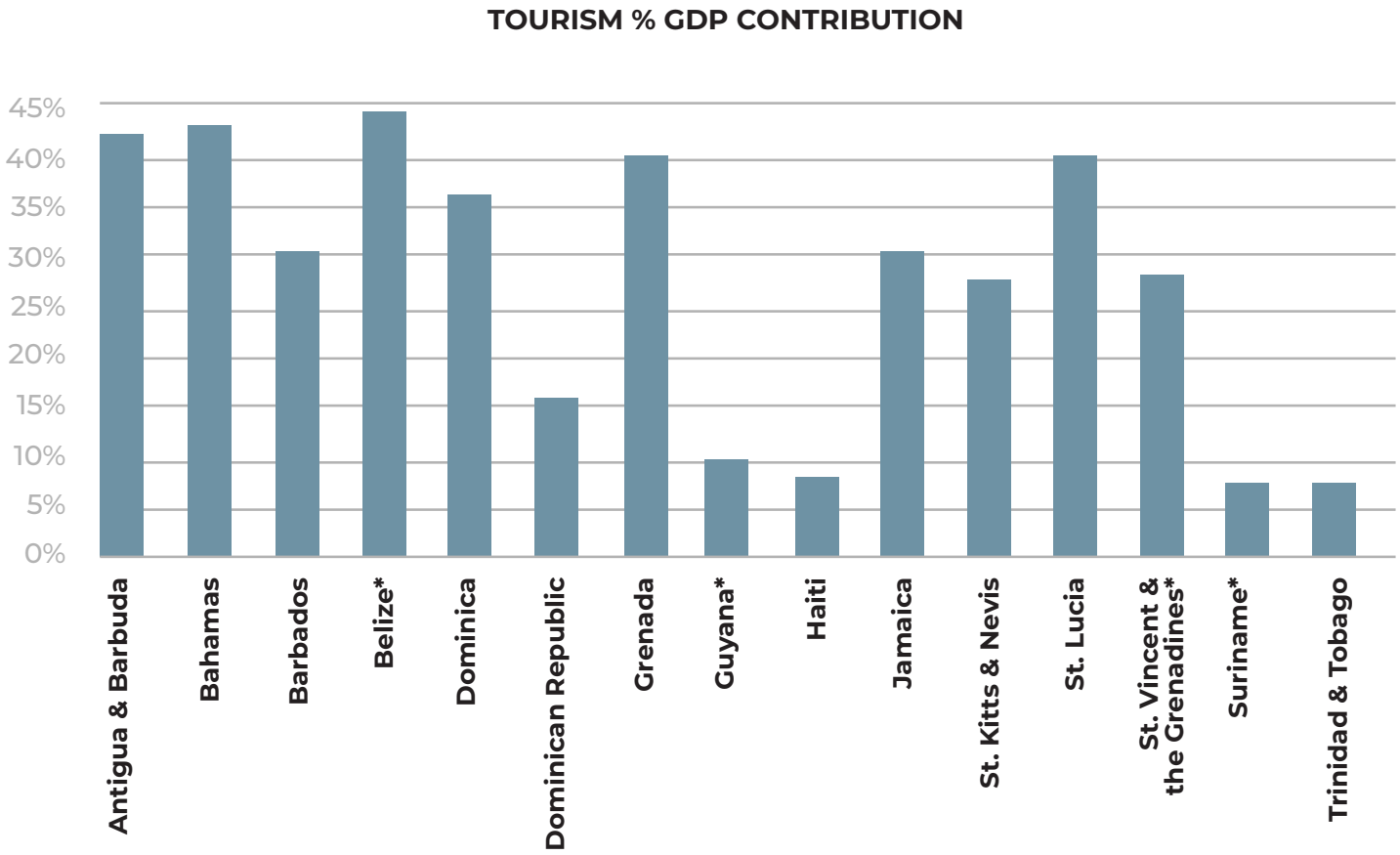
## 4.5.1 | TOURISM

The tourism sector is a major contributor to most of the economies of the Caribbean, reaching US$59.8 Billion in 2019. The GDP contributions to economies exceed 40% for 5 countries and 30% for another 3. With only 4 countries with single digit contributions, the level of dependence on tourism and related travel can be seen to be drivers of energy consumption for this region. It would therefore be expected that the energy sectors of most of the countries in this study, have strong linkages to the tourism sector and would want to focus on tourism as a major sector for energy transformation. See table 4:12 and figure 4:12 for detail contributions.

| COUNTRY | % GDP CONTRIBUTION |
|---|---|
| Antigua & Barbuda | 42.7 |
| Bahamas | 43.3 |
| Barbados | 30.9 |
| Belize* | 44.9 |
| Dominica | 36.9 |
| Dominican Republic | 16.3 |
| Grenada | 40.5 |
| Guyana* | 9.8 |
| Haiti | 8.4 |
| Jamaica | 31.1 |
| St. Kitts & Nevis | 28.2 |
| St. Lucia | 40.7 |
| St. Vincent & Grenadines | 28.6 |
| Suriname* | 7.7 |
| Trinidad & Tobago | 7.8 |

** Estimates Source: https://www.statista.com/statistics*

***Table 4.12 | GDP Contributions from Direct and Indirect Tourism***




***** ***Countries in South or Central America***

***Figure 4.12 | GDP Contributions from Direct and Indirect Tourism***

Besides a high level of service, the sustained success of the traditional tourism products also depends on marine and coastal resources, air and water quality, all of which have been compromised by fossil fuel use amongst other factors. This is supported by the implementation of energy conservation and efficiency, and the promotion of renewable energy. Business and leisure tourists are becoming more sensitive to environmental issues and are factoring in the mitigation efforts and progress of countries when they plan their vacation destination. Key goals for implementations are:

- Energy efficiency in hotel properties (lighting/AC/etc.)
- Use of solar water heaters for guest and property use
- Generation of electricity from renewable energy
- Compliance with efficiency building standards

Interventions in this sector do not represent new work to be done in countries apart from their RE and EE plans. It provides an opportunity to focus efforts and resources on two critical sectors at the same time expecting compounded benefits from clear synergies; expanding revenues from more eco-friendly properties and lowering operating costs from cheaper more efficient energy consumption. Even though not quantified in this study, these interventions will engage the services of the RECs to their own benefit and to the MSMEs directly and indirectly involved in the tourism industry.

## 4.5.2 | TRANSPORTATION

As discussed in section 1.5.4, the transportation sector is a more significant energy consumer than the electricity sector. As reported in their policy documents, major impacts are seen in Antigua and Barbuda (54%) Belize (51%), Barbados (51%), Grenada, Dominica (52%), St. Vincent (67%), Saint Lucia (41%) and St. Vincent and the Grenadines (40%). Countries have developed goals to achieve vehicular use that depend on:

- Better fuel efficiency
- Environmentally clean fuels
- More efficient public transport system
- Better traffic management
- Alternative to individual vehicle use
- Electric and hybrid Vehicles
- Flexi-work hours
- Tele-commuting
- Biofuels
- Vehicle emission and fuel efficiency standards

Mandatory quotas for dealers regarding hybrid, EV and efficient vehicles. A holistic approach for the region must consider both land and marine transport sectors since they impact the land, atmosphere and marine environments. Aside from the selected methodologies to account for emissions related to international travel, the region does own and operate planes and ships it needs to account for.

**The bar for progress in transforming our transportation systems has unfortunately been set too low given its economic and environmental impact. E.g. targets of between 5% and 15% improvement or no target at all!**

### 4.5.3 | WATER

The water sector plays a very important role in the region. Unlike some of the others, it is not usually described as a productive sector but rather an essential service, given the importance of clean running water to the health of a nation. Pumping water is also a popular method of delivering water to customers and this makes the water utility the largest customer of the electricity utility. As with tourism, this is not an additional energy consideration and it is characterized by cost, reliability and dependency. The high cost of electricity is a direct cost to the water utility, notwithstanding the additional cost borne by some customers who have residential pumping systems to deal with water pressure inconsistency or access to individual storage tanks when there is a water outage.

Water utilities are impacted when power to their pumping systems is lost. This can result in falling water levels in reservoirs causing a low-pressure supply or a complete water outage. These negative impacts stem from a strong if not total dependence on the electricity utility. Therefore, in order to maintain a sustained, high quality water supply service, the water sectors across the region have sought to enhance their energy systems by implementing energy efficiency options and some renewable energy options to generate electricity onsite. This approach should not be taken in isolation since there would most likely be regulatory implications in relation to electricity utility's requirement to meet its cost-of-service obligations. It is critical that both utilities work together to develop solutions that would not result in increased tariffs for customers on the grid. This is a very specific isolated dilemma which, if managed properly, need not impact the cost of electricity to MSMEs while providing potential work for firms in the area of EE and RE. The GCF has committed US$68.4M[4] to the region for projects in the water sector. Opportunities include:

- Wastewater treatment and reuse
- Water conservation
- RE generation aligned with electricity utility

### 4.5.4 | ENVIRONMENT

Energy and the environment have long enjoyed a strong synergy. The burning of fossil-based fuels is believed to be the single largest contributor to the emissions of greenhouse gases such as carbon dioxide and nitrous oxide. It is widely accepted that these gases are linked to global warming and climate change which negatively impacts beach erosion, bleaching of coral reefs, marine species and other natural ecosystems along the coastline. The region requires consistent adaptation to assist vulnerable countries like those in this study, to cope with the effects of climate change and decisive mitigation action to slow or prevent further damage. The latter is deeply reliant on renewable energy and energy efficiency which reduce harmful emissions into the atmosphere.

The Kyoto Protocol to the UNFCCC which required developed countries to reduce greenhouse gas (GHG) emissions to an average of 5% against 1990 levels over the period 2008-2012, created added opportunities for RECs to contribute locally, subject to national policies. This and the subsequent Copenhagen and Paris

4 - GCF Portfolio for the Caribbean, 2020

Agreements support market mechanisms like the Clean Development Mechanism (CDM) which allows developed countries to purchase certified emission reduction credits from EE, RE and other projects in developing countries. This reduction in emissions contribute to sustainable development. The GCF is also a major funding agency for climate action projects having committed a portfolio with a budget of US$168.3M; US$86M for national projects and over US$82M for multi-country projects[5]. Country focal points are therefore encouraged to collaborate and develop climate projects together which deploy:

- New, clean technologies in various industries
- Promote a cleaner environment
- Reduce GHG emissions through conservation and energy efficiency

Projects tend to be broad-based and usually draw on high-level technical skills and various other skills around RE and EE technologies. This provides opportunities for RECs to collaborate. This is not currently common among RECs due to lack of opportunity and poor networking and may therefore be addressed regionally.

### 4.5.5 | MANUFACTURING

While manufacturing equipment can be energy intensive, this sector across the Region is relatively small and includes a small number of MSMEs. The Commonwealth Caribbean has an average country contribution of around 7% of GDP, with Trinidad and Tobago having the most active manufacturing sector with 19% of GDP because of its successful petrochemical industry[6]. This is therefore not significant for most countries. However, it would be significant for the MSMEs who are in that sector. Nationally, the linkages are weak with little mention in national energy policy documents. Potential impact would therefore depend on the initiatives of the affected MSMEs to seek out experienced energy firms to assist with their RE and EE needs. Preliminary actions include:

- Educating the firms in the manufacturing sector.
- Reducing electricity tariffs to the manufacturing sector.
- Providing manufacturing firms with access to RE and EE technologies.

5 - GCF Portfolio for the Caribbean, 2020
6 - http://www.commonwealthofnations.org/sectors/business/industry_and_manufacturing/

### 4.5.6 | CONSTRUCTION

It is widely accepted that the best time to consider RE and EE is in the planning stage. This phase of the construction cycle is also important because buildings are responsible for 40% of energy consumed in the commercial sector. For most of the region retrofits represent most of the EE interventions and usually come at a higher cost than if the action was taken during construction. While not well articulated in policies, governments with international agencies involved in rebuilding from the many natural disasters in the Caribbean have often opted to build smarter, more environmentally friendly and more energy efficient. While this is good, it has been ad hoc and still requires the requisite policy support. This would require architects and engineers to involve energy management experts when designing and renovating buildings, to incorporate energy efficient principles into the selection of lights, cooling systems, building materials and construction methodologies. In order to strengthen the linkages, it will be necessary to:

- Promote Green Buildings.
- Provide standards for buildings and construction such as LEED.
- Implement the Energy Efficiency Building Code (EEBC).

### 4.5.7 | WASTE MANAGEMENT

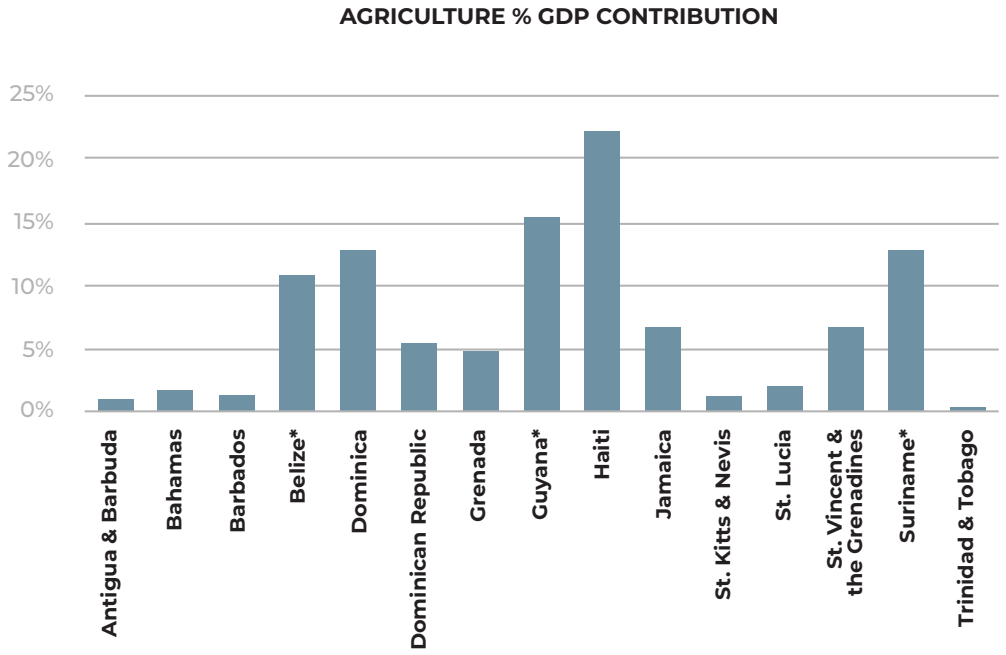
The waste management sector has been one of concerns for many small developing states. Disposal is easy to do using landfills, but its sustainability is a challenge in terms of the practicality of continuing the old methods given the environmental impact of accumulating waste materials such as non-biodegradable plastics. Alternative ways of waste disposal, including incineration, have been considered. Bagasse has been a waste product for decades but is now being used to generate electricity. Guyana generates 60GWh a year for the grid and has potential for twice as much. Belize generates 135 GWh a year from biomass with the potential to increase that by 10% with minimal investment based on a recent feasibility (5Cs, 2019).

Current technologies present a fortuitous opportunity to solve the problem with great benefits; converting waste to energy. Even though the WtE technology is well established, its viability has often been a concern. Relatively speaking we generate lots of garbage but technically it may not be enough from a single country in most cases. Proper studies on this sector are still required but energy generation opportunities exist in:

- Combustion of biomass (bagasse, wood chips, sawdust and dried grass)
- Effective waste separation system to produce safe combustible waste

## 4.5.8 | AGRICULTURE

Agriculture is a major consumer of energy in the process of food cultivation and production. This sector is particularly interesting because it traditionally focused on producing food and is now becoming a part of the energy sector where land and crops are key resources to produce biofuels, thereby creating a food-fuel conflict. Animals used for food production which produce substantial waste can now contribute waste to produce biogas. Sustainability in agriculture can therefore help to safeguard the sustainability of the energy sector in the long term. See contribution of agriculture to national GDP below.




*Source: https://www.statista.com/statistics*

***Figure 4.13 | Percentage Contribution of Agriculture to GDP by Country***

Despite the performances of the agriculture sector, all countries recognize the importance of this sector and want to see it improved, not just for food production but also for its potential contribution to the energy sector. The biofuel subsector is directly linked to and dependent on a resurging agriculture sector to solve one of the most significant energy challenges for the Caribbean.

The advancement of biofuels such as ethanol and biodiesel, even though very necessary, must occur in a collaboration environment including ministries responsible for land use, water resources, energy and agriculture. The agriculture sector uses significant amounts of water and the water sector uses significant amounts of energy. The sector aims to see: -

- Supply of bagasse for electricity generation.
- Supply of other plant as off-season fuel to complement bagasse.
- Installed capacity at farms to produce biogas for electricity or burning.
- Conservation of water to reduce energy consumption.
- Recycling and harvesting of water to reduce the energy requirements to pump it.

## 4.5.9 | INDUSTRIAL AND COMMERCIAL SECTORS

The industrial and commercial sectors represent all other business activities not specifically highlighted previously. As a result, many of the interventions and plans presented previously, overlap with this sector. Included in industrial and commercial sector consumption are areas of manufacturing, agriculture, tourism and businesses. Trinidad reported a 70% contribution from this sector which include all business activities (Ministry of Energy, 2011). Given this approach to reporting under this sector, the broadest approach to capture the concerns of this sector is to focus on energy consumption in buildings since this is a feature of all businesses. The alternative approach is to focus on the specific operations which have high energy intensities. E.g. Bauxite in Jamaica. The distribution for the region by country is shown in figure 4.13 and table 4.18.

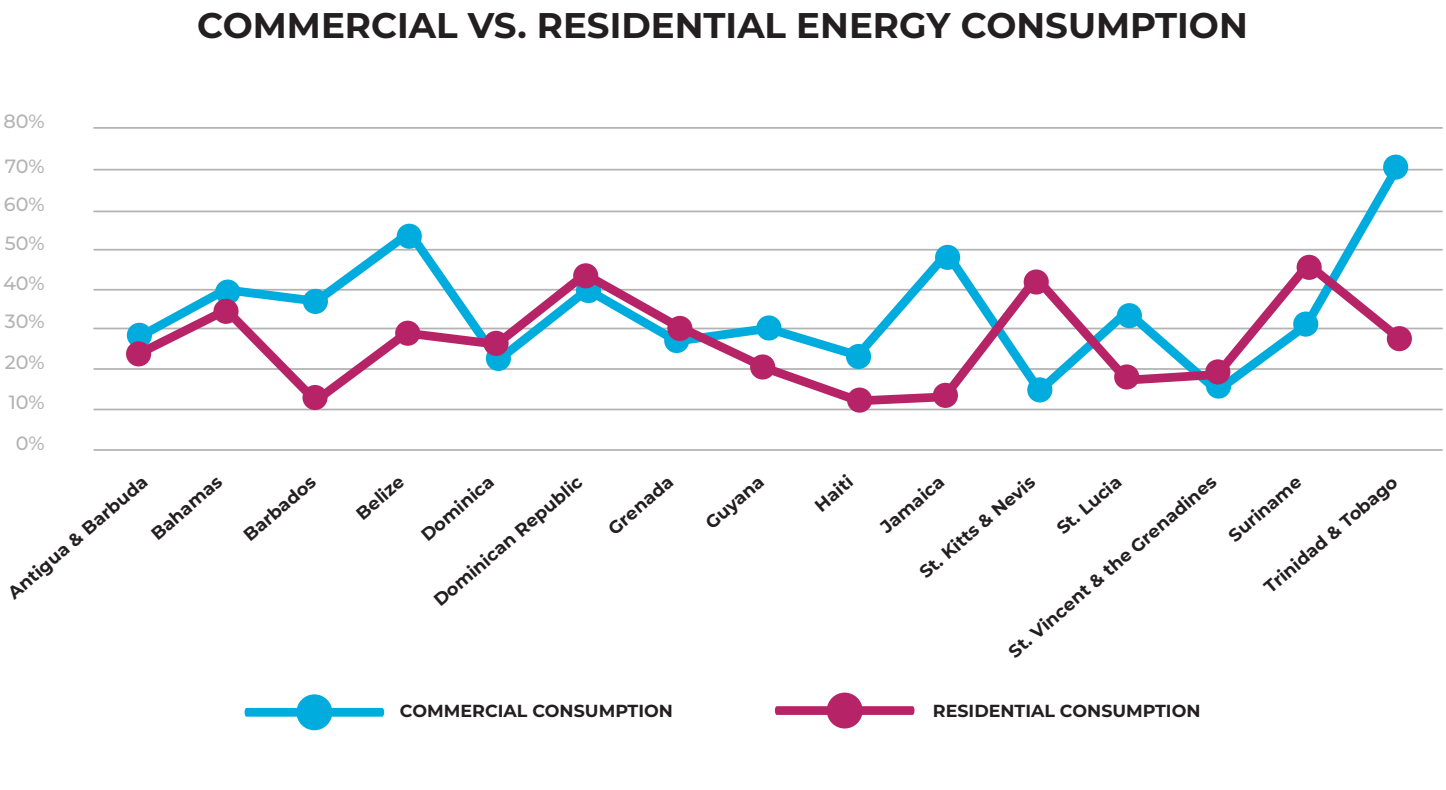



*Figure 4.14 | Industrial & Commercial Sectors vs Residential Sector Consumption*

| COUNTRY | INDUSTRIAL & COMMERCIAL % CONSUMPTION | RESIDENTIAL % CONSUMPTION |
|---|---|---|
| Antigua & Barbuda | 28% | 23% |
| Bahamas | 40% | 35% |
| Barbados | 37% | 12% |
| Belize | 54% | 29% |
| Dominica | 22% | 26% |
| Dominican Republic | 40% | 44% |
| Grenada | 27% | 31% |
| Guyana | 30% | 20% |
| Haiti | 23% | 11% |
| Jamaica | 48% | 13% |
| St. Kitts & Nevis | 15% | 43% |
| St. Lucia | 34% | 17% |
| St. Vincent & Grenadines | 14% | 18% |
| Suriname* | 31% | 46% |
| Trinidad & Tobago | 70% | 28% |
| Average | 34% | 26% |

** Estimated* *Source: Energy policy for the countries*

***Table 4.13 | Industrial & Commercial Sectors vs Residential Sector Consumption***

Because of the significant energy consumption in buildings, implementing RE and EE in buildings can impact all sectors, especially those used to conduct business. Some low energy consumers like warehouses have vast roof space that provide convenient space for RE deployment while other office and production environments with high energy intensities and targets for EE interventions.

Opportunities include: -

- Energy Efficiency in Building (e.g. Lighting/AC/etc.).
- Use of Solar Water Heaters to meet all hot water needs (e.g. Laundries).
- Generation of electricity from Renewable Energy to meet business needs or supply grid (e.g. PV Biogas/Wind).
- Compliance with Efficiency Building Standards (LEED).
- Cogeneration where extreme temperatures are used.
- Greater application of combined heat and power (CHP) concept.
- Energy recovery systems.

### 4.5.10 | DOMESTIC/RESIDENTIAL SECTOR

The domestic sector accounts for approximately 26% of electricity consumption in the region. Figure 4.13, page 170, shows the contributions by country. This sector has been the target of government and utility driven energy efficiency programmes in the past and remains a priority area. Success at this level would benefit every citizen. These efforts are independent of any specific regulations and may be deployed based on individual decisions to reduce cost. Decisions around RE implementations are also within the control of individuals if they remain disconnected from the grid. Any connection to the grid to enhance the residential energy solution would require the approval of the electricity utility and depend on the specific policies and regulations governing the connection.

Given the wide reach of residential EE programmes or RE projects, it is critical that good communication that presents customer benefits exists. The desired actions in this sector include:

- Educational and action-oriented programmes to promote household energy efficiency and conservation
- More EE residential programmes
- Exploration of national energy policy options to increase RE implementations
- Introduction of EE standards
- Greater availability of energy efficient household appliances

## 4.5.11 | FINANCE

The Finance sector needs to provide the funds required to execute all projects. This must be supported by the finance policies of government which can enable the sector and make investments in projects and programmes attractive for all sectors. The financial directorate needs to develop and implement a programme of sustainable incentives and fiscal measures to enable and support investments in more efficient infrastructure, including:

- Building relationships and meeting the financing criteria of funding agencies.
- Empowering the domestic financial sector to participate in energy sector development.
- Creating systems to share information about government decisions.
- Developing measures to encourage the use of energy saving devices in all new and existing buildings.
- Providing fiscal incentives to promote the use of solar water heating in new and existing building (homes, offices, hotels, etc.)
- Providing incentives for energy efficiency audits and retrofits in buildings
- Introducing beneficial tax systems to promote the purchase of more energy economical transportation
- Providing incentives for improvements of the public transport system
- Lowering import duties on hybrid and electric cars
- Creating the appropriate tax regime to encourage importation of fuel-efficient vehicles.

## 4.5.12 | SECTORAL REC ACTIVITY

National REC activities vary across sectors. In response to local demands, they not only offer the products and services required by the market but they also focus on those specific sectors which have a demand for their services. The number of RECs operating in each sector is a good indication of where this demand exists. Figure 4.15 below presents this view by country.

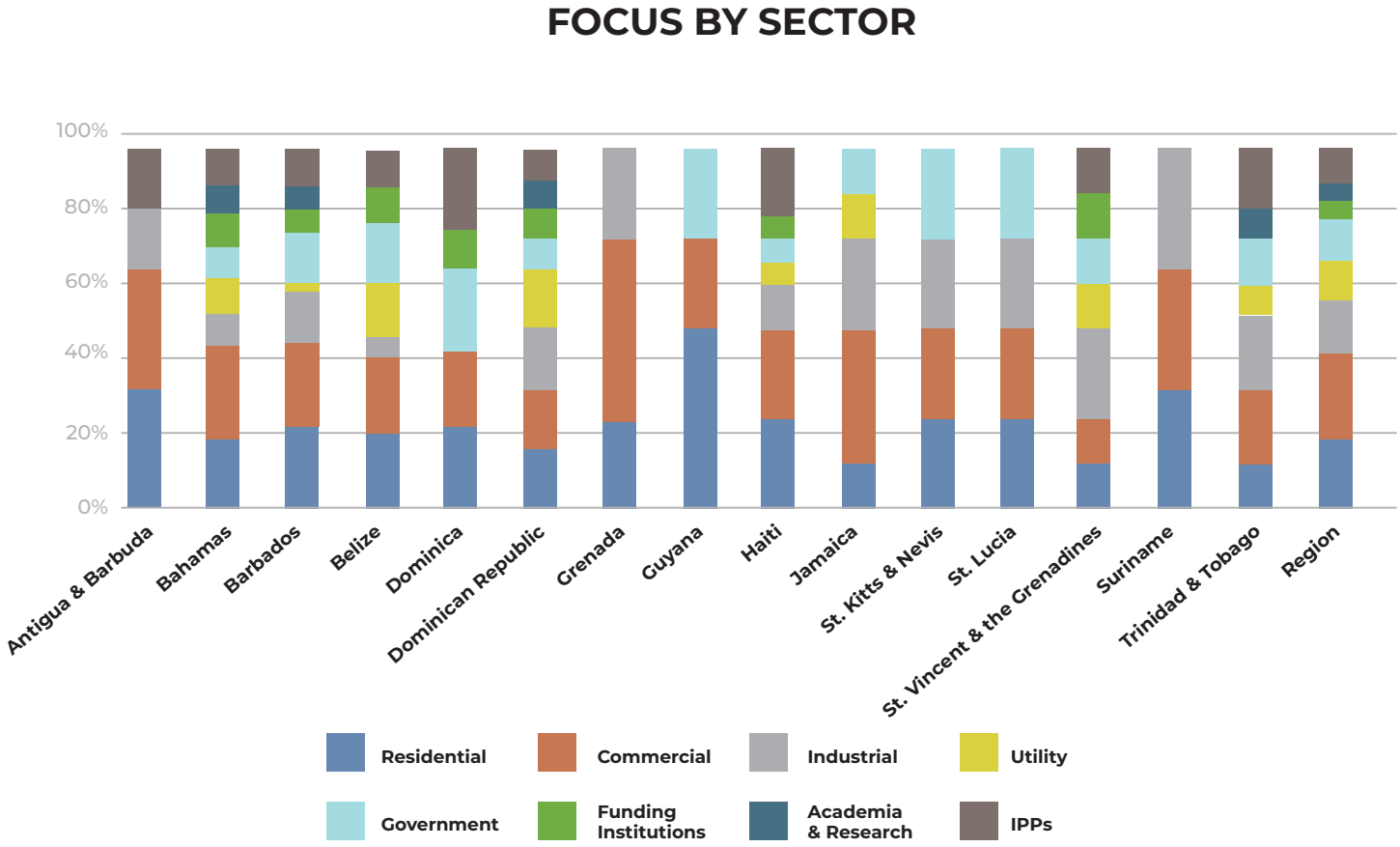



*Figure 4.15 | RECs Proportional Sector Focus By Country*

| COUNTRY | Residential | Commercial | Industrial | Utility | Government | Funding Institutions | Academia & Research | IPPs |
|---|---|---|---|---|---|---|---|---|
| Antigua & Barbuda | 6 | 6 | 3 | 0 | 0 | 0 | 0 | 3 |
| Bahamas | 10 | 15 | 5 | 5 | 5 | 5 | 5 | 5 |
| Barbados | 13 | 13 | 8 | 2 | 8 | 4 | 4 | 6 |
| Belize | 13 | 13 | 3 | 10 | 10 | 7 | 0 | 7 |
| Dominica | 3 | 3 | 0 | 0 | 3 | 2 | 0 | 3 |
| Dominican Republic | 26 | 26 | 26 | 26 | 13 | 13 | 13 | 13 |
| Grenada | 2 | 3 | 2 | 0 | 0 | 0 | 0 | 0 |
| Guyana | 7 | 4 | 0 | 0 | 4 | 0 | 0 | 0 |
| Haiti | 11 | 11 | 6 | 3 | 3 | 3 | 0 | 8 |
| Jamaica | 8 | 24 | 16 | 8 | 8 | 0 | 0 | 0 |
| St. Kitts & Nevis | 2 | 2 | 2 | 0 | 2 | 0 | 0 | 0 |
| St. Lucia | 3 | 3 | 3 | 0 | 3 | 0 | 0 | 0 |
| St. Vincent & the Grenadines | 1 | 1 | 3 | 1 | 1 | 1 | 0 | 1 |
| Suriname | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 |
| Trinidad & Tobago | 6 | 10 | 10 | 4 | 6 | 0 | 4 | 8 |
| Region | 113 | 136 | 88 | 59 | 65 | 34 | 26 | 54 |

*Table 4.14 | Number of RECs Focusing on a Sector By Country*

## 4.6 | CAPITAL & INSURANCE MARKETS

Because of the size of the local markets and the numerous commonalities, countries tend to access the same capital and insurance markets. They have some common banks and insurance companies. Regional governments have subscribed to common approaches to the energy transformation process even though unique in their implementation. E.g. through CARICOM and OECS. The same multilaterals and funding institutions tend to operate in the region even though not everyone operates in all countries. E.g. IDB covers some countries and the EU covers some countries. Consequently, a regional view is adopted with specific local references where necessary.

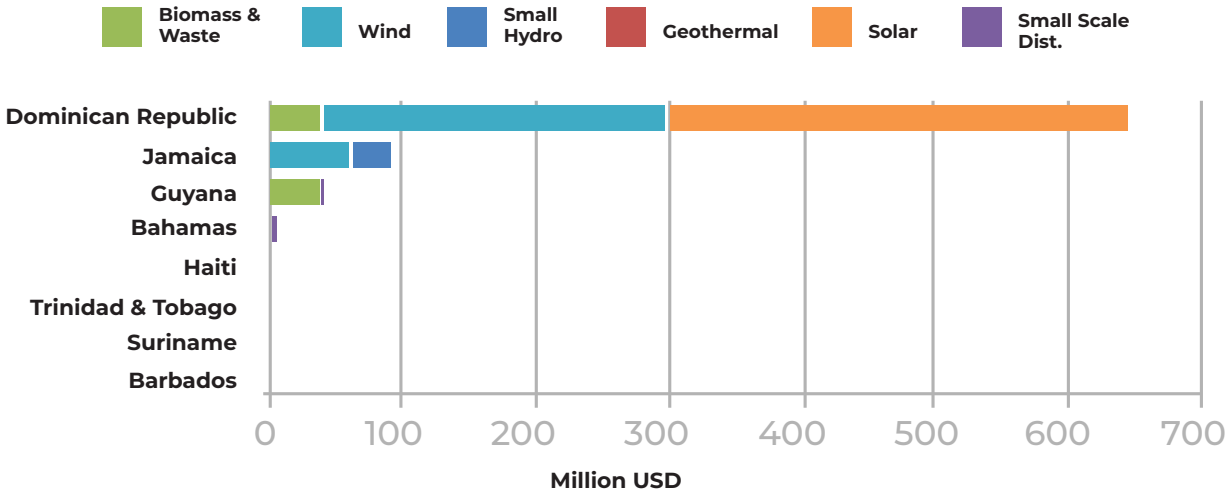
## 4.6.1 | CAPITAL MARKETS

As indicated in the previous assessment the region needs to mobilize some US$60 Billion to complete the transformation work for its grids. This may be estimated at US$6 Billion annually but the national requirements will depend on the energy road map established for each country. In order to maintain the effort and rate of investment in RE and EE, the region will depend largely on available international funding, significant investment from the local financial sector and direct investors.

The C-SERMS report estimates that the Caribbean will require US$20 Billion in energy investment to achieve its 2027 C-SERMS targets, which represents a subset of the total transition investment. Given the significant investment required across the region, multilaterals and other international funding institutions alone are unlikely to invest enough to meet the full requirement. Beside sustainable energy investments, the region also has many other development priorities which compete for funds, such as health, education, and public security.

The USA-CARICOM Taskforce report suggests that many of our countries face limited access to capital markets along with unique regulatory and policy frameworks, which can create barriers to realizing the required investments to affect the necessary energy sector transformation. The prevailing high energy cost is believed to contribute to a sustained cycle which also inhibits growth.

The IDB in their assessment of the development of the renewable energy sector in the Caribbean, considers the actual investment of US$0.8 Billion between 2006 and 2012, to be small (IDB, 2014). Of this, wind energy attracted over 50%. Dominican Republic benefited from 78% of this investment largely due to its favourable tax incentives. In 2010, Jamaica would have received some investment for wind and small hydro, and Guyana for biomass. In summary, most of their investment did not reach most of the Caribbean territories.




*Source: IDB assessment of RE investment in Latin America and the Caribbean*

***Figure 4.16 | Cumulative RE Investment in Caribbean IDB Countries (2006–2012)***

During the more recent period between 2013 and 2019, the Caribbean has benefited from a more active multilateral and international funding community. Admittedly the pursuit of these funds has also been more competitive, with countries broadening their scope and identifying more of their needs under their climate change agendas. Several funding agencies now participate.

## Funding Agencies

- The EU provides up to US$12M for multi-country projects and CIF which has been financed for US$130M.
- IDB invested over US$5 Billion over the last 5 years in the Caribbean and Latin American region and has committed between US$200M and US$300M to the Caribbean region annually until 2030.
- UNDP provides country assistance that can vary from US$5M to US$10M annually.
- RMI currently has US$1 Billion in projects in the pipeline and estimates that their work will save the region US$9 Billion annually and create 75,000 new jobs by 2030.
- Spain, Germany, China, Japan and others provide supplemented funds for developing regions like the Caribbean.

Consequently, a significant portion of the funds required for investment in the RE sector may be mobilized from the multilaterals and international funders and all countries need to pursue this option diligently. However, their dependence on these sources will vary by country as may be gathered from Table 4.2. Countries focusing on utility scale projects with little focus on small and medium size projects require larger investment at more favourable terms.

- **Countries focused on large IPP utility scale implementations will depend heavily on financing from multilaterals and international funding agencies along with direct investment from local and foreign investors and less on local financial institutions.**

- **Countries focused on all-scale generation will depend less on financing from multilaterals and international funding agencies and more on direct investment with a greater focus on local financial institutions.**

a) **Energy units** in the lead government ministries have the responsibility to develop appropriate linkages and relationships with the funding agencies to build projects of interest to attract funds. This happens now but to varying degrees of success. Funding agencies do have criteria that guide their interests towards certain type of projects and ministries would do well to develop their capacity to pursue and mobilize such funds. The capacity gap for this stakeholder group is shown in Figure 4.17 below. It shows that this stakeholder group in most countries' performance fell below their potential to deliver their mandate. That is, they did not deliver as much of their mandate as they could achieve.

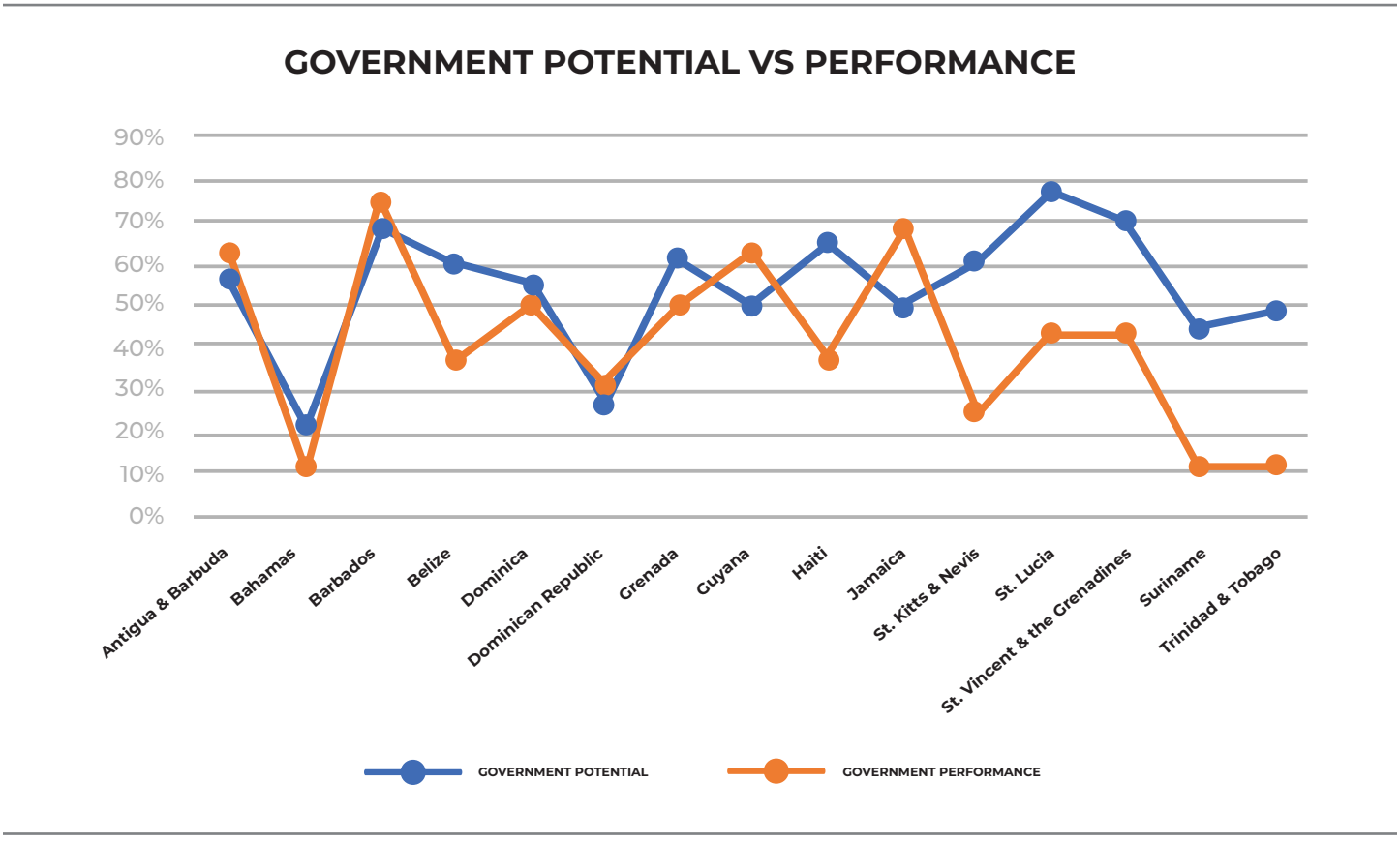



*Figure 4.17 | Potential Vs Performance for Government*

Similarly, in most countries there is the need to increase the human resources necessary to support their mandate as shown in table 4.15 below. Again, most countries are understaffed. In the case of Grenada, Haiti and Suriname, their staff support multiple ministries and do not reflect the energy resources alone.

| COUNTRY | ENERGY UNIT HUMAN CAPACITY |
|---|---|
| Antigua & Barbuda | 4 |
| Bahamas | 40 |
| Barbados | 40 |
| Belize | 10 |
| Dominica | 8 |
| Dominican Republic | 250* |
| Grenada | 156 |
| Guyana | 112 |
| Haiti | 2000 |
| Jamaica | 250 |
| St. Kitts & Nevis | 2 |
| St. Lucia | 7 |
| St. Vincent & Grenadines | 6 |
| Suriname | 850 |
| Trinidad & Tobago | 7 |

** Estimates based on Barbados & Jamaica respectively*

***Table 4.15 | Energy Unit Staffing Capacity by Country***

The underperforming countries' energy units will need to address their capacity issues.

- **Do capacity building to enhance the knowledge and understanding of the necessary project financing procedures to support government's energy policy.**
- **Increase the human resources in the Government's energy units**

**b)** **Private sector institutions** have mandates to support government and businesses, including RECs In many cases, there is an investment focus that seeks to court foreign and local investors to ultimately secure their investment funds, using a package of incentives in most cases. Figure 4.18 gives insight into how well they performed; that is, to what extent they accomplished their mandate

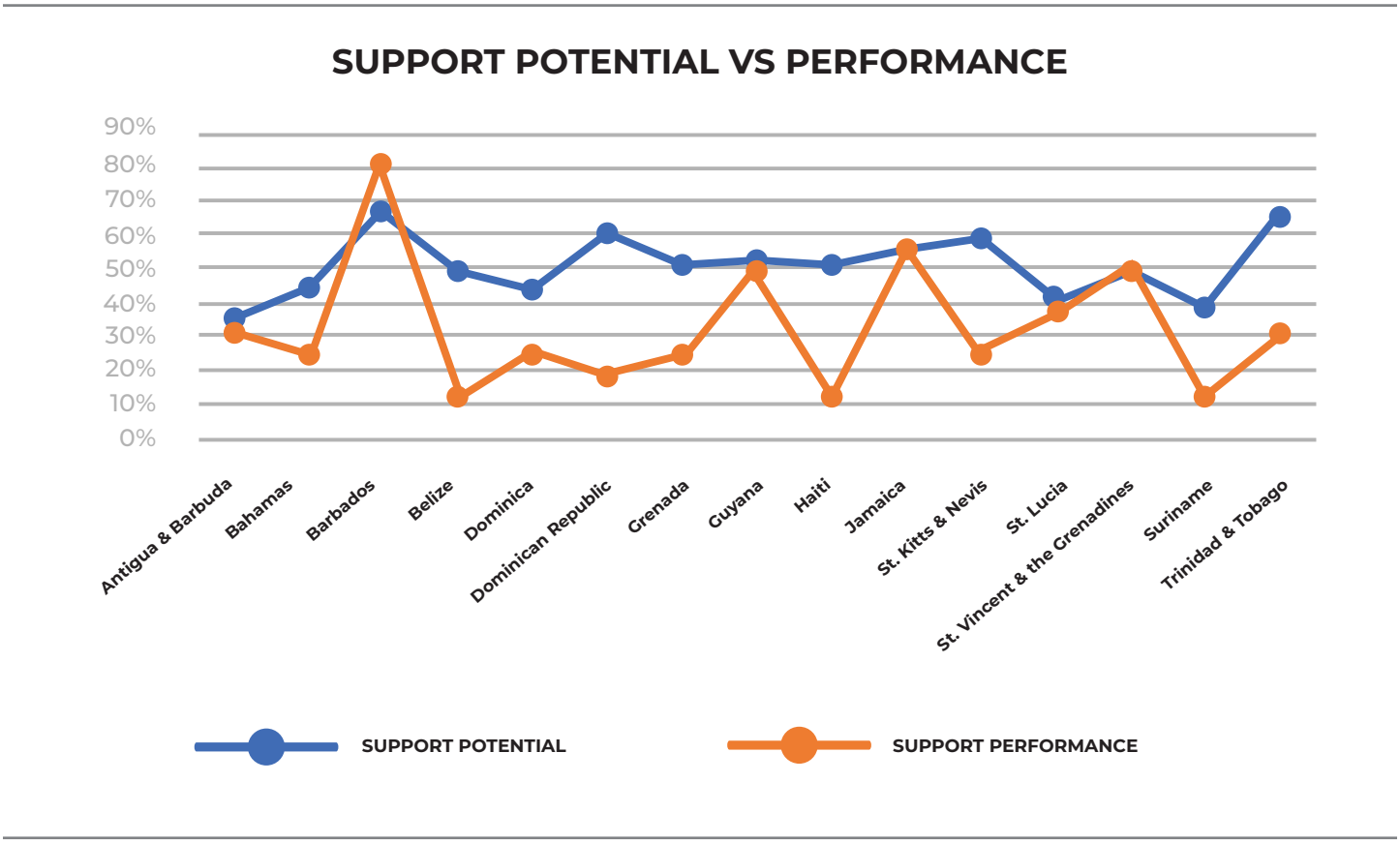



***Figure 4.18 | Potential Vs Performance for Support***

Figure 4.18 also shows private sector institutions underperforming in terms of securing the needed investments for the RE sector. For those underperforming countries, this reflects an unarticulated or unclear policy environment. Once this is addressed the only additional concern would be to provide the appropriate human capacity levels. Some estimates are made based on Barbados and St. Vincent and the Grenadines.

In summary, given the commitments made by the funding agencies and international governments, there are adequate funds available for energy projects. The challenge is the actual mobilization of these funds which depends greatly on the individual countries' ability to attract and secure these funds.

| COUNTRY | SUPPORTING UNITS AVERAGE CAPACITY |
|---|---|
| Antigua & Barbuda | 8 |
| Bahamas | 20 |
| Barbados | 25 |
| Belize | 5 |
| Dominica | 2 |
| Dominican Republic | 25* |
| Grenada | 35 |
| Guyana | 25 |
| Haiti | 11 |
| Jamaica | 25* |
| St. Kitts & Nevis | 6 |
| St. Lucia | 7* |
| St. Vincent & Grenadines | 7 |
| Suriname | 3 |
| Trinidad & Tobago | 21 |

*Table 4.16 | Supporting Capacity by Country*

- **Currently there appears to be adequate resources for most countries.**
- **Given their active policy for large scale implementations, St. Kitts and Belize need to significantly enhance their human capacity**
- **Countries with unsettled policy must address this before the support requirements can be determined**

## Financial Institutions

Research completed by the Taskforce, IDB and others, all suggest that the private sector can play a critical role in providing the required capital investment if a favourable environment is created by governments. Such an investment environment needs to be stable, clear, competitive, and fair, with full considerations of the local context and other social and environmental interests. Consequently, several institutions like 5Cs, GCF, EU, IDB and others are actively engaging the private sector in order to gain their support in the transformation efforts. Notwithstanding their ongoing efforts, several risks still exist and they consider these financial sectors to be underdeveloped.

a) **International investment** is difficult to secure according to the IDB study in 2014. Political and regulatory risks are still major factor preventing the mobilization of the capital required. Market risks are heightened due to the lack of economies of scale, limited experience with renewables, and the macroeconomic circumstances of Caribbean nations, among other factors. These include relatively low international credit ratings, high vulnerability to disasters and the impacts of climate change at various levels in the economy.

b) **Local financing** is also considered inadequate for some markets. There is a general lack of RE financial products in the form of special credit lines or grants. RE projects usually have a payback period exceeding seven years while debt financing is often not available for periods above that. Before 2014, only 53% of the financial institutions in the Caribbean and Latin American region offered some products for financing renewable energy. However, as indicated previously, a few development banks (Jamaica, Saint Lucia, Grenada, Belize) have provided support with adequate products, while most territories still do not have this facility. In Jamaica, the capacity and willingness of commercial banks to engage in renewable energy lending has increased significantly in recent years along with the other non bank financial institutions in Barbados. This financing is aimed at small and medium scale investments.

c) **Equity financing** is also unusual for the local markets. Equity requirements are high; on average 40% according to the IDB report which also sights the absence of policies that establish debt financing as notable. Local banks and credit unions indicated their lack of interest in equity investment. While the EU has not discarded the possibility, they do not currently offer this facility.

d) **Risk assessment** is also a concern since some local financial products still do not correctly assess and address inherent risk, leading to prohibitive interest rates. This is however changing with the ongoing education of the sector. More education is however needed in all territories based on the ratings in table 4.1 which show scores from 3.19 to 4.62, where 1 is the best score and 5 is the worst. It is hoped that the engagement of the local financial institutions will help to accelerate the necessary transformation in this critical sector.

For those territories whose strategy is hinged on the participation of its citizenry, governments must encourage active financial institutions to support their efforts to mobilize multilateral and international funding. Once the challenges above are addressed and efforts to educate that sector are implemented it has the potential to complete the funding mobilization effort since commercial banks are reported to have the financial resources to put forward.

### 4.6.2 | INSURANCE MARKETS

The insurance markets across the Region are less challenging than the financial markets since the traditional insurance standards are less onerous. Whilst referencing traditional financial lending norms significantly disadvantages the RE sector with respect to risks and terms, the insurance traditional norms parallel the RE assets to property in the residential and commercial sectors. Insurance companies therefore unreservedly provide coverage for residential and commercial RE assets as they would for a property and its contents. Furthermore, in territories where grid connection is practiced, the requisite public liability insurance is automatically included in policies. This is quite adequate and therefore supports the RE industry well across the region. For utility-scale RE systems, implementations require two separate insurance instruments. Firstly, the plant assets are covered against damage and loss and secondly, public liability provides the coverage for accidents when interacting with the equipment. This coverage is generally available to IPPs.

## 4.7 | TYPES OF EXPORTS, MARKETS AND VOLUMES

The demand for RE and EE products and services are significant in all the countries in this study. This varies by country as presented in table 4.4. There is also limited and varied REC capacity and capability across the region, as shown in tables 4.8, 4.9 and 4.10. In most cases there is an apparent gap between supply and demand. This appearance exists due to inadequate policy and regulatory frameworks which could change, resulting in a different appearance in the RE Industry. Changes in policy take time to be reflected in the industry. Therefore, we can expect to see the gap persist for some time. To be clear, a small local RE industry in the presence of a great need that cannot be accessed, does not represent a real gap (only apparent) since the opportunities may not be available to local or regional RECs.

As the accessible market grows (demand) we can expect the number and size of RECs to also grow (supply).

In cases where the real capacity exceeds the local demand, then there is additional capacity which may be utilized to pursue export opportunities. Where RECs are limited in a market that is liberalized with a supporting legal and regulatory framework, there is opportunity for RE products and services to be imported. Both situations exist throughout the region to different degrees. Unfortunately, there exists a long traditional language barrier between the Dominican Republic which is the largest market and the rest of the region. This trade barrier has existed for many years.

Given the fluidity of the market status which depends on the regulatory frameworks, it is difficult to quantify the real opportunity beyond what is presented in section 4.2 on "Market Size". However, RECs in some territories have seized the opportunities to export their RE and EE products and services. Other territories simply have no capacity to pursue external opportunities. Table 4.17 on the following page provides some estimates provided by the RECs. Firms are very sensitive about divulging their exact sales information.

| COUNTRY | RE PRODUCTS** ($000) | EE PRODUCTS* ($000) | RE & EE SERVICES ($000) | EXPORT MARKETS |
|---|---|---|---|---|
| Antigua & Barbuda | | | | |
| Bahamas | | | | |
| Barbados | $1,500 | $1,500 | $750 | CARICOM<br>International |
| Belize | $50 | | | Dominica |
| Dominica | | | | |
| Dominican Republic | $50 | | | El Salvador<br>Guyana |
| Grenada | | | | |
| Guyana | | | | |
| Haiti | $100 | | | Guinée Conacry<br>USA |
| Jamaica | $250 | | | Mexico<br>Dominica<br>USA<br>Trinidad and Tobago |
| St. Kitts & Nevis | | | | |
| St. Lucia | | | | |
| St. Vincent & Grenadines | $25 | | | Dominica |
| Suriname | | | | |
| Trinidad & Tobago | | $5,000 | $50 | Barbados<br>Jamaica<br>Dominican Republic<br>Eastern Caribbean<br>Puerto Rico<br>Dominica |

** Solar Water Heaters without installation*
*** RE systems including some installation*

***Table 4.17 | Estimated Exports by Country***

## 4.8 | GRAPHICAL REPRESENTATION

The density of RE and EE services across the region varies significantly and is represented in the following charts. The number of firms operating in each area is shown in table 4.18 and table 4.19 shows the key used. Further graphical displays are shown in figures 4.19 to 4.25. The REC density per capita is shown in figure 4.26 where Antigua and Barbuda and Barbados indicate the better positions and Haiti and Dominican Republic the worst.

| COUNTRY | Renewable Energy Systems Design and Installation | Energy Auditing Services | Energy Service Companies (ESCOs) | Renewable Energy Consulting Services | Renewable Energy & EE Product manufacturing | Solar Water Heating (Assembly, Sales & Installation) | Energy Equipment and Efficient appliances Retailing |
|---|---|---|---|---|---|---|---|
| Antigua & Barbuda | 2 | 1 | | 1 | | 1 | 2 |
| Bahamas | 8 | 1 | | 2 | 1 | 2 | 6 |
| Barbados | 9 | 4 | | 2 | 1 | 3 | 7 |
| Belize | 10 | 2 | | 2 | | 2 | 3 |
| Dominica | 2 | | | | | 1 | 1 |
| Dominican Republic | 22 | | | 6 | | 3 | 9 |
| Grenada | 3 | | | 1 | | | 2 |
| Guyana | 4 | | | 1 | | 1 | 5 |
| Haiti | 8 | 3 | 2 | | 3 | | 7 |
| Jamaica | 23 | 6 | 2 | | | 14 | 14 |
| St. Kitts & Nevis | | | | | | | 2 |
| St. Lucia | 3 | 1 | | 1 | | | 1 |
| St. Vincent & the Grenadines | 2 | 2 | | | | 1 | 1 |
| Suriname | 1 | | | | | 1 | 1 |
| Trinidad & Tobago | 7 | 5 | 3 | 3 | | 1 | 3 |

*Table 4.18 | Number of firms in each area by Country*

| Number of Registered Firms | Colour code for Graphics on following pages | Per Capita Quartiles |
|---|---|---|
| 1-10 | | 1st Quartile |
| 11-20 | | 2nd Quartile |
| Not used | | 3rd Quartile |
| 21-30 | | 4th Quartile |

*Table 4.19 | Intensity Graphics key*


*Figure 4.19 | Density of Firms Offering RE Systems Design and Installation*


*Figure 4.20 | Density of Firms Offering Energy Auditing Services*


*Figure 4.21 | Density of Firms Offering ESCO Service*


*Figure 4.22 | Density of firms offering Renewable Energy Consulting Services*


*Figure 4.23 | Density of firms doing RE & EE Product Manufacturing*


*Figure 4.24 | Density of firms offering SWH (Assembly, Sales & Installation)*


*Figure 4.25 | Density of firms offering Energy Equipment and EE Appliances Retailing*


*Figure 4.26 | REC Density Per Capita*

# 5.0 | SUMMARY
# RECOMMENDATIONS & CONCLUSIONS

## 5.1 | NATIONAL CAPACITY BUILDING

Many of the early movers have learnt much of what is required to build a sustainable energy industry by trial and error. However, the late starter does not need to travel this road. They can learn from others and on-board the requisite skills to see their national sustainable energy industries succeed. Interventions for lead ministries and the utility regulators may include training to provide:

- Technical knowledge of future energy infrastructures.
- Human resource management for a modern energy environment.
- Regulation for sustainable energy utilities.
- Seminars/conferences to share Caribbean experiences and progress in energy transformation.
- Workshops to teach skills in support and sector management.
- Project development.
- Proposal writing for finance mobilization.
- Stakeholder engagement.
- National awareness for regionally funded plans.

These interventions should result in a better policy and regulatory environment for the development of the RE industries and a more enabled supporting group.

## 5.2 | NATIONAL AWARENESS CAMPAIGN

Given the lack of information flow from government to other supporting institutions and the general public, some intervention is required. Awareness campaigns are required to address:

1) Clear articulation of policy to private sector institutions.
2) Information seminars with RE industry actors.
3) Targeted workshops with financial institutions.
4) Consistent messaging to the general public on EE and RE.
5) Energy technology fairs for general public and students.

These interventions should result in a more engaged RE industry and a more informed public.

## 5.3 | REGIONAL TECHNICAL CAPACITY

Building technical capacity should be treated as a regional issue. Individual national educational institutions often lack the capacity to develop the requisite courses and deliver them in a way that provides both theoretical and hands-on components. In some cases, the number of potential students is also small. Educational institution models across the region suggest that a centre of excellence for the common PV technology and installation may be beneficial. This would also promote the development of standards for the related equipment and services.

This type of regional development has also attracted the attention of CCREEE and may therefore represent an opportunity for collaboration and partnership. Conversations with HEIs in some countries have indicated a high level of interest. E.g. Dominica and St. Kitts. Those countries with sustainable energy (SE) programs or courses can also be instrumental in the coordination a regional response. Based on the adopted and planned technologies in the region the following subject areas would be beneficial.

**1)** PV Systems and Installation
**2)** Wind Systems and Installation
**3)** SWH Assembly and Installation
**4)** Biomass Systems and Installation
**5)** Biofuel Manufacturing and Retailing
**6)** Sustainable Energy Development
**7)** Energy Management
**8)** Energy Auditing
**9)** RE and EE Technology assessment for local use
**10)** Business Development for Energy Entrepreneurs
**11)** Proposal Writing for sustainable energy
**12)** Project Management for SE projects

These interventions should result in RE firms being better equipped to respond to the demands of the public.

Given the interest in hydro and geothermal power there is also the need to understand and manage such implementations. This should be undertaken as part of any utility-scale project and not necessarily for MSMEs and RECs.

## 5.4 | SECTORAL DEVELOPMENT

As demonstrated in section 4.6 on Economic Linkages of the RE Industry, there is an opportunity to advance the EE and RE agendas where strong linkages exist. Such linkages exist with the dominant economic sectors like tourism in Antigua and Barbuda, Grenada, Bahamas and Saint Lucia, and Agriculture in Haiti, Guyana and Suriname. This approach has been successful with the IDB CHENACT project which explored the EE linkages with Caribbean hotels.

A similar approach may be taken to strengthen the RE linkages in the same sector as well as other key sectors.

## 5.5 | REGIONAL COOPERATION

There needs to be deeper inter-regional cooperation through CARICOM and CCREEE. These are two key regional institutions which can facilitate and promote such engagements. This may be actioned through:

- Regional events which attract participants ranging from policymakers to practitioners.
- Seminars designed to share experiences and lessons learnt.
- Workshops to build regional capacity and explore potential synergies.
- Development of online tools to share resources across the region.

These interventions will result in a quicker transformation of the RE sector.

## 5.6 | CONCLUSIONS

RECs in the participating countries are keen to play a role in the development of their RE industry. Those within an enabling environment are progressing and those without that environment are looking forward to experiencing its eventual manifestation. Every attempt to help create this enabling environment is effort well spent.

Many country challenges are common, making the option of work together the preferred one. The role of the regional institutions in the sustainable energy space is therefore an important one. The common priorities must be identified so that appropriate solutions may be developed and shared.

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**Solar Energy International (SEI)** is one of the most established renewable energy training organizations in the world. Founded in 1991 as a 501(c)3 educational non-profit, our mission is to provide industry-leading technical training and expertise in renewable energy to empower people, communities and businesses worldwide. Our vision is a world powered by renewable energy.

- SEI was named the 2015 Accredited Clean Energy Training Provider of the year by the Interstate Renewable Energy Council (IREC). Our PV curriculum was one of the first programs in the United States to be certified by IREC, which is the premier resource for credentialing and best practices regarding renewable energy.

*SEI has trained 70,000 people in renewable energy since 1991.*

- Our textbooks, Photovoltaic Design and Installation Manual (over 75,000 copies have been sold; also available in Spanish) and our newly published Solar Electric Handbook: Photovoltaic Fundamentals and Applications are used in hundreds of colleges and training programs around the world.
- We have 10 instructors who are IREC Certified Master or Affiliated Trainers and 44 instructors who are NABCEP Certified Photovoltaic Installation Professionals — more than any other solar training organization in the US.
- SEI was also selected by the US Department of Energy to pilot Solar Ready Vets, which provides intensive solar training to transitioning military members who want to work in the solar industry.
- SEI's training counts for NABCEP educational hours and is a Registered Provider for the NABCEP PV and Solar Heating Associates Exams.
- SEI has trained people from all 50 states and has conducted trainings in Mexico, Costa Rica, Peru, Ecuador, Chile, Colombia, Suriname, Antigua, Barbados, Haiti, Guam, Solomon Islands, India, Kuwait, United Arab Emirates, Pakistan, Palestine, Egypt, Kazakhstan, Benin, Angola, Nigeria, Equatorial Guinea, and Sierra Leone.

SEI partners with governments, utilities, distributors, manufacturers, NGOs, and universities. Our list of clients includes: NREL, Antigua Public Utilities Authority, Hawaiian Electric Companies, Arizona Public Service, Salt River Project, Navajo Tribal Utility Authority, Lockheed Martin, National Park Service, US Forest Service, Solar City, Sungevity, First Solar, MK Battery, Trojan Battery, Unirac, Outback Power, InterSolar, Solar Electric Trade Shows, Solar Middle East, University of Hawaii, University of Arizona, Kuwait Institute of Scientific Research, Solar Electric Light Fund, among many others.

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| Course Code | Courses Offered | Cr | New Code | Courses Offered | Cr | New Code | Courses Offered | Cr |
|---|---|---|---|---|---|---|---|---|
| | ***Year 1, Term 1*** | | | ***Year 1, Term 2*** | | | ***Year 1, May-July Session*** | |
| MATH1045 | Introductory Mathematics for Technicians | 4 | MATH1006 | Mathematics for Technicians I (A) | 4 | | | |
| HSEV1017 | Health, Safety and Environment (A) | 3 | ELEC1017 | Electrical and Electronic Workshop | 4 | | | |
| COPG1004 | Introduction to Computer Programing and CAD | 3 | ELEC1002 | Electrical Principles I | 3 | | | |
| ELEC1016 | Science for Technicians | 4 | CTLP1004 | PLC and HMI | 3 | | | |
| CTLP1002 | Instrumentation and Control Principles (A) | 3 | ELEC1018 | Introduction to Electronics | 3 | | | |
| COMM1023 | Communication for Technicians | 2 | REET1001 | Introduction to Renewable Energy Engineering. | 3 | | | |
| | ***Term Credits*** | ***19*** | | ***Term Credits*** | ***20*** | | | |
| | ***Year 2, Term 1*** | | | ***Year 2, Term 2*** | | | ***Year 2, May-July Session*** | |
| MATH1007 | Mathematics for Technicians II (A) | 4 | REWS2001 | Wind Energy Systems | 3 | COOP2007 | Internship | 5 |
| REMW2001 | Mechanical Workshop | 3 | REPE2001 | Power Electronics for Renewable Energy Systems | 4 | | | |
| REEE2001 | Energy Efficiency for Buildings | 3 | REST2001 | Solar Thermal Systems | 2 | | | |
| REEM2001 | Electric Machines for Wind Energy and Electric Vehicles | 3 | REES2001 | Energy Storage for Renewable Energy Systems | 2 | | | |
| PRJT2013 | Project Writing, Entrepreneurship and Ethics | 2 | PRJT2017 | Renewable Energy Capstone Project Phase II | 4 | | | |
| REPV2001 | Solar Photovoltaic Systems | 4 | MATH2013 | Mathematics for Technicians III (A) | 4 | | | |
| | ***Term Credits*** | ***19*** | | ***Term Credits*** | ***19*** | | ***Term Credits*** | ***5*** |
| | | | | ***Total Program Credits: 82*** | | | | |

| COURSE CODE | COURSE TITLE | CREDITS | COURSE DESCRIPTION | COURSE ASSESSMENT | PRE-REQUISITE |
|---|---|---|---|---|---|
| **REET1001** | Introduction to Renewable Energy Engineering. | 3 | This course provides an introduction to Renewable Energy. The course covers content on solar energy, wind energy, bioenergy, as well as hydro, tidal, and ocean energy. The course provides a multidisciplinary approach and integrates economic, social, environmental, policy, and engineering issues related to renewable energy. It explains the fundamentals of energy, including the transfer of energy, as well as the limitations of natural resources. | **In-course Assessment ONLY**<br>Quizzes: 40 %<br>Case Study & Presentation: 30%<br>Software Simulation: 10%<br>Assignments: 20% | Science for Technicians ELEC1016 |

| COURSE CODE | COURSE TITLE | CREDITS | COURSE DESCRIPTION | COURSE ASSESSMENT | PRE-REQUISITE |
|---|---|---|---|---|---|
| **REEE2001** | Energy Efficiency for Buildings | 3 | The course will expose students to the principles and industry best practices as it relates to Energy efficient building design, analysis and retrofitting of commercial and domestic buildings. The content and practical case studies and simulations provided in this course will directly aid the implementation of the recently developed and adopted Regional Energy Efficient Building Code (REEBC). Students will be exposed to energy efficient technologies and practices in the building industry which includes: Air conditioning (HVAC) system, Lighting systems, Renewable energy systems, water heating, the building's thermal envelope and Ventilation (natural and mechanical). | **In-course Assessment ONLY**<br>Quizzes: 30 %<br>Case Studies: 30%<br>Software Simulation: 40% | Science for Technicians ELEC1016 |
| **REEM2001** | Electric Machines for Wind Energy and Electric Vehicles | 3 | This course will expose course attendees to the design and operation of Electric Generators used in Wind Power generation and traction Electric Machines used in Electric Vehicles (EV's). EV's have been proven to be more efficient than Internal Combustion Engine (ICE) based vehicles. This efficiency gain is calculated when the entire well to wheel process is investigated. The higher efficiency of EV's over ICE's is mainly due to the use of high efficiency traction electric machines for propulsion. The mass adoption of EV in both public and private transportation will significantly reduce the petrol or diesel used by ICE vehicles and hence reduce Green House Gas emissions. | Quizzes: 30 %<br>Laboratory exercises: 30%<br>Final Examination: 40% | Introduction to Electronics ELEC1018<br><br>Electrical Principles I ELEC1002 |

| COURSE CODE | COURSE TITLE | CREDITS | COURSE DESCRIPTION | COURSE ASSESSMENT | PRE-REQUISITE |
|---|---|---|---|---|---|
| **REPV2001** | Solar Photovoltaic Systems | 4 | The course will cover the design of photovoltaic systems, with an emphasis on residential scale systems for both stand alone and grid connected systems. Students will learn about the function and operation of various Photovoltaic (PV) system components, including inverters, batteries and DC-DC converters. Students will obtain an in-depth understanding of the main design decisions required for planning an effective and efficient PV installation. | Quizzes: 20 %<br>Laboratory exercises: 20%<br>Software Simulation: 20%<br>Final Examination: 40% | Science for Technicians - ELEC1016<br><br>Electrical Principles 1 – ELEC1002 |
| **REWS2001** | Wind Energy Systems | 3 | The course covers the technology, design, installation and maintenance of small wind turbines. The course begins with the internationally accepted best practices and procedures for the design and implementation of a Wind Resource Assessment (WRA). The course covers the Darrieus and Savonius style small wind turbines but places an emphasis on the Horizontal Axis Wind Turbine (HAWT). The course explores the different technologies and designs used in the electric generator, the controller and the power electronics associated with a small HAWT. The course also exposes courses attendees to industry grade Wind Resource Assessment simulation software | Software Simulation: 20%<br>Final Examination: 40% | Vehicles REEM2001 |

| COURSE CODE | COURSE TITLE | CREDITS | COURSE DESCRIPTION | COURSE ASSESSMENT | PRE-REQUISITE |
|---|---|---|---|---|---|
| **REPE2001** | Power Electronics for Renewable Energy Systems | 4 | The intermittency of Renewable Energy sources, especially Wind and Solar Photovoltaic (PV) systems with randomly varying power output, requires the integration of power electronic circuitry. To efficiently interface a renewable energy source with a load or power grid, the power converters perform power conditioning, voltage boosting, and control of the flow of power to ensure a reliable and high-quality power supply. This course will expose course attendees to the theory and application of single-phase Power Electronics in Renewable Energy systems, with a focus on Photovoltaic (PV) and Small Wind Energy systems. Course attendees will be exposed to the theory and circuit design of standard invertor, rectifier and converter circuit architecture used in PV and Small Wind Energy systems and also assemble and test these circuits in the laboratory. | Quizzes: 30 % Laboratory exercises: 30% Final Examination: 40% | Science for Technicians ELEC1016<br><br>Electrical Principles I ELEC1002<br><br>Introduction to Electronics ELEC1018 |
| **REST2001** | Solar Thermal Systems | 2 | Students will study the theory and design of solar thermal systems with specific applications to Solar Water Heaters, Solar Thermally Driven Cooling Systems and Solar Thermal Desalination. Students will be able to verify the effectiveness and efficiency of their proposed solar thermal system design using both theory and solar thermal systems engineering software. Students will be taught industry best practices as it relates to the installation and maintenance of these solar thermal systems and be guided by the specific local standards. | Quizzes: 20 % Case Study & Presentation: 10% Software Simulation: 20% Final Examination: 50% | Science for Technicians – ELEC1016 |

| COURSE CODE | COURSE TITLE | CREDITS | COURSE DESCRIPTION | COURSE ASSESSMENT | PRE-REQUISITE |
|---|---|---|---|---|---|
| **REES2001** | Energy Storage for Renewable Energy Systems | 2 | The course will expose course attendees to existing and emerging Electrical Energy Storage (EES) devices and technologies related to the storage of Variable Renewable Energy (VRE). Course attendees will be presented with applications of EES for utility scale storage, however the primary focus of the course would be EES for domestic and commercial applications. A significant portion of the course would be devoted to the two (2) most popular types of domestic and commercial EES which are Lead Acid type batteries and Lithium Ion type batteries. Course attendees would be taught the theory and industry best practices as it relates to the selection of EES type and technology, sizing of battery banks, cable selection and rating and battery installation and handling safety practices for a given VRE installation. Existing battery disposal and recycling practices are also discussed in the course. | **In-course Assessment ONLY**<br>Quizzes: 40 %<br>Case Studies: 30%<br>Assignments: 30% | Science for Technicians ELEC1016<br><br>Electrical Principles I ELEC1002 |

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