# ROADMAP FOR INTEGRATED CLIMATE RISK MANAGEMENT

*Climate Risk in Barbados' Renewable Energy Sector*

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

MCII

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## EXECUTIVE SUMMARY

Natural disasters and their associated damages severely impact people around the world every year. Increases in exposure and vulnerability at a global level, linked to the multiple concurrent trends such as climate change, population growth and globalisation of supply chains are making it imperative to find strategies to manage disasters more holistically.

Integrated Climate Risk Management (ICRM) is an approach to dealing with the risk and manifestation of climate-related disasters. It is characterised by a holistic perspective with regards to the various components of risk management. ICRM differs from previous concepts in the disaster management paradigm that focused almost exclusively on response, and didn't pay significant attention to opportunities to reduce the incidence or potential impact of climate disasters.

This roadmap is developed from work undertaken on ICRM through the "Advancing Climate Risk Insurance plus" (ACRI+) proejct implemented by the Deutsche Gesellschaft für International Zusammenarbeit (GIZ) GmbH and the Munich Climate Insurance Initiative (MCII). In Barbados, the ACRI+ project is working with stakeholders to improve the resilience of existing and future renewable energy generation, transmission and distribution infrastructure to climate and disaster risks.

The roadmap focuses on opportunities for risk transfer, particularly through insurance mechanisms in the Barbados solar photovoltaic (PV) sector. Risk transfer instruments, such as insurance, are increasingly being used by governments, business and households to reduce the immediate and long-term losses associated with extreme weather events. The potentially catastrophic nature of climate risks in the Caribbean, particularly in the context of climate change, means that risk transfer is likely to play an important role in building resilience. This is enabled by the design of appropriate financial instruments, including insurance.

Currently, there are significant barriers to scaling up risk transfer in the renewable energy sector. The roadmap identifies some of the major such barriers, and suggests actions and recommendations that could be followed to address them. It considers the roles of different actors, including the insurance industry and government, in scaling up renewable energy technologies in a manner that considers and integrates risk management principles.

The roadmap makes recommendations about immediate, short, medium and long-term actions primarily related to scaling up the potential role of risk transfer in integrated climate risk management in the Barbados solar PV sector.

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| ACRI+ | Advancing Climate Risk Insurance plus |
| BL&P | Barbados Light & Power Company Ltd |
| BMU | Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (Federal Ministry for Environment, Nature Conservation and Nuclear Safety, Federal Republic of Germany) |
| BREA | Barbados Renewable Energy Association |
| CBB | Central Bank of Barbados |
| CARICOM | Caribbean Community |
| CDEMA | Caribbean Disaster Emergency Management Agency |
| CCRIF | Caribbean Climate Risk Insurance Facility |
| DREAM | Disaster Risk and Energy Access Management |
| DRM | Disaster Risk Management |
| ECA | Economics of Climate Adaptation |
| ELPA | Electric Light and Power Act |
| GIAB | General Insurance Association of Barbados |
| GIZ | Deutsche Gesellschaft für International Zusammenarbeit |
| ICRM | Integrated Climate Risk Management |
| ICRM project | "Promoting Integrated Mechanisms for Climate Risk Management and Transfer" project |
| INDC | Intended Nationally Determined Contribution |
| IRENA | International Renewable Energy Agency |
| LCOE | Levelized Cost of Electricity |
| LPG | Liquid Petroleum Gas |
| MCII | Munich Climate Insurance Initiative |
| MW | Mega Watt |
| NAP | National Adaptation Plan |
| NCCP | National Climate Change Policy |
| NSEP | National Sustainable Energy Policy |
| OPM | Oxford Policy Management |
| PV | Photo Voltaic |
| SIDS | Small Island Developing State(s) |
| UNFCCC | United Nations Framework Convention on Climate Change |

# Introduction

1

## 1.1 PURPOSE

This document provides guidance and technical support to policymakers and other stakeholders involved in the identification, management and reduction of climate risks, and the impact of climate-related disasters, in Barbados' renewable energy sector.

Having adopted ambitious renewable energy targets, Barbados has in recent years begun a transition away from an energy system dependent on imported fossil fuels. The forthcoming scale-up of renewable energy means that it is timely at this stage to consider the risks entailed, and appropriate mitigation measures. Given the inherent exposure of the Caribbean region to natural hazards, it is imperative to consider how climate and weather risks to energy infrastructure can be effectively managed.

Insurance is likely to be a key strategy for risk management: local financial sector actors (banks, credit unions, finance companies) have stressed that strengthening the insurance landscape was a critical precondition for them in extending their financing offering to support the scale-up of renewable energy (Robinson and Rogers 2018).

The roadmap discusses specific practical interventions and policy ideas that could be applied to strengthen the climate resilience of the sector, in the context of Barbados' commitment to a renewable energy transition. It focuses mainly on renewable electricity, though with some references to other uses of energy. In terms of intervention type, the roadmap covers various stages of the disaster risk management cycle *(→ see below)*, but has a particular focus on the potential for risk transfer. The roadmap is therefore relevant to the achievement of renewable energy policy objectives on the one hand, and climate change and disaster risk objectives on the other.

The content is primarily sourced from work undertaken through the "Advancing Climate Risk Insurance plus" (ACRI+) project that is funded by the Federal Ministry for Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (BMU)), Federal Republic of Germany. ACRI+ is implemented by the Deutsche Gesellschaft für International Zusammenarbeit (GIZ) GmbH and the Munich Climate Insurance Initiative (MCII). The primary source of data was reports produced through the project, though some secondary literature was also included. A further source of data was reports and notes from two workshops held with key stakeholders in Barbados during the course of the project *(→ see Annex A)*.

The primary audience for the roadmap is policymakers and government officials, particularly within the Energy Division (Prime Minister's Office) and the Ministry of Environment and Drainage. Additionally, institutions who influence and engage with renewable energy policy and initiatives, in particular the Barbados Renewable Energy Association (BREA). Representatives of the primary audience have been involved in the drafting process of the roadmap. They have provided strategic and technical inputs to inform the content of the document through a formal peer review process and other meetings and coordination channels.

A potential secondary audience is a wider set of stakeholders working on climate risk management across various sectors within and outside of Barbados, for whom the roadmap could provide useful guidance in terms of developing an approach to mainstreaming and strategy. Additionally, those interested in learning about the application of an integrated approach to climate management.

## 1.2 INTEGRATED CLIMATE RISK MANAGEMENT

Integrated Climate Risk Management (ICRM) is an approach to dealing with the risk and manifestation of climate-related disasters. It is characterised by a holistic perspective with regards to the various components of risk management, which are depicted in the outer layer of Figure 1.

The key emphasis of integrated approaches is upon treating these aspects as integrated and overlapping. The middle circle provides more detail on the types of activities that should be implemented at each stage. Resilience, in the centre of Figure 1, represents the system's capacity to absorb and recover from hazardous events, and is the variable that is enhanced by successful integrated disaster and climate risk management (Gonsalves et al., 2011). In disaster risk management, the system can include social, economic, physical, natural and human capital.

FIGURE 1: Integrated Climate Risk Management Cycle

ICRM differs from previous concepts in the disaster management paradigm that focused almost exclusively on response, and didn't pay significant attention to opportunities to reduce the incidence or potential impact of climate disasters. The imperative to broaden this perspective comes from increases in exposure and vulnerability at a global level, linked to the multiple concurrent trends such as climate change, population growth and globalisation of supply chains (MCII 2017). A further advantage of the ICRM approach is that it enables alignment of the DRM agenda, as exemplified in the Sendai Framework on Disaster Risk Reduction, with the climate change and sustainable development agendas, codified at a global level by the Paris Agreement and Sustainable Development Goals respectively.

# Climate risk and the energy sector in Barbados

# 2

## 2.1 RENEWABLE ENERGY STATUS AND POTENTIAL

### 2.1.1 Energy sector overview

The economy of Barbados is heavily dependent on fossil fuels (heavy fuel oil, diesel, gasoline, kerosene and Liquid Petroleum Gas (LPG)). Whilst Barbados has its own sources of crude oil, it lacks refining infrastructure, and as a result relies entirely on imports.

The costs of importing and distributing fossil fuels are significant in the context of the Barbadian economy. The country spent 4.5% of its GDP on fuel imports in 2016 (IDB 2018), making it a major consumer of the country's scarce foreign exchange. Saving on foreign exchange would be a significant benefit to the country's economic situation. The global oil market is notorious for its price fluctuations, and price spikes such as that experienced in 2008 have highlighted the risks that high import dependence pose to energy security. Energy is a key input into almost all economic activity, and due to Barbados's dependence on oil, price spikes can lead to high inflation.

Renewable energy is additionally attractive, because the costs of wind and solar are rapidly falling. The International Renewable Energy Agency (IRENA), notes that "the fall in electricity costs from utility-scale solar photovoltaic (PV) projects since 2010 has been remarkable. The global weighted average levelized cost of electricity (LCOE) of utility-scale solar PV has fallen 73% since 2010, to USD 0.10/kWh for new projects commissioned in 2017". Additionally, some stakeholders point to potential employment opportunities linked to renewable energy, and the sector's contribution to climate change mitigation goals.

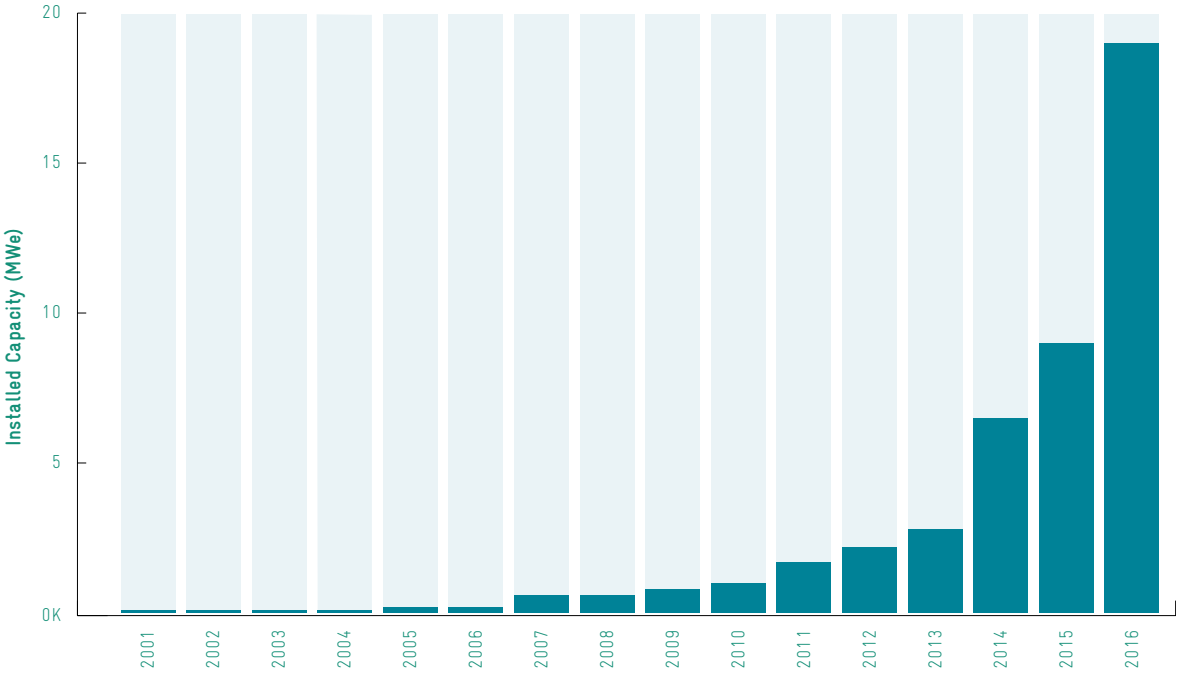
Barbados has an electrification rate of 98% (GIZ, 2017). The Barbados Light & Power Company (BL&P) is responsible for production, transmission and distribution of electricity in the country. It has a total installed capacity of 239.1 MW to meet a peak demand of 157 MW (Grainger 2017). Electricity is generated mainly through three BL&P generating stations which use a combination of gas turbines, low speed diesel engines and steam turbines.

### 2.1.2 Renewable energy technologies and their potential

Other than the bagasse used in the sugar industry, renewables currently play a small role in the country's energy profile. Bagasse contributed 6% of fuel inputs for electricity production in 2015, with solar contributing 1% and natural gas 0% (Ince, n.d.).

However, renewable energy installed capacity has significantly increased in the last five years, as demonstrated by Figure 3.

Figure 2: Installed renewable energy capacity by solar PV technology 2001 – 2016 (GIZ 2017)




According to analysis undertaken by NREL (cited in Grainger 2017), solar Photo Voltaic (PV) technologies have the highest potential compared to other renewable energy sources, followed by wind and biomass energy. In Barbados, the main types of solar PV are a) household-based use with limited sales of surplus to the grid, b) solar PV farms, c) government solar PV systems, mainly functioning as back-up systems for essential public services.

In 2015, there were more than 710 solar-PV roof top installations connected to the grid (Grainger 2017). Demand is high amongst middle-high income electricity customers, incentivized by reduced overall electricity costs.

Recent years have seen a growing integration of small-scale renewable energy systems into the national grid. Integrating multiple small-scale systems into the grid can help to diversify risk through the provision of a network of smaller grids that can continue to operate in isolation if the rest of the power system is down. However, small-scale renewable energy can also present challenges for reliability and quality, due to the intermittency of supply from sources such as wind and solar. Thus, such an integrated system would require sophisticated management systems and infrastructure to draw on other generation sources on stand-by that can 'step-in' and provide a constant energy supply in low-generation periods (BREA 2018).

### 2.1.3 Renewable energy policy framework

While the presence of renewables in the energy mix has been low, it has seen significant growth in recent years and is considered to have significant potential. This potential is reflected, and buoyed, in ambitious policy commitments.

The first renewable energy policy was introduced in 2007. In 2009, the Government of Barbados started to develop a National Sustainable Energy Framework (NSEF), which makes a case for renewable energy as relying on three pillars: (a) reduce energy costs, (b) improve energy security, and (c) enhance environmental sustainability.

A key element of the NSEF is the National Sustainable Energy Policy (NSEP), which was adopted in 2014, and establishes a target of meeting 29% of electricity needs through renewable energy sources by 2029. A further target was established in Barbados' Intended Nationally Determined Contribution (INDC), discussed below, namely, meeting 65% of peak electricity demand with renewable energy sources by 2030. The implementation of the NSEP is the responsibility of the Division of Energy, within the Office of the Prime Minister. There is also a multi-sectoral National Energy Policy Task Force, established in October 2015.

The passing of the Electric Light and Power Act (ELPA) in 2013, and the subsequent Amendment Act in 2015, was an important milestone in the pathway to achieving these targets.
Among other things, ELPA liberalises the power sector, permitting Independent Power Producers to supply energy alongside BL&P[1].

Various other entities within government have roles to play in achieving these targets, including the Town and Country Planning Development Office and the Government Electrical Engineering Department. Entities like the Barbados Renewable Energy Association (BREA) advocate for greater use of renewable energy.

### 2.1.4 Renewable energy and the private sector

While the government sets policy frameworks and provides market parameters, it is the private sector that is relied upon for energy supply.

Large companies specialising in solar PV have not yet emerged; instead, solar businesses are relatively small (though growing) components of larger companies. No licenses for Independent Power Producers have yet been granted, although demand exists following the ELPA, and BL&P is actively exploring options with the relevant government entities and the Fair Trading Commission (Todd 2018).

BL&P is a key player. The company announced in June 2017 its intention to achieve 100% renewable energy production by 2045 and, by the same year, a nationwide electrification rate of 100%.

BL&P's efforts to explore and experiment with renewable energy began in the 1990s, when the company constructed a solar PV pilot farm. These early efforts led to the emergence of the Renewable Energy Rider System, an initiative that allows eligible customers with renewable power sources to sell excess power to the grid[2] . This system was given regulatory approval by the Fair Trading Commission on a pilot basis in 2010 and a permanent basis in 2013, though in fact the third party generation and sale of electricity to the grid was only operationalised in 2015 with issuance of ELPA regulations.

In 2015, BL&P installed a new 10MW solar farm. In recent years, some other, smaller, companies and entrepreneurs have entered the solar PV field. Feed-in tariffs have not been implemented in Barbados.

1 http://www.lse.ac.uk/GranthamInstitute/law/electric-light-and-power-act-2013-and-electric-light-and-power-amendment-act-2015/
2 https://www.ftc.gov.bb/index.php?option=com_content&task=view&id=212

## 2.2 CLIMATE CHANGE AND DISASTER RISK MANAGEMENT

### 2.2.1 Climate change and extreme events

Barbados has a tropical climate, with the rainy (hurricane) season lasting from June to November, and a dry season between December and May. Recent decades have seen changes in the frequency of rainfall, with an increase in the length of dry spells. (Todd 2018). Climate change is projected to further increase temperatures, reduce frequency of rainfall, limit freshwater availability and likely increase the frequency and severity of extreme weather events (GIZ 2017).

According to Knutson et al. (2010), existing climate modelling studies consistently project decreases in global averaged frequency of tropical cyclones by 6-34%. Nevertheless, higher resolution modelling studies conclude that projections show a substantial increase in the frequency of the most intense cyclones, with shifts towards stronger storms of 2-11% increase in intensity by 2100 (Walsh et al. 2016; Knutson et al. 2010). With a high probability, the frequency of category 4 and 5 storms will increase (Knutson et al. 2010). In the long term, simulations from a range of models show that tropical cyclone frequency will not be affected much by continued global warming but mean intensity, as well as the frequency of the most intense tropical cyclones, is projected to increase (ibid.).

The main extreme weather events include hurricanes, floods and storm surges. Due to its small size, a densely populated low-lying coastal zone, and a tourism-based economy, hazards often put a large proportion of the population and capital at risk (DEM 2015). One prediction suggests that a 100-year flood event would affect 6,000 residences along the south and west coasts, and 70% of west coast hotels (DEM 2015).

Table 2 provides a summary of historical hazard exposure between 1650 and 2000. Barbados has not experienced a major climate shock since Hurricane Janet in 1965, and nothing on the scale of the catastrophic events that its neighbours have experienced in recent years. It has, however, been affected in recent decades by various climatic shocks including Hurricane Tomas in 2011 which damaged approximately 1,500 houses, caused interruptions to 80% of the island's electricity supply and resulted in approximately USD1.85m (BBD37 million) worth of damages (Grainger 2017), as well as Hurricane Matthew in 2014, and a tropical depression in 2016 which led to flooding throughout the island (Robinson and Rogers, 2018).

Table 1: Hazard events 1650 – 2000 by type (DEM 2015)

| Hazard Type | Time Period | Events | Return Period |
|---|---|---|---|
| Tsunami | 1751 – 2000 | 7 | 35.57 |
| Landslide | 1901 – 2000 | 8 | 12.38 |
| Earthquake (and felt shocks) | 1670 – 2014 | 10 | 34.40 |
| Tropical system | 1786 – 2010 | 20 | 11.20 |
| Flooding | 1886 – 2000 | 34 | 3.35 |
| Drought | 1946 – 2009 | 222 | 2.86 |

Environmental and coastal degradation, deforestation, poverty and unplanned urban development exacerbate climate risks (DEM 2015). For example, deforestation and land and coastal

degradation remove natural barriers or mediators of floods, storm surges and landslides.

### 2.2.2 Policy and institutions

This section summarises Barbados' climate change and disaster risk management policy frameworks.

#### National level

The National Climate Change Policy (NCCP) was adopted in 2012, and is aligned with the Intended Nationally Determined Contribution (INDC) which was submitted in 2015 to the United Nations Framework Convention on Climate Change (UNFCCC). The Ministry of Environment is responsible for formulating and implementing policies relating to climate change mitigation and adaptation.

The Emergency Management Act Cap 160A outlines the effective management and organisation of disasters. It calls for the development of mobilisation and demobilisation plans for emergency response, operational plans for specific types of response action, and sectoral plans that address various specific areas of work (GIZ 2017). This Act established the Department for Emergency Management (DEM) and the National Emergency Management System (NEMS).

The DEM is responsible for the development, implementation and coordination of DRM activities in Barbados. This includes ensuring the implementation of regional policies and guidelines from the Caribbean Disaster Emergency Management Agency (CDEMA). It operates through a national structure that includes District Emergency Organisations.

The contents of the NEMS are detailed in a National Disaster Plan, for whose implementation the DEM is responsible.

The NEMS is a broad-based multi-sector stakeholder mechanism comprising an Emergency Management Advisory Council and 15 Standing Committees, as well as emergency services, volunteers, NGOs, regional and international partners and the private sector (DEM 2015).

#### Regional and global level

CDEMA is the regional body responsible for coordinating planning, preparedness and response to major events. CDEMA led the development of the Caribbean Community (CARICOM)'s Comprehensive Disaster Management (CDM) strategy for 2014 – 2024. It is currently still in draft form, but is publicly available, and accompanied by a CDM management action plan and performance management framework.

The CDM strategy reflects a holistic perspective on the DRM cycle, addressing stages from risk reduction through prevention, preparedness and recovery. The strategic framework calls for enhancing disaster resilience in key sectors including "physical and environmental planning", though energy is not referred to specifically.

In December 2016, CARICOM countries reviewed their national DRR priorities and published their top three, along with five regional priorities which were[3]: early warning systems; community resilience; capacity building, training and public awareness; institutional strengthening, public-private partnerships.

Barbados has actively engaged with global DRM frameworks. The country submitted national progress reports on its implementation of the Hyogo Framework in 2010 and 2013. It also took part in a national consultation on the Post-2015 International Framework for Disaster Risk Reduction in April 2014, and endorsed a regional DRR action plan for the Americas at a Regional Platform on DRR in 2017.

3 http://dipecholac.net/annual-achievements-in-barbados/docs/disaster-risk-reduction-priorities-for-the-caribbean-region.pdf

### 2.2.3 Challenges facing climate risk management

While there is a legislative and institutional framework for DRM described above, many of the government entities whose mandate and activities influence DRM in practice (e.g.: Prevention of Floods Act, Cap 235) do not recognise or identify it as such, and therefore limit the influence and coordinating power of DRM frameworks (DEM 2015). Many sectoral areas and entities have not explicitly considered DRM in their planning and priorities; and for those that have, there tends to be a primary focus on response ('emergency management'), less on the prevention and reduction of risks and building systemic resilience. This is true in the renewable energy sector, discussed below.

Additionally, there are human resource and institutional capacity challenges around implementation and enforcement. This is also true at the regional level: while comprehensive on paper, the CDM system is under-resourced which constrains its realisation in practice (Todd 2018).

## 2.3 CLIMATE RISKS AND THE RENEWABLE ENERGY SECTOR

Private investment in renewable energy development will not be forthcoming without the appropriate risk-adjusted returns. Governments and development finance institutions (DFIs) frequently play a role in de-risking investment for renewable energy independent power producers (IPPs) (Hogarth, 2017). This report focuses specifically on climate risks, but these are only one type of risks that IPPs face. Other major risks in renewable energy projects include:

- Technological risk: Actual risks exist where new technologies have yet to be proven reliable at scale or in a specific context. 'Perceived risks' can also affect the cost of capital where investors are unwilling or unable to evaluate investments in unfamiliar technologies.
- Regulatory risks: Changes in laws or regulations may adversely affect a project.
- Political risks: Political instability or host government actions may undermine a project.
- Payment risks: The off-taker (i.e. utility) may default on payment contracts or pay late.
- Currency exchange and convertibility risks: Shifts in currency values or difficulties in converting between currencies could adversely affect a project where financing is foreign currency denominated and project revenue is in the local currency.
- Risks around land procurement and transmission infrastructure: A project may be cancelled or delayed if an IPP is not able to acquire the land on which a power plant is based or if the transmission lines required to exit the power are not constructed in time.

The energy sector is highly exposed to the impacts of tropical depressions, storms or hurricanes. Energy infrastructure is situated close to the coast on many islands which makes it susceptible to sea level rise, coastal flooding and storm surges. Generation and transmission infrastructure is above ground; and, due to the size of the islands, options for relocating assets to less vulnerable areas are limited (Grainger 2018). The sector underpins the function of many other economic areas and activities, including tourism, health and agriculture. According to Grainger (2018), 'between 1972 and 2010, approximately 70% of damages to infrastructure caused by storms and hurricanes in the Caribbean were to the transport sub sector, while 25% was to the energy subsector and the remainder to the water and sanitation sub sector'. The lack of road access after extreme weather can hinder the process of restoring transmission and the operation of generating facilities, and thus these

two sectors need to work together to increase their adaptation capabilities to extreme weather.

With Barbados beginning its energy system transition by integrating more renewable energy sources, it is important to ensure that the existing and future energy generation and transmission/ distribution infrastructure is climate resilient. In the case of a climatic shock, the power sector is highly exposed, but it is generally the transmission and distribution infrastructure that presents systemic risks. If generation units are damaged, they can be replaced relatively quickly with emergency diesel generation sets. Further, disruption to the energy sector through price fluctuations, climate shocks or other types of shock would have significant ripple effects across the economy. Reducing the vulnerability of the energy sector to climate risks is therefore crucial to resilient national economic growth. Solar infrastructure is increasingly discussed as part of the solution to the systemic risk, by designing power systems with a network of integrated ‚islanded' grids that can continue to operate when others go down, mostly powerd by solar PV and wind energy.

Barbados has made progress in mainstreaming climate change and climate risk into sectoral plans and policies, however, the focus has been on tourism and agricultural sectors with very little attention paid to critical infrastructure, in particular energy.

Government policies on renewable energy have minimal focus on disaster preparedness, response or recovery. As discussed above, however, the policy framework is still evolving and there are many gaps to fill (particularly as regards practical implementation); therefore it is a good time to be raising attention to, and advocating to deal with, this gap.

Institutions that lend financial backing to energy, mostly banks, usually put forward the majority of upfront costs of a power plant via project financing. As such, lenders bear a significant amount of risk along with the power producers themselves. Given this, banks and other lenders are likely to drive efforts to increase the resilience of larger scale wind and solar generation.

Private companies demonstrate some level of risk awareness and management. For example, BL&P considers climate change within the scope of its strategic planning and has a Disaster Management Plan which incorporates climate change considerations and is tested annually. Some measures have been implemented to improve the resilience of energy infrastructure to climate hazards. In 2004, a sea wall was constructed at one of the power stations in recognition of the impacts of sea level rise and storm surge. Equipment in the stations has also been raised to reduce the probability of damage caused by an influx of water. The company's 'Hurricane Plan' specifically focuses on response and management of those events, and dealing with impacts that typically damage transmission and distribution infrastructure, and sometimes generation infrastructure too. Procedures and measures are in place to respond to the forecasts issued by the National Hurricane Centres by implementing preparedness measures.

As the client of IPPs, and sole distributor of electricity on the island, BL&P bears the risk of supply interruptions. Going forward, as it signs more power purchase agreements with IPPs, it may include contractual clauses that require IPPs to implement similar risk management procedures to theirs.

# Piloting an Integrated Climate Risk Management Approach

# 3

## 3.1 INTRODUCING THE PILOT PROJECT

In Barbados, the ACRI+ project is working with stakeholders to improve the resilience of existing and future renewable energy generation, transmission and distribution infrastructure to climate and disaster risks. The local project partner is the Barbados Renewable Energy Association (BREA).

The project has a particular focus on opportunities for risk transfer, particularly through insurance mechanisms. The potentially catastrophic nature of climate risks in the Caribbean, particularly in the context of climate change, means that risk transfer is likely to play an important role in building resilience. This is enabled by the design of appropriate financial instruments, including insurance. Currently there are significant barriers to risk transfer in the renewable energy sector, and the project has sought to identify, assess and propose solutions to those barriers.

The project has sought to facilitate activities and conduct studies on relevant topics, and to organise multi-stakeholder consultations with key stakeholders and decision makers in the energy, disaster risk management, and insurance sectors.

Activities have included scoping and research studies, each focusing on a different phase of the ICRM cycle, and workshops with local stakeholders, for sharing information, building capacity, gathering data to inform studies and validating project outputs (October 2017, April 2018 and December 2018).

## 3.2 INTEGRATED CLIMATE RISK MANAGEMENT FOR SOLAR PV: ANALYSIS OF GAPS, ACTIONS AND ACTORS

This section demonstrates the application of an ICRM framework to support the identification of gaps and corresponding activities to better manage risk for the Barbados solar PV sector. The focus of the following analysis is on solar PV, as the energy type with the highest potential in Barbados. It includes stand-alone and grid-connected systems, from household-level installations to solar parks and utilities.

The analysis proceeds through each of the five areas of ICRM (prevention, retention or transfer or residual risk, preparedness, response and recovery). It identifies some of the main gaps that exist with regards to the solar PV sector, and suggests actions that could be taken to address those gaps. The tables are organized as follows:

- Topic/baseline: shows the particular focus area within the ICRM cycle that the gap is within
- Baseline: the current status of the topic/programme listed in the same row, highlighting what has been done through it and its strengths and weaknesses.
- Gap: describes the gaps related to the area (i.e.: the ICRM stage).
- Action: provides actions that relate to the area (i.e.: the ICRM stage).

## PREVENT

| Baseline /topic | Gap | Action |
|---|---|---|
| Availability of good quality risk data | No publicly available loss and damage data for the energy sector. This data is a necessary input to risk models that should underpin DRM strategies and instruments. | Create a claims database for all losses. Potential to build upon the National Coastal Risk Information and Planning Platform (NCRIPP) expected to be launched in September 2018.<br>The Second National Communication to the UNFCCC will also provide updated information on climate risks; it is currently in draft form.<br>Consider option of acquiring access to private sector data; e.g.: BL&P has undertaken a flood risk assessment for its facilities based on a 150 year event. |
| Availability of climate change forecasting information | Climate change projections for Barbados have been completed and are available for use by both the public and private sector. However this information could be better disseminated to ensure that both the private and public sector can incorporate the latest projections as part of their decision making processes. | Provide capacity building to relevant institutions and stakeholders for the use of climate change projections and disseminate projections to incorporate into decision making processes. |
| Risk assessments | Inconsistent approaches to risk assessment at the time of, and during maintenance of, solar PV installations. In the case of rooftop installations, the quality of the underlying roof is not always taken into account despite being a major risk factor. | Standardise and professionalise risk assessment practices, for instance through requiring certified installers / surveyors. |
| Standards for siting, construction and maintenance of infrastructure | In the case of household solar PV installations, poorly enforced planning regulations and building codes can be a key risk factor. For example, some solar panels and batteries were provided to buildings designated as hurricane shelters, but appear not to have worked well due to inadequate technical installation (Todd 2018).<br>Although many solar panels are constructed to withstand Category 3 Storms, this design specification will be insignificant if the structures to which they are affixed are not structurally sound or constructed in accordance with the building code. DEM has identified poor quality of housing, drainage infrastructure and zoning (leading to occupation of hazard-prone areas) as factors increasing vulnerability to floods, storm surge and high winds (Grainger 2017). The regulations outlined in the Caribbean Uniform Building Code published by the CARICOM Secretariat in 1985 have seen poor enforcement in the region. | Review building standards and mechanisms to ensure enforcement.<br>Review requirements for siting solar farms, including alignment with zoning and environmental impact assessments.<br>Approach to building code enforcement must be equitable; consider financial or other support to households of low means. |

## RESIDUAL RISK

| Baseline /topic | Gap | Action |
|---|---|---|
| High exposure to catastrophic risk and limits to risk retention | MSME suppliers to grid lack contingency funds and are not prepared for damaging events.<br>As a result of catastrophic events, MSME suppliers lose income from energy sales to the grid, and from having to replace units, as well as incurring costs relating to damage to units. This doubly damages their business model. For example, damage to transmission and distribution nfrastructure prevents BL&P from offtaking power produced by IPPs. | Government and private sector (and development partners) to work together to develop risk transfer solutions for suppliers, noting in particular the challenges faced by MSMEs.<br>Consider options for transferring extreme / catastrophic risk to international reinsurance markets via intermediaries (e.g.: development banks). This is in recognition of the limits of domestic insurance markets at least in the short/ medium term.<br>Enable establishment of Independent Power Producers' Association, which could improve bargaining power and collective action of renewable energy companies including MSMEs. |
| Local insurers hesitate to develop products given various perceived risks and challenges | 2017 hurricane damage to solar units in neighbouring countries has made insurance companies wary of over-exposure to solar sector.<br>[→ See row below for specific perceived risks] | Consider removing some of the highest risk to the balance sheets of international partners, to encourage domestic insurance industry participation. Ideally over time, as the domestic industry becomes more capable and confident, their risk thresholds would increase.<br>Consider options to reducing risks for local investors. For instance, BL&P could buy parts of suppliers' systems in return for reduced payments for energy supplied. Ensure risks of such actions are considered and weighed: for instance, this action could contradict the ongoing de-bundling of the electricity sector, and would involve distorting incentives for risk reduction on the part of IPPs. |
| Holistic risk assessment, beyond PV equipment alone | For home and small farm units, the roofs on which they are located present a higher insurance risk than the units themselves.<br>Acceptance and enforcement of building standards is very challenging in the region.<br>Lenders and insurers are aware of this, and it becomes a further disincentive for them to offer products. | Improve enforcement of building standards, and ensure the standards are designed in line with climate risk information.<br>Design loan and insurance products that better integrate all aspects of the risk profile – for example, ‚credit and insurance risk assessment should consider both the lifespan of the solar panels and the lifespan of the roofs they are mounted on. System of certification of solar installers and verification that units are installed by certified personnel. Lenders and insurers would require certification before offering policies. |
| Lack of understanding and technical capacity among insurers of renewable energy | Insurers feel that they lack the knowledge and information to fully understand the risks and renewable energy systems; this means they feel unable to consider whether a product is viable, and therefore to develop products at all. | Provide technical training packages tailored to needs of insurance industry.<br>Encourage dialogue between insurers and renewable energy companies. |

| | | |
|---|---|---|
| Insurance regulations | Regulations are generally not up to date, or enabling, to the trajectory and objectives relating to the expansion of the sector. In particular, regulations do not provide sufficient guidance and reassurance in relation to the diversity of suppliers to the grid enabled by the ELPA. The newly liberalised electricity market represents an increased risk of disruption to the entire grid due to the diversity of suppliers. | Creation of guidelines in conjunction for the mandatory cover of insured risk coverage for grid interconnected renewable energy generating systems (Robinson and Rogers 2018). |

**PREPARE**

| Baseline /topic | Gap | Action |
|---|---|---|
| Shock-resilient infrastructure | BL&P power and main substations were constructed to resist category 3 storms. Overhead transmission and distribution lines are designed to easily attached from poles when exposed to high winds. Also, generation infrastructure was constructed decades ago and there are concerns about its ability to withstand future climate stressors particularly given evidence that such events might increase in frequency and severity due to climate change.<br><br>For household systems, it is important to consider the resilience of the roofs and structures to which renewable energy systems are attached as well as the systems themselves. | BL&P should continue plans to upgrade or replace aging or weakened infrastructure.<br><br>Insurers of home solar units should stimulate standards covering the quality of the existing roof and its capacity to support PV panels.<br><br>The formation of two Category 5 storms in region in the 2017 hurricane season should lead to a renewed risk assessment and consideration if this scale of storm is the 'new norm'.<br><br>Pilot, and/or encourage application of, flexible systems that can be removed in the case of weather warnings eg: solar water heating systems which can be slotted in place, and easily removed, on roofs; or ground-mounted systems; or removable roof-top solar panels. This approach may be necessary in the case Category 5 hurricanes (which systems are unlikely to withstand if exposed to), and/or as a cheaper option to re-fitting household infrastructure. |
| Contingency planning | Larger companies in both the private and public sector in Barbados would at least have a hurricane plan and or a business continuity plan in place. BL&P's Hurricane Preparedness Plan ensures that some critical parts will be in stock, especially during the storm season, and its Operational Plan specific procedures. It also has a Business Continuous Plan, which arranges for staff re-deployment in case of damage. However, the same cannot be said for MSMEs as many have limited financial resources or limited capacity to develop a contingency / business continuity plans. | Provide support to MSMEs to understand their risks and develop contingency plans. An IPP association, or linkages with regional industry associations, could help with knowledge-sharing, capacity building and standard-setting. |

**PREPARE (continued...)**

| Baseline /topic | Gap | Action |
|---|---|---|
| Early warning systems | The use of the Common Alerting Protocol (CAP) for EWS in Barbados is in its start-up phase, other work in EWS has been building towards the CAP over the years. The CAPwas launched in November 2017, and is designed to allow emergency officials to share alert messages with the population using various models of communication (text messages, email, radio, TV interrupts). Alert messages currently provide generic information about an imminent event. | Alert messages should be tailored to become less generic and more helpful for renewable energy providers (Todd 2018).<br>Information provision and/or capacity-building on how to access and respond to EWS, including links to contingency plans (above). |
| Readiness of back-up power | Critical infrastructure (e.g.: health facilities and emergency shelters) need back-up power to prevent disruption to service provision. For solar to be used for this purpose, there would need to be adequate battery storage (Todd 2018). Cost-benefit analysis shows that batteries are far more expensive than generators as a back-up energy supplier; this is seen as a major factor preventing more complete conversion of the country to solar-based power. Also, reliance on batteries alone for back-up power is only suitable for short periods of time.<br>PV units on homes don't generally have any specific back-up, other than the possibility of switching back to use of electricity from the grid.<br>More technologically-advanced ways of restoring the grid through Vehicle-to-Grid or Vehicle-to-Home technologies, which could use electric car batteries, have not yet been piloted or assessed (Todd 2018). | Ensure lessons learned and, where relevant, scale-up from various programmes, for example, UNDP's Disaster Risk Assessment Management Project is installing battery backups using PV-generated power for polyclinics.<br>Explore options to roll-out captured solar combined with a battery as an approach to back-up: this may be a more effective back-up system than diesel, especially if fuel supply lines become cut.<br>For vehicle-to-grid schemes and vehicle-to-home technologies: BL&P to research and pilot costs and benefits to the grid of its financial participation in purchase of batteries for electric cars, for use as a short-term back-up grid in disaster situations.<br>Education and awareness programmes in the use of renewable energy technology as a tool to increase resilience against the impacts of climate change would be useful. There is a need to promote the success stories, best practices and lessons learned. |

## RESPOND

| Baseline /topic | Gap | Action |
|---|---|---|
| Implementation of contingency plans | (→ See contingency planning discussion above) | (→ See contingency planning discussion above) |
| Funds for rapid response | There are no substantial contingency funds in place for relief and response in general, let alone for solar PV in particular.<br><br>In general, funds would have to be requested from international partners eg: Caribbean Development Bank, World Bank, IADB. This takes time, and it is not possible to plan in advance as the amount of funds that may materialise is not clear or the conditions of their provision.<br><br>The primary interlocuter for receipt of international finance is the Ministry of Finance – so allocation depends on decisions taken there. It's unlikely that solar would be perceived as a high priority claim (Todd 2018).<br><br>Currently, it is likely that insurance ayouts to provide rapid liquidity and smooth financial impacts are either not available due to lack of viable products, or would be delayed while insurance companies deal with an unfamiliar situation with unclear payout criteria. | Develop a comprehensive disaster risk financing strategy which includes different financing instruments for different 'layers' of risk. Contingency funds could be included, along with risk transfer to deal with catastrophic risk.<br><br>Strengthen and mainstream with relevant actors the business case for allocating rapid response funds to the renewable energy sector.<br><br>Strengthen insurance coverage for renewable energy infrastructure and supply in against climate risk.<br>(→ see Section 4) |

| RECOVER | | |
|---|---|---|
| Baseline /topic | Gap | Action |
| Liquidity | Insurance companies and financial institutions need to be able to disburse funds quickly to ensure that there is access to finances to commence repairs to or replacement of infrastructure (renewable and non-renewable assets) as quickly as possible. | Explore options for insurance of lost income, as well as damaged infrastructure.<br>Improve access to emergency lines of credit for suppliers, noting the particular challenges faced by MSMEs in accessing such finance. |
| Using CCRIF insurance pay-outs for recovery | Although CCRIF funds could potentially be used to restore solar power systems, it seems unlikely that this use would be a government priority. | GIZ could explore with CCRIF the possibility of a specific solar PV restoration funding envelope, based on specific premiums paid in by government. |
| Affordability | The socio-economic implications of "Building Back Better" can be negative; the value of real estate properties and construction costs in Barbados are already considered to be relatively high and by increasing the amount of steel and concrete used during construction, this will have an impact on the ability of lower and middle income groups to purchase homes in the future. It can also result in raising insurance premiums. | Conduct a comprehensive study of the socio-economic implications of building standards, and where impacts are regressive, consider remedial actions that can be implemented without diluting building code enforcement. |

# Residual Risk

# 4

*Risk transfer instruments, such as insurance, are increasingly being used by governments, business and households to reduce the immediate and long-term losses associated with extreme weather events. They not only offer funds for post-disaster relief and reconstruction, but can also contribute to supporting ex-ante risk mitigation measures. Thus, throughout the international climate change negotiations following the Bali Action Plan, risk management and insurance have been increasingly featured as a means to advance climate change adaptation and manage risks of extreme weather events. The Bali Action Plan is "a comprehensive process to enable the full, effective and sustained implementation of the United Nations Framework Convention on Climate Change through long-term cooperative action*[4].

## 4.1 EXPLANATION RESIDUAL RISK

Residual risk is the risk that remains after prevention and mitigation activities have been undertaken. There are different ways of managing residual risk. In many cases, the risk-bearer retains the risk, meaning that they would shoulder the costs should the risk manifest in a disaster. Where the risk-bearer chooses to retain their risk, they may pursue a risk financing strategy. This could include 'ex ante' measures, in which finance is raised prior to a disaster actually occurring. Examples include precautionary savings and reserves, or arrangements for contingent credit facilities. The feasibility of these options depends upon the financial situation of the entity. 'Ex post' measures include reallocations of normal spending to cover post-disaster needs, borrowing and loans.

Risk transfer is an alternative to risk retention whereby the risk, or a portion of it, is passed onto a third party. That third party would be responsible for assuming some or all of the costs should a disaster occur. Risk transfer reduces the financial exposure of the risk-bearing entity, and can contribute in various other ways to risk management (see MCII 2017). For example, through price or other incentives, risk transfer can stimulate preventative measures that can help to reduce the overall and/or long-term impacts of shocks. Risk transfer can either be direct or indirect.

- Direct risk transfer is where the at-risk entity (individual, household, business) enters directly into an agreement with a risk-bearing entity (such as an insurance or reinsurance company).
- Indirect risk transfer involves an intermediary institution in between the entity whose risk is being transferred and the entity bearing that risk

Risk transfer is usually a rational option for managing most types of climate risk, given the potential of climate shocks to be catastrophic and covariate and therefore beyond the manageable risk retention limit for most entities.

### Financing residual risk in Barbados

Currently Barbados appears not to have a comprehensive disaster risk financing strategy that sets out different financing tools in relation to the specific role they play in risk management.

In terms of risk retention, the Government of Barbados has a catastrophe fund with an approximate balance of US$20 million, financed by national insurance contributions. The fund was established to assist homeowners whose small timber homes are uninsurable, and therefore it is not available for the renewable energy sector (though its size would be inadequate for the purposes of the sector in any case).

4 For more information see: https://unfccc.int/process/conferences/the-big-picture/milestones/bali-road-map

In terms of risk transfer, besides CCRIF SPC and traditional insurance services, there are no other mechanisms presently operating in the market designed specifically to reduce the impacts of climate change and extreme weather events.

This is a major gap: risk transfer in the form of insurance has a major role to play in renewable energy financing in Barbados. One outcome of greater insurance penetration would likely be to improve the confidence of investors in the security of their investments, hence expanding financing for new renewable energy projects.

## 4.2 INSURANCE MARKETS FOR RENEWABLE ENERGY

Barbados has a relatively well-developed financial services industry. The insurance industry accounted for around 15% of total financial assets in 2017: there are large number of entities offering insurance in Barbados, though both life and general insurance markets are heavily dominated by a few large companies. In 2017 the general insurance industry accounted for 29% of total industry assets, with the life insurance sector accounting for the rest.

### 4.2.1 Availability of insurance

#### Homeowners

To date, most renewable energy investments have been incorporated into existing home or commercial property insurance policies that cover domestic and commercial solar PV investment. The investments covered range between USD10,000 to USD250,000.

Currently, the installation of a solar PV system requires the owner to purchase public liability insurance. This requirement is stipulated by BL&P in relation to potential damages or losses incurred as a result of the PV system's connection to the grid.

As a condition of offering public liability insurance and/or coverage for panels, insurance companies require confirmation that the buildings to which solar panels will be affixed are structurally sound and can support the load of solar panels and are built in accordance with the requirements of the draft national building code.

Some insurers offer coverage to domestic and commercial customers as a (voluntary) add-on to their property insurance policy, but do not usually offer it as a stand-alone option. This constrains the options of people seeking insurance and also means that insurance isn't an option for those who do not have property insurance.

Property insurance in Barbados is mandatory only if an individual has applied for a mortgage through a financial institution for the construction or purchase of a property/asset. Therefore, once the mortgage payments have been completed, the onus is on the property owner to ensure that the property is insured after the mortgage agreement has been completed. Uninsured or underinsured properties are relatively common in Barbados. From the perspective of insurance renewable systems, this directly contributes to a significant protection gap, as well as a large underserved set of potential customers for solar PV insurance. Of course, in addition to the latter are customers who do not own a property.

#### MSMEs

SMEs and MSMEs in agriculture and fisheries sectors have indicated some demand for incorporating renewable energy within their operations. While this is good for Barbados' ability to meet its renewable energy targets, there are specific challenges that need to be addressed if this emerging market were to be adequately insured. A major challenges relates to the difficulties faced by SMEs and MSMEs in purchasing insurance coverage as they are

perceived as high risk and may have difficulty accessing finance.

### Small and medium sized solar farms

Large companies specialising in solar PV have not yet emerged in Barbados; instead, solar businesses are relatively small (though growing) components of larger companies. These cases are discussed in the section below.

Small and medium-sized private solar farms typically perceive non-climate related threats as the most urgent, such as theft and damage to units. They would usually use risk reduction measures other than insurance to address these threats, such as such as installing fences and security cameras (Todd 2018).

If they choose to however they can use insurance as an additional or alternative means of protection. Coverage is provided by the general insurance market for generation plants, solar farms and associated assets within the plant and any assets situated within 300m of the generation plants.

However, insurance is not currently available to cover all risks. Most solar farms generate income to recover their investment cost through selling power to the grid. If units are damaged, their replacement cost can be insured, and recovered, but currently not the income loss; which could render them non-viable or at least greatly delay the return period. Insurance to cover such loss of income does not appear to be available, and therefore this may be perceived as a disincentive by those who might otherwise be interested in establishing solar farms.

### Larger companies, including utilities

The gap in the insurance market for renewable energy is particularly clear at the utility scale, referring both to the availability of products and the role that utilities are anticipated to play in meeting the country's renewable energy goals. Investment in wind, waste-to-energy and biomass for example, will largely take place at the utility scale (Robinson and Rogers 2018).

Larger companies who invest in solar operations perceive the risk associated with the latter as relatively small, within the scope of their overall risk profile. The cost of insuring systems is included within broader policies, and as such as the specific risk from solar is seen as marginal (Todd 2018). For instance, BL&P incorporates its solar operation within the risk management approach of its overall power generation, transmission and distribution operations.

As described above, the general insurance market provides coverage for assets within and close to plants. BL&P power plants (including generators), and infrastructure outside the plants, are insured against flooding and tropical storms/hurricanes, through traditional commercial insurance coverage.

The general insurance market does not, however, provide coverage for damages caused to transmission and distribution infrastructure as a result of climate-related perils. The costs of underwriting these losses are perceived to be excessively high. These results in a protection gap for energy companies.

To address this protection gap, BL&P established a self-insurance fund in 1993. The decision to retain the perceived risk confirms the point made above, that large companies like BL&P perceive the size of the risk associated with solar as small in relation to its overall operations.

The fund is resourced by annual contributions legislated by government. In July 2016 the fund was reduced to USD22 million, following an analysis undertaken by the company and its Canadian owner (Emera) showing that it had become over-subscribed. It is understood that the fund and contributions are to be re-assessed in the light of the 2017 hurricanes in the region, however (Todd 2018).

### 4.2.2 CCRIF – SPC

Barbados is a member of the Caribbean Climate Risk Insurance Facility Segregated Portfolio Company (CCRIF-SPC). This is a regional risk pooling scheme that allows governments to purchase insurance coverage for a range of catastrophic climate events. Barbados has policies relating to hurricane, excess rainfall and earthquake risk. The country has received three pay-outs worth around USD11.5m in total, in 2010, 2014 and 2016 (GIZ 2017).

Currently, there is no arrangement whereby CCRIF funds are specifically directed to the renewable energy sector. The use of pay-outs is determined by the Ministry of Finance, and it is very unlikely that in the event of a pay-out, this sector would be considered a high priority. In the case of the USD1.28m pay-out for excess ranfall in 2014, the money was directed for use by the Ministry of Public Works for repair work (GIZ 2017).

It would be possible to explore options for carving out an arrangement whereby a certain envelope of pay-out funds would be designated for the sector. The potential value of a catastrophic risk insurance facility for the sector was underscored by the destruction of renewable energy facilities in Antigua and Anguilla in 2017, and noting the growing importance of RE generation for electricity and transportation across the region. This type of discussion has a precedent. In 2009/2010, CCRIF collaborated with the Caribbean Electric Utility Services Corporation (CARILEC) to develop a product to provide catastrophe coverage for power companies which are members of CARILEC. The coverage would be offered through a separate captive insurance company independent of CCRIF's current operations. However, there were a number of unresolved questions which hindered the finalisation of a new product was unsuccessful. Some of the main issues that appear to have halted progress on discussions are: (1) the method by which the facility would be capitalized and (2) what should be the structure of governance for the facility (Grainger 2017).

### 4.2.3 Supply side challenges

While the industry has experience with lending for solar water heaters, beyond this its experience in financing renewable energy projects is limited. This is particularly true in the area of insurance: there is a clear absence of standard insurance products available that address the specific risks associated with the renewable energy sector, particularly at utility scale (Robinson and Rogers 2018). There is also a scarcity of products offered specifically to deal with climate risks.

Local insurance companies currently perceive insurance for solar PV as higher risk than other types of consumer loan, and lack the information and enabling environment to serve the renewable energy lending market effectively and efficiently. Risks are perceived to be technological and financial, the latter resulting from lack of insurance, and the latter exacerbated by policy uncertainty (Robinson and Rogers 2018).

**Specifically, challenges include:**

- Lack of understanding of the technology and associated risks.
  Lending institutions and insurers state a need for greater understanding of the technology, availability of systems, spare parts, maintenance requirements and risks.

- Lack of capacity to design products
  Linked to a lack of understanding of the sector is difficulty creating appropriate insurance products. In general, companies are not sure what needs to be insured as part of the loan package – the panels, the whole system and/or installation costs? Further questions relate the determination of pay-outs, which could be done in various ways such as according to replacement cost at installation or taking into account depreciation over time.

- Inadequate enabling conditions for enforcement and compliance
  Companies involved in financing and/or insuring solar systems feel that they lack systems to protect their interests by reducing basic risks. In particular, they lack the expertise or personnel to ensure the physical quality of the panels, check quality of installation, inspect electrical connections and systems. They would like to see a formal certification system in place, where certificates could be a requirement for loan qualification, and regular maintenance could be built into insurance renewal processes. This is also desirable for BL&P, for whom stability of supply is a key concern in relation to connecting personal solar units to the grid. The current system of documents and agreements does not currently cover reliability questions.

- Difficulty securing loans
  Loan companies are currently treating funding of solar systems as if they are car loans, repaid over a six-year period. However, these loans are treated as unsecured, as it is not clear that the used systems have a resale value. It is complicated for lenders to take a lieu on other assets such as property. This contributes to perceived high risk.
  International support to accelerate loans (such as an internationally-financed loan guarantee fund) is not a feasible option in the short-term given the state of public finances in Barbados.

- Lack of reinsurance
  Improved access to reinsurance would likely have an important stimulus effect on the local solar PV insurance market. Local companies perceive that their potential exposure to catastrophic climate risk is too high to be financially viable, and therefore the presence of reinsurance would enable them to reduce their exposure through risk transfer. However, the presence of international reinsurance to support the local solar PV insurance market has so far been limited.

## 4.3 AN INTEGRATED RISK MANAGEMENT APPROACH

Insurance is only one component that contributes towards reducing risks and should be used with other risk management, particularly risk reduction, measures in order to reduce vulnerability. Some of these risk reduction measures include enforcement of building codes, preparation and use of hazard maps, vulnerability assessments on climate impacts and public awareness campaigns on the impacts of natural hazards.

Although progress with regard to the role played by the insurance industry in the expansion of solar PV in Barbados is shown to be necessary, it is also clear that there are other critical areas where substantial improvements must be made. Some of these were described in Section 3, in relation to the various stages of the ICRM cycle. For example, relating to improvements in technology, improvements in law enforcement and improvements in data on risks and damages.

As Todd (2018) points out, whilst some of these are susceptible to technical solutions, there remain fundamental challenges in the governance of renewable energy, and particularly the solar PV sector as the frontrunner. While there are signs of progress in recent years, with the ELPA and its amendments and the willingness of the government to engage with the private sector, further work is needed to convince investors that the renewable energy sector is a viable option.

# Implementation Plan

# 5

*This "implementation plan" is presented in the format of a table with a general gap area, a more specific gap area, some actors who could be responsible for addressing the gap, and some next steps or 'actions' that could be taken to address that gap.*

The implementation plan builds upon the outcomes of a stakeholder validation workshop carried out in Bridgetown in December 2018 (→ *See Annex A*). Specifically, it builds upon conclusions reached at the workshop with regards to suggested actions to facilitate financing and extreme weather insurance for Solar PV and renewable energy technologies in general. This exercise was a preliminary consultation and should thus not be taken as a conclusive implementation plan but as a useful starting point to activate progress on achieving an integrated disaster risk financing approach for renewable energy in Barbados. A more comprehensive implementation plan would require a more in depth, lengthy, consultation with all relevant stakeholders and would follow-on from this starting point.

The implementation plan is intended to be complimentary to the gap analysis shown in Chapter 3, which focuses more generally on achieving ICRM in Barbados and the gaps and actions needed to achieve that. It is also intended to be complimentary to the activities that GIZ and MCII are continuing to implement in Barbados, as well as the activities of other development partners in the Caribbean region.

## Table 2: Implementation Plan (by Gap Area)

| Access to Information, Awareness & Capacity Building | | | |
|---|---|---|---|
| Specific Gap | Action | Period | Actor/s |
| Lack of adequate communication channels and knowledge gaps in and across renewable energy sectors is needed to allow multi-sectoral approaches for institutional framework building (e.g. exchange forums) | 1. Initiate partnerships (1) between academia & private sector for R&D and innovation on challenges from the renewable energy sector or (2) academia, BREA (NGOs) and government agencies to conduct in-depth research on disaster risk management solutions and renewable energy, or (3) academia, emergency management, the meteorological office and the renewable energy sector. | Short-term | STPI, University of West Indies, BCC, etc. |
| | 2. Design and consultation of innovative communication and educational tools to raise public awareness on renewable energy technologies. For example, the creation of an online platform to facilitate the sharing of data on renewable energy systems. | Short-term | BIDC, BREA |
| | 3. Create sector specific coordination for improved exchange. The National Inter-Sectoral Coordination Mechanisms (NICs) of the United Nations Environment Programme offers a best practice model (UNEP). | Short-term | UNEP |
| | 4. Creation of renewable energy research topics, pursued across the education spectrum. | Short-term | University of West Indies |
| Lack of energy efficient tools that allow reliable recovery systems (e.g. tools like water tanks, electric pump) in case of an incident | 1. Establishment of Best Practices in terms of energy usage & efficiency & conservation. | Medium-term | BREA, BL&P, BWA |
| | 2. Collaboration between different utility and RE agencies to facilitate more efficient use of emergency/recovery tools. | Short-term | BREA, BL&P, BWA |
| Vulnerability of disaster response management such as adequate battery storage (DEM having capacity for emergency powers etc.) | 3. Energy disaster management planning should be integrated into the national energy policy. | Medium-term | Ministry of Energy, DEM |
| | 4. The need for research on renewable energy systems to determine how long they can hold up to corrosive (salt water) conditions in Barbados. | Short-term | University of West Indies |

| Access to Information, Awareness & Capacity Building (continued...) | | | |
|---|---|---|---|
| Specific Gap | Action | Period | Actor/s |
| Insufficient public understanding of the full scope of renewable energy technologies, batteries safety & insurance options<br>Need for public education and awareness, including about 2030 target and what it means | 1. Explain what it means to be 100% renewable as well Barbados' climate change goals for the public. Breakdown of national energy and climate change goals to the wider public and what is required on day-to-day operations to achieve the goals . | Short-term | GoB, BREA |
| | 2. Comprehensive programme for measuring and tracking the process of energy efficiency and renewable energy, of which the public can be kept abreast in a transparent manner. | Medium-term | Ministry of Energy |
| | 3. Integrate renewable energy in public education and awareness programmes and on the educational curriculum. This can be supported establishing a public education fund. | Long-term | Ministry of Education, NGOs, BREA |
| | 4. Identification of technical capabilities and trainings in schools, and of youth and vulnerable groups. | Short-term | BREA |
| Resolution of local information | 1. Extend elements of the Disaster Risk and Energy Access Management (DREAM) project of the Energy Division from the community level to the national level. | Short-term | Ministry of Energy |
| Technical challenges (local) of Energy Monitoring Systems (EMS) to integrate EMS information for further RE deployment<br>Innovation support (locally) for renewable energy technologies and support of innovation by local practitioners | 1. Make use of a best practice identified at the Barbados Light & Power, which is mapping the location of existing RE systems and uploading the information on a software. This information can be further used to conduct vulnerability assessments on existing energy infrastructures and ultimately leads to product design and development of post disaster recovery solutions. | Medium-term | BL&P, BIDC, DEM, BREA |
| | 2. Establish RE innovation hubs for local practitioners and provide financial incentives to support new technologies. | Medium-term | Ministry of Finance, NGOs, BL&P |
| Insufficient replacement equipment for energy infrastructure in case of disasters | 1. Assess and monitor replacement equipment needs for energy infrastructure and establish effective international and regional relationships to access such equipment needs. | Long-term | DEM, BL&P, BREA, CDEMA |
| Climate resilient communities (Solar Projects) | 1. Promote community level PV installation and pilot more community driven energy projects to gain valuable experience in decentralized energy support systems. | Medium-term | BL&P, INGOs, NGOs, DEM, Ministry of Energy |
| Lack of joint forces across RE sector stakeholders to enable capacity building of (local) government entities | 1. BREA should partner with the Ministry of Environment and Future Centre Trust for educational and public awareness purposes. | Short-term | BREA, Ministry of Environment |
| | 2. Stakeholder cooperation's on standards, specific implementation goals, monitoring & control. | Medium-term | tbd. |
| | 3. Implementation of recommendations from past and ongoing projects and policies. | Medium-term | tbd. |

| Legislation & Technology | | | |
|---|---|---|---|
| Specific Gap | Action | Period | Actor/s |
| Lack of enforcement of building codes and standards | 1. Legislate existing standards with the Barbados National Standards Institution. | Long-term | GoB, TC |
| | 2. Compliance with sector specific professional standards and mandatory compliance of the building codes for all new construction with permission required for new RE installations. | Medium-term | Insurance Agencies, BAPE Engineers |
| Lack of climate resilient Solar PV system installation | 1. Cooperation between Utility & PV installers to achieve network resilience. | Medium-term | Ministry of Energy, T&C |
| | 2. Regulate future buildings be fitted with energy efficient solutions. | Medium-term | Planning Office, Installers |
| Energy grid infrastructure (distribution, centralized) | 1. Setting up micro-grids to break up the transmission of energy, possibly per parish, and the installation of batteries (back-up). | Long-term | Ministry of Energy |
| | 2. Establish appropriate agreement with independent power producers during state of emergencies. | Long-term | Ministry of Energy |
| Need for greater transparent market participation | 1. Initiate team-based competitions to find solutions for specific problems involving the private sector, NGOs and the state. | Ongoing | Private sector, NGOs, MoEn, MoEdu, MoIndustry |

| Finance & Insurance | | | |
|---|---|---|---|
| Specific Gap | Action | Period | Actor/s |
| Lack of stable electricity price | 1. Establish a fixed term Feed-In-Tariff framework for various renewable energy technology options. The temporary Fixed Feed-in Tariff needs to be extended from the current 10 years to at least 20 years, the average lifespan of a RE system. | Short-term | Fair Trade Commission, BL&P |
| Access to Insurance / Insurance uptake<br>Knowledge and capacity of local insurers to understand the renewable energy sector, and thus the parameters of product design | 1. Introduction of a RE insured Risk training program for underwriters to assist with them with the upsurge in RE insurance business over the next decade. | Short-term | BIDC, CGI, GIAB, Sector Professionals, MoFin |
| | 2. Creation of a claims data database for all losses. | Short-term | |
| | 3. Providing information and/or training to local companies would help to build their understanding and also be a means to understand in more detail their concerns. It may be possible to work with development partners or development banks to finance and design these types of activities. | Short-term | |
| | 4. Creation of guidelines in conjunction with the GIAB and FSC for the mandatory cover of insured risk coverage for grid interconnected RE generating systems. This recommendation is essential as in the new liberalized market with distributed generation and independent power producers now all forming part of the island's energy network, as opposed to a single entity in the form of a utility company. There is now increased risk of disruption to the entire due to the diversity of the power generation suppliers. | Medium-term | |
| Poor (local) investment climate and lack of specific financial instruments | 1. Introduction of a RE financing training programme for financial institutions to capitalize on the increase in reinvestments over the next decade. Creation of a new financing instruments ideally suited from a credit risk perspective for the small to medium sized Renewable Energy Investments of less than 500kw of installed capacity and less than BDS$2,000,000.00 in value. This will require the extension of loan maturities to at least 10 years, as well as the possible reduction in interest rates. | Short-Term | Ministry of Finance, Credit Unions, Local Finance Institutions, etc. |
| | 2. Creation of a Technical Working Group on RE Financing and Insurance. The working group should include senior officials from the Ministry of Energy, Fair Trading Commission, Insurance Industry, Banking and Credit Union Industry, GIZ and BREA. | Ongoing | |
| | 3. Creation of an internet based online matching platform that links producers, installers, service and maintenance providers, insurers, financing organizations and the government. BREA can source the financing as the concept and blueprint are already available. | Short-term | |

| **Finance & Insurance** (continued...) | | | |
|---|---|---|---|
| Specific Gap | Action | Period | Actor/s |
| Design and enforcement of formal certification systems for small-scale renewable energy systems | 1. Establishment of an insured risk assessment quality assurance and installation inspection checklist for systems in Barbados. This checklist will be completed by independent installers/ inspectors in the Renewable Energy industry and will assist in assuring insurers and financial institutions that the assets and investments will be insuring, and financing are comprised of the appropriate quality and installed to the requisite technical standards to provide the stated returns and durability. | Medium-term | RE Suppliers, Installers, BL&P, MoEn |
| CCRIF payouts being used for response or recovery to renewable energy infrastructure | 1. Engage CCRIF-SPC to explore options for allocation of future pay-outs to support response and recovery in the renewable energy sector. A business case for doing so should be explored and should prioritise those areas of renewable energy which are of high national priority, for instance grid-linked systems and/or those linked to essential services such as hospitals and water supply. This business case would need to be communicated to the Ministry of Finance. Working at a regional level, for instance through CARILEC, would present a more diversified and thus attractive portfolio to CCRIF-SPC or other reinsurance vehicles. | Long-term | CCRIF, GoB, CARILEC |
| Availability of reinsurance | 1. Comprehensive engagement with reinsurers is critical to the successful introduction of the types of insurance products required by the sector. An engagement process will ensure reinsurers are aware of the gaps and changes to the sector, and of the role that they need to play in stimulating the local insurance market. Given the small size of the country's economy, it is likely that international reinsurers would need to be engaged. | Short-term | GIAB |

## 5.1 KEY ACTORS

Grainger (2017) identifies the following actors as relevant to the topic of climate risk management in the renewable energy sector, and hence to the implementation of the recommendations discussed already.

| Topic | Sector | Organisations |
|---|---|---|
| Energy | Government | Energy Division, Office of the Prime Minister |
| | Utility | Barbados Light and Power company (BLP): mixed ownership |
| | Government/Utility | National Insurance Scheme (minority shareholder of BLP) |
| | NGO | Barbados Renewable Energy Association |
| Climate Change | Government | Ministry of environment and drainage<br>Ministry of Foreign Affairs: |
| | NGO | Caribbean Community Climate Change Centre |
| Disaster Risk Mngmnt. | Government | Department of Emergency Management |
| | International organisation | Caribbean Disaster Emergency Management Agency (CDEMA) |
| | Private Sector | Caribbean Risk Managers (CaribRM) |
| | Government/Regulator | Financial Services Commission |
| | NGO | Caribbean Climate Risk Insurance Facility (CCRIF) and CARIBISAVE |
| | Private insurers | [Various] |
| Sustainable Tourism | Government | Ministry of Tourism: |
| | Private Sector | Barbados Hotel and Tourism Association |
| | International organisation | The Caribbean Tourism Organization (CTO) (Tourism development agency) |
| | Private Sector | Caribbean Hotel and Tourism Association |
| Donors | International organisation | Caribbean Development Bank<br>UNEP CEP Caribbean Environmental Programme<br>UNDP (Barbados and Outer Eastern Caribbean States)<br>International Finance Corporation<br>United Nations Office for Disaster Risk Reduction<br>USAID |

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# Annex A

*ICRM Validation Workshop & Toolkit Training – 4th December 2018*


Flyer of ICRM Workshop, December 4th, 2018


Eike Behre from GIZ


Kerry Hinds from DEM

Dirk Kohler from MCII in discussion with participants

Participants discuss ICRM measures for PV installations

# Annex B

## SWOT Analysis of the Barbadian RE Sector

Source: ICRM Validation Workshop & Toolkit Training, 4th December 2018, Marriot Hotel, Bridgetown (Organiser: BREA, GIZ, MCII)

| S Strengths | W Weaknesses |
|---|---|
| • Strong climate (energy) policy and political will<br>• Good conditions for renewable energy production backed by strong national energy policy<br>• Expertise in the area of renewable energy technologies (RETs) and the ability to install the technology<br>• General recognition of the benefits and importance of RET<br>• Renewable energy is captured in corporate goals of many companies<br>• Space available for solar farms<br>• Clients interest in alternative energy production and development<br>• Willing insurance sector to develop appropriate products<br>• Solar and wind resources – Barbados' natural resources. The country has wind and a very high solar irradiance<br>• Cadre of existing renewable energy and industry professionals<br>• High availability of local capital being accessible through credit unions<br>• High availability of donor funds for specific work in the renewable energy sector and climate action<br>• The clear articulation of Government's new vision towards 100% renewable energy by 2030 has created the opportunity for the development of businesses<br>• Progress with the current project (GIZ ACRI+). Buy-in from the utilities, insurance sector and, for the most part, the financial sector | • Access to finance and insurance for RET<br>• Lack of capacity and knowledge sharing among local stakeholders<br>• Limited knowledge of disaster risk management for RET<br>• Many SMEs operate informally and likely do not access insurance<br>• Limited reinsurance coverage for RET and underwriting capacity of local insurers<br>• Knowledge gaps between technical and financial institutions<br>• Lack of adequate information sharing hindering access to funds in credit unions and from donors<br>• Insufficient collaboration across the RE sector and at the ministry level<br>• New industry – lack of appetite in RE sector<br>• Lack of effective legislative framework to mandate insurance of RE systems<br>• Inadequate building and installation standards and insufficient enabling environment<br>• Incentives from financial sector – ordinary Barbadians do not have the disposable income to purchase a renewable energy system<br>• Finance sector vs. client's needs. (Insurance costs, interest rate to purchase PV systems, affordability of the RE systems<br>• Limited expertise in the insurance industry about the RE sector<br>• Availability of renewable energy jobs |

| O | Opportunities | T | Threats (Risks) |
|---|---|---|---|
| | • Ongoing work on industrial investment policy with a green policy component<br>• Global Agreements + National Energy Targets<br>• RE integrated into Comprehensive Disaster Management work program (DEM)<br>• BIDC and other institutions already have a captive audience (clients) to inform, trade and advise about RETs<br>• Research and Development<br>• High price of petroleum products presents opportunity for RE advancement<br>• Energy efficiency must be viewed as a first-case implementation strategy<br>• Government's 2030 policy objective is an opportunity for growth in the sector, including in the areas of research and development<br>• Policy commitments & open Data<br>• The creation of policy commitment towards open data sharing. The National Inter-sectoral Coordination Mechanisms (NICs) of the United Nations Environment Programme offers a best practice model (UNEP)<br>• Electrical Vehicles<br>• Environmental Benefits<br>• Employment opportunities<br>• Cost advantage - offer more tax incentives for PVs<br>• Multi-sector teamwork | | • Householders and businesses buy-in of RET as an area of investment<br>• Climate Vulnerability<br>• Limited understanding of the vulnerability of RET to specific hazards (local)<br>• Costs to acquire and maintain RET<br>• Lack of continuity of corporate objectives due to leadership changes (Government of Barbados)<br>• Lack of knowledge and unwillingness of persons to take insurance seriously<br>• Limited availability of space for RETs / Small size: -saturation, -land availability<br>• Lack of an aggressive entrepreneurial spirit in the RE sector<br>• Focus on the oil sector<br>• Lack of policy coordination within and across ministries and sectors<br>• Potential loss of government revenue as a result of the transitionary approach<br>• Lack of product development<br>• Critical Human Resources (Retrenchment)<br>• Oil Price Development / Barbados remains at the mercy of the oil market.<br>• Lack of diversity with RE systems with the predominant focus on solar PV<br>• Possible loss of expertise due to public sector layoffs. |

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## About ACRI+

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## About GIZ

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH offers customized solutions to complex challenges. GIZ is an experienced service provider and assists the German government in achieving its objectives in the field of international cooperation. GIZ offers demand-driven, tailor-made and effective services for sustainable development.

## About MCII

The Munich Climate Insurance Initiative (MCII) was launched in April 2005 in response to the growing realization that insurance-related solutions can play a role in adaptation to climate change, as advocated in the Framework Conventionand the Kyoto Protocol. This initiative brings together insurers, experts on climate change and adaptation, NGOs and policy researchers who intend on finding solutions to the risks posed by climate change. MCII provides a forum and gathering point for insurance-related expertise on climate change impact issues. MCII is hosted at UNU-EHS in Bonn, Germany.

www.climate-insurance.org/projects/advancing-climate-risk-insurance-acri

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ACRI+

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