
MAINSTREAMING CLIMATE CHANGE INTO BELIZE'S DEVELOPMENT PROCESS

A succinct assessment of
climate change risks and adaptation opportunities for the
Tourism, Coastal Zone and Fisheries Strategies

An integral part of the Project
“Enhancing Belize’s Resilience to Adapt to the Effects of Climate Change”,
supported by the EU Global Climate Change Alliance (GCCA)

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March 2015



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Executive Summary

Climate change poses serious risks to the meeting of the Millennium Development Goals. However, development planning still rarely considers climate related risks, jeopardizing the success and long-term sustainability of the development efforts. Small islands and low lying states are particularly vulnerable. Belize's economy depends on agriculture, fishing and to a very significant degree, tourism and related industries; all these sectors, among others, are highly vulnerable to various climate change impacts ranging from extreme weather events, namely cyclical hurricanes and floods, to the rise in sea level and concomitant consequences such as coastal erosion and intrusion of saltwater into aquifers. The EU funded Global Climate Change Alliance (GCCA) and UNDP have developed a project entitled "Enhancing Belize's Resilience to Adapt to the Effects of Climate Change", which supports the mainstreaming of climate change into sectorial plans. [1]

The aim of this process is to identify key risks from climate change to the coastal zone management, tourism and fisheries sectors, as well as opportunities for adaptation and building resilience, to the sectors in general but also specifically with regard to the main, respective Strategies or Plans [1.1]. While there may be limited financial resources in the Belizean public sector to invest in building capacity, develop protective systems and invest in mid- and long-term adaptation projects and activities (as opposed to quick response measures, such as disaster response and recovery) with the view to decreasing vulnerability and increasing resilience to climate change, there are in fact various studies, research initiatives, donor-supported projects and institutions concerned with climate impacts to the country and region which provide a sufficiently justified support to the identification of measures and design of suitable adaptation projects [1.3]. This report takes into consideration a varied methodological approach, including interviewing senior representatives of stakeholding institutions, workshop discussions with professionals from different sectors as well as civil society and private sector organizations, informal meetings with hotel operators and site visits, as well as desk study and research into available literature [1.4]. The main methodological approach for reporting on climate risks and corresponding adaptation recommendations was the UNDP Quality Standards for the integration of adaptation into development planning [3].

Belize, which as a typically moist tropical climate subject to tropical cyclones and hurricanes from July to October [2.1] has witnessed through historical records an increase in air temperature, reduction in precipitation and increase in sea level; floods and storms contribute the most to International Reported Losses and Average Annual Losses [2.2]. Climate projections point to increase in temperature, reduction in precipitation, increase in sea surface temperature and increase in the intensity of tropical storms and hurricanes. [2.3]. However, given the small size of Belize, and the complexity of climate interactions, there is a degree of uncertainty that must be considered when interpreting Global Circulation Model and Regional Climate Model data [2.4].

Integrated Coastal Zone Management counts with a strong and well fundamented Plan [4], which clearly identifies climate risks [4.1] and opportunities [4.2] pertinent to the coastal zone, which is therefore also useful to inform climate integration considerations for the Tourism [5] and Fisheries [6] sectors, which have insufficient, or no, climate change information or resilience enhancing considerations in their respective Strategy documents. The Tourism sector in particular, given its very significant importance to the Belizean economy [2.4], and considerable climate risks and vulnerabilities [5.1], should have a strong climate risk screening and adaptation planning strategy, especially in the present crucial phase of strong growth scenarios, yet there are issues with enforcement of building guidelines, and eco-performance of buildings and facilities [5.3]. The Fisheries sector is presently developing its own Strategy document [6.3]; it has a more

passive role in being affected by climate impacts and risk [6.1], as opposed to being a sector which through its development focus can lead to aggravated climate vulnerability. Proper observation of fishing stocks, and management of artisanal and commercial fishing, are appropriate strategies to risk vulnerabilities to health and livelihoods from fishing, which sector is inextricably linked to the health of the coral reef system and other biological and natural physical coastal resources.

A series of recommendations are proposed [7] in order to reduce vulnerability, improve adaptation and resilience, and improve as well Belize's competitiveness in the tourism sector by focusing on optimizing eco-efficiency in the use of energy and water resources, as well as improving building performance.

1. Introduction

Climate change poses serious risks to the meeting of the Millennium Development Goals. However, development planning still rarely considers climate related risks, jeopardizing the success and long-term sustainability of the development efforts. Small islands and low lying states are particularly vulnerable. Belize's economy depends on agriculture, fishing and to a very significant degree, tourism and related industries; all these sectors, among others, are highly vulnerable to various climate change impacts ranging from extreme weather events, namely cyclical hurricanes and floods, to the rise in sea level and concomitant consequences such as coastal erosion and intrusion of saltwater into aquifers.

The United Nations Development Program (UNDP) has made climate change an institutional strategic priority, as has the EU. The EU funded Global Climate Change Alliance (GCCA) and UNDP have developed a project entitled "Enhancing Belize's Resilience to Adapt to the Effects of Climate Change"¹, which supports the mainstreaming of climate change into sectorial plans. The project is implemented by the UNDP with the Ministry of Forestry, Fisheries and Sustainable Development (MFFSD) and the National Emergency Management Organization (NEMO), with a budget is EUR 3.2 Million project. The project focuses on the following national priorities for climate change mainstreaming: Tourism, Health, Municipal Development, Fisheries and Coastal Zone Management.

Global climate change is the most serious threat to sustainable development facing CARICOM states.
CCCCC. 2009

1.1. Objectives

This report and its underlying assessment is undertaken as a component of a consultancy to mainstream climate change into a sub-set of these sector specific development programs, which are interconnected and all highly sensitive to climate change:

- Coastal Zone Management;
- Tourism
- Fisheries

The aim of this process is to identify key risks from climate change to these sectors, as well as opportunities for adaptation and building resilience, to the sectors in general but also specifically with regard to the main, respective Strategies or Plans. The project also focussed on opportunities for climate mitigation, that is to say, reduction in emissions of carbon and other greenhouse gases (GHG). Given the irrelevant overall contribution by Belize to global GHG emissions (422 kt CO₂eq, a statistical 0%, in 2010²), climate mitigation opportunities identified are framed as opportunities for enhancing competitiveness through optimization of consumption of resources for which a carbon impact can be calculated, such as energy and water, i.e. opportunities for eco-efficiency.

There have already been various projects, reports and research findings on climate change and Belize, focussing in particular on issues pertaining to vulnerability and adaptation opportunities, by international organizations, regional programmes as well as civil society organizations (see below).

¹ More detailed information can be seen on the respective website of the GCCA:

² [World Bank data: <http://data.worldbank.org/indicator/EN.NTVC.OE.KT.countries>](http://data.worldbank.org/indicator/EN.NTVC.OE.KT.countries)

The objective of this particular assignment was not to carry out a listing of the climate related projects undertaken in the country, nor to focus or expand on adaptation or mitigation opportunities already identified in existing literature. Rather, and taking into consideration the constraints of time resources allocated, the objective was to identify climate change mainstreaming opportunities which had not been readily identified in other projects, focussing primarily on strategic, institutional, juridical or capacity building initiatives as opposed to concrete physical project needs (such as building of sea defences or supporting coral regrowth schemes).

1.2. Belize in context

Belize is a Central American country but with strong ties to the Caribbean region. It has 8 800 sq mi of land, but approximately half its population of 340 844 live along the coastal zone. The country has among the lowest population density in Central America but the second highest growth rate³. Though it is a continental country, it is listed as a Small Island Development State (SIDS). Belize has a significant coverage of marine and land protected areas, the 2nd largest coral reef and abundant mangrove and seagrass coverage along its coastal area.

An upper middle income country (GNI of USD 4 510 in 2013), the country's economy has suffered from stagnant growth and impact of natural disasters, particularly affecting key agricultural export crops such as citrus fruits. National debt is high and fiscal pressures constrain public sector investment decisions by policymakers. Poverty in Belize has actually increased: from 2002-2009, the overall poverty rate increased from 34% to 41%, with extreme poverty reaching 16%. Originally a predominantly agriculture-based economy, the services sector now accounts for about 60% of GDP. Agriculture, in particular citrus and sugar, now account for only 10% of the GDP but over 50% of total exports⁴ and is an important source of livelihoods.

The importance of tourism cannot be understated. According to the 2014 Annual Research by the World Travel & Tourism Council (WTTC, 2014), this activity generated 13.5% of Direct Contributions to GDP in 2013, but more than a third (36.6%) of Total Contributions to GDP. With a forecast growth of between 4.4 and 4.5% per annum, this sector is forecast by 2024 to achieve 16% of Direct Contributions, and 43.7% of Total Contributions to GDP (see Figure 1). Travel & Tourism makes a Direct Contribution of 12% of the total employment in Belize, but the Total Contribution to employment, including jobs indirectly supported by the industry, was of 33% of all jobs registered (2013 values).

³ Data from CIA World Factbook, August 2014

⁴ World Bank data extracted from <http://www.worldbank.org/en/country/belize/overview#1>

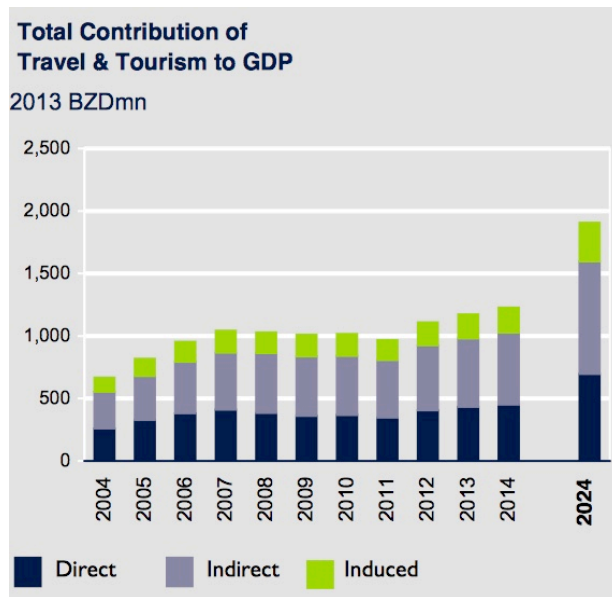


Figure 2 Total contribution of Travel & Tourism to GDP
 Source: extracted from WTTC, 2014

Belizean tourism’s comparative advantage is largely supported by its natural resource assets. In addition to attractive beaches and climate, it has diverse ecosystems and many interesting terrestrial and marine species. The Mesoamerican Barrier Reef system in particular is a key asset. Belize has 300km of reef, which is considered to be generally well preserved. There are about 70 species of hard coral, 30 of soft coral, 500 fish species and hundreds of invertebrate species identified, but over 90% of the reef is still to be researched⁵. This is a very significant natural resource which sustains both fisheries and tourism industries, and naturally provides ecosystems services and physical protection to the coastal zone. In contrast to Caribbean island states, Belize has also several natural parks and a very rich cultural heritage with various historic sites, of Mayan origin in particular, which make the country a very attractive destination not only for coastal activities but also inland pursuits.

Belize’s main development challenges stem from high vulnerability to external shocks, including terms of trade, natural hazards and impacts of climate change⁶. These can include cyclical hurricane damage, tidal waves, floods and wind damage, as well as sea level rise and associated threats to coastal areas and aquifers, and cause significant threats to human life, economic activities and integrity of ecological systems.

“Horizon 2030: Planning our Future Together 2010-2030” is the key long term national development framework for Belize. Published in 2011, it identifies climate change and its potential impact on the country as “critical” and emphasizes that sustainable management of the natural resources requires planning that takes into account the “potential adverse impacts of climate change” (Barnett *et al*, 2011, p60). The “Growth and Sustainable Development Strategy” for Belize, a hybrid effort joining the strategy for sustainable development with a poverty reduction strategy paper for a 5 year period, is presently underway and due for cabinet review in June 2015. This will be a key Strategy document for the country.

⁵ Belize Barrier Reef Case Study. Westminster.edu. Retrieved October 2011
<http://www.westminster.edu/staff/athrock/BELIZE/Reef.html>

⁶ World Bank Belize Overview: <http://www.worldbank.org/en/country/belize/overview#1>

1.3. Managing Climate Change Support

While there may be limited financial resources in the Belizean public sector to invest in building capacity, develop protective systems and invest in mid- and long-term adaptation projects and activities (as opposed to quick response measures, such as disaster response and recovery) with the view to decreasing vulnerability and increasing resilience to climate change, there are in fact various studies, research initiatives, donor-supported projects and institutions concerned with climate impacts to the country and region which provide a sufficiently justified support to the identification of measures and design of suitable adaptation projects (ex: Caribsave *et al*, 2014; Caribsave 2012, Chatenoux & Wolf, 2013). Some official Belizean Strategy documents also provide a sound exploration of natural resources, their characterization, vulnerabilities and recommendations for sustainable management; a case in point is the Integrated Coastal Zone Management Plan (CZMAI, 2013). In other words, there are presently enough data and information to support a greater emphasis on improving the country's ability to prepare for (ex ante) and contend with (ex post) the effects of climate change.

For instance, at an institutional level, the **National Climate Change Office (NCCO)** provides economic, social and environmental expertise and coordination support as the Focal Point for climate related issues and initiatives on behalf of the Government of Belize; the NCCO is subordinate to the Ministry of Forestry, Fisheries and Sustainable Development and works closely with other key Ministries and agencies, such as the Ministry of Natural Resources and Agriculture (MNRA), and the Tourism Board (BTB). Belize hosts the **Caribbean Community Climate Change Centre (CCCCC)**, which has been operational in Belmopan since 2005 after approval by CARICOM with the mandate to “address the impact of climate variability and change on all aspects of economic development through the provision of timely forecasts and analyses of potentially hazardous impacts of both natural and man-induced climatic changes on the environment, and the development of special programmes which create opportunities for sustainable development”⁷ and provides an archive and very interesting clearing house resource⁸ for regional climate change data and documentation. **UNDP** is a key implementation agency in Belize with regard to Climate Change projects through its Environment & Energy Program, including the implementation of the “Enhancing Belize’s Resilience to Adapt to the Effects of Climate Change” Project by the GCCA, of which this reporting process is a part. But there have been and are other larger scale projects to promote climate adaptation and resilience in Belize, in particular to its natural capital base including the coastal zone and its biodiversity, such as the very recently approved project financed by the Adaptation Fund (Box 1, below).

⁷ <http://www.caribbeanclimate.bz/mission/mission.html>

⁸ <http://clearinghouse.caribbeanclimate.bz>

Belize Marine Conservation and Climate Adaptation Project by the World Bank

Recognizing the significance of the Tourism sector in Belize, and the importance of marine conservation for this sector *inter alia*, this project aims to strengthen the climate resilience of its Barrier Reef and support “sustainable alternative livelihoods”. Concretely, the marine conservation and climate adaptation project seeks to:

- Increase the number of hectares of marine and coastal protected areas;
- Promote and provide sustainable alternative livelihoods for fishing communities adversely impacted by climate change;
- Raise awareness on the impact of climate change, as well as build capacity and train fishing communities in business and other technical; skills including mari-culture and eco-tourism.

The 5-year project was very recently approved (March 2015) by the Adaptation Fund, which finances USD 5.31 Million of a total budget of USD 7.31 Million, the remainder being matched by the Government of Belize.

Full details on the Project can be seen on the World Bank’s Projects & Operations webpage: <http://www.worldbank.org/projects/P131408?lang=en>

Box 1 Belize Marine Conservation and Climate Adaptation Project (World Bank)

1.4. Methodological approach

As referred above, the objective of this report is not to research existing literature and present an exhaustive list of mitigation and adaptation opportunities for Belize, but rather propose specific opportunities for mainstreaming climate into strategies, planning or legislation which may not have been already dealt with, for the sectors of Tourism, Fisheries and Coastal Zone. For instance, the Caribsave Climate Change Risk Atlas (Caribsave, 2012) already provides an interesting sectorial analysis of Vulnerability and Impacts Profile for Belize (Section 4), Adaptive Capacity Profile (Section 5) and Recommended Strategies, both for cross-cutting issues (including climate mainstreaming into planning, policy and practice) as well as for sectors (Chapter 6).

Background information for this analysis and to support the recommendations comes from a range of sources. In addition to a desk study of relevant reports and websites and the key subjacent sector Strategy documents or Plans, meetings with representatives of relevant, stakeholding Ministries and other agencies were held during a work mission in Belmopan and Belize City in February 2015, as well as field missions along a significant extent of the coastal zone and to San Pedro, and in the interior of the country, organized by the National Climate Change Office. Also, and importantly, a training seminar on climate mainstreaming and sector-focussed workshops were held in Belize City, which brought together professionals representing the sector Ministries and Agencies, as well as private sector and civil society representatives. During these sessions, these qualified participants were able to present their group results of quick assessment of vulnerabilities and opportunities for adaptation and enhancing resilience. This enabled an informal and pragmatic understanding of “needs assessment”, as felt by the Belizean participants, on issues of culture, society, passing and enforcement of legislation, future perspectives, etc.

The approach to identifying, in a succinct way, the climate hazards and sensitivities which result in concrete risks, and the identification of adaptation opportunities, checks for maladaptation, and comment on the viability of sector Strategy documents or Plans, follows the general methodological guidance developed by the UNDP, the “Quality Standards for the integration of adaptation to Climate Change into Development Programming”. This is described in Section 3, below.

The three sectors under study – Tourism, Fisheries and Coastal Zone Management – in fact overlap in that they all cover the coastal zone; therefore, the analysis of climate risks to the three is similar, though there are different risks to each sector from the same climate hazards (for instance, sea level rise may not be a serious threat to sea grasses, but it is to tourism infrastructure). However, Tourism also includes inland interests; conversely, fisheries sector is also concerned with economic stocks and biodiversity away from the coastal zone.

For each sector and respective Strategy document under analysis, adaptation or resilience promoting ideas are provided in a very succinct way in the “Adaptation opportunities” box (Sections 4-6). However, where several adaptation ideas can be joined in such a way as to substantiate the development of a project, activity or strategic or legislative recommendation, these are described in more detail in Section 7, Recommendations, for further consideration by the Belizean stakeholding authorities and development into actual programs for action. Climate mainstreaming, adaptation and mitigation ideas presented are thus derived from reading of available literature, personal meetings with representatives of relevant Belizean institutions, and perceptions gained from informal discussions with Belizeans in the interior of the country and along the coastal zone.

2. Climate Profile for Belize

2.1. Climate Profile

Situated at latitude of 16-18°N, Belize has a typically moist tropical climate. There is little seasonal variation in temperature, but distinct 'wet' (May to October) and 'dry' (November to April) seasons. In the wet season, mean monthly rainfall can be 150 to 400 mm, with highest rainfall totals in the south. In the dry season, most of the country receives less than 100 mm of rainfall per month. The coastline of Belize is also vulnerable to Atlantic tropical cyclones and hurricanes from July through to October. Heavy rainfalls accompanying these storms contribute a significant fraction towards the high wet-season rainfall totals.

Mean annual temperatures are 23-27 °C, varying little with season through the year. The south-west, interior region of the country tends to be a little cooler than regions in closer proximity to the coast. Inter-annual variations in climate in southern Central America are caused by the El Niño Southern Oscillation (ENSO). El Niño events bring relatively warm and dry conditions between June and August, and decreased frequencies of Atlantic tropical cyclones, whilst La Niña episodes bring colder and wetter conditions at that time of year, and more frequent than average tropical cyclones⁹.

The current climatic characterization of Belize is properly reported and in more detail on the webpage of the National Meteorological Service of Belize¹⁰. A good, succinct description of Geography and Climate of Belize can be found in Caribsave, 2012.

2.2. Historical Trends

The National Meteorological Service of Belize¹¹ has been collected data since 1981 when Belize became independent. As with the rest of the CARICOM¹² members the mean annual temperature has increased by 0.45 °C since 1960, in average rate of 0.10 °C per decade. The average rate of increase is most rapid in the wet seasons at 0.14-0.15 °C per decade and slower in the dry seasons at 0.08-0.09 °C per decade. The annual rainfall over Belize has decreased at an average rate of 3.11 mm per month per decade since 1960. The percentage of rainfall that falls in heavy events has not increased significantly since 1960¹³.

Climate change information from recently observed climate data sources are documented in Caribsave, 2012, and summarized below (Box 2).

⁹ http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/UNDP_reports/Belize/Belize.lowres.report.pdf

¹⁰ <http://www.hydromet.gov.bz/climate-summary>

¹¹ <http://www.hydromet.gov.bz/climatology>

¹² <http://www.caricom.org/>

¹³ http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/UNDP_reports/Belize/Belize.lowres.report.pdf

Recent trends in climate variables for Belize

Temperature: Observations from the gridded temperature datasets indicate that mean annual temperatures over Belize have increased at an average rate of 0.11°C per decade over the period 1960 - 2006. The observed increases have been more rapid in the seasons JJA and SON at the rate of 0.15°C and 0.16°C per decade respectively.

Precipitation: Gridded observations of rainfall over Belize do not show statistically significant trends over the period 1960 - 2006. Long-term trends are difficult to identify due to the large inter-annual variability in rainfall in Belize.

Wind speed: The available observations are insufficient to determine trends in winds speeds around Belize.

Relative humidity: Observations from the HadCRUH show statistically significant decreasing trend in relative humidity over the period 1973 - 2003 in Belize only in the MAM season (-0.47% per decade).

Hours of sunshine: The number of 'sunshine hours' per day are calculated by applying the average clear-sky fraction from cloud observations to the number of daylight hours for the latitude of the location and the time of the year. The observed number of sunshine hours, based on ISCCP satellite observations of cloud coverage, indicates statistically significant increase only in DJF sunshine hours in Belize by 0.57 hours per decade over the period 1983 - 2001.

Sea Surface Temperature: The HadSST2 gridded dataset does not indicate statistically significant trend in sea-surface temperatures around Belize over the period 1960 - 2006.

Temperature Extremes: Extreme hot and cold values are defined by the temperatures that are exceeded on 10% of days in the 'current' climate or reference period. This allows us to define 'hot' and 'cold' relative to the particular climate of a specific region or season and determine relative changes in extreme events. The frequency of 'hot' days and 'hot' nights has increased significantly since 1960 in all seasons in Belize. The frequency of mean annual 'hot' days has increased at the rate of 4.25% hot days per decade with the strongest increase in JJA (by 4.99% of hot days per decade) between 1960 and 2006. The frequency of mean annual 'hot' nights has increased by 2.37% of hot nights per decade with the strongest increase in DJF (by 3.56% of hot nights per decade).

Rainfall Extremes There is insufficient daily observational data to identify trends in all aspects of rainfall extremes in Belize. The magnitude of maximum 5-day rainfall shows increasing trend of 5.37 mm per decade over the period 1960 - 2006.

Hurricanes and Tropical Storms Several analyses of global and more specifically North Atlantic hurricanes have indicated increases in the observed record of tropical storms over the last 30 years. It is not yet certain to what degree this trend arises as part of a long-term climate change signal or shorter-term inter-decadal variability. The available longer term records are riddled with inhomogeneities (inconsistencies in recording methods through time) - most significantly, the advent of satellite observations, before which storms were only recorded when making landfall or observed by ships. Recently, a longer-term study of variations in hurricane frequency in the last 1,500 years based on proxy reconstructions from regional sedimentary evidence indicate recent levels of Atlantic hurricane activity are anomalously high relative to those of the last one- and-a-half millennia.

Sea Level Rise

Observed records of sea level from tidal gauges and satellite altimeter readings indicate a global mean SLR of 1.8 (+/- 0.5) mm yr⁻¹ over the period 1961 - 2003. Acceleration in this rate of increase over the course of the 20th Century has been detected in most regions.

Box 2 Recent trends in climate variables for Belize

Source: combination of climate data sources, published in the Caribsave Climate Change Risk Atlas (Caribsave, 2012)

Storms and floods are a significant threat to human life and economy in Belize. Storms, in particular, comprise the most frequent “Internationally Reported Losses”, i.e. disasters which result in 10 or more people reported killed, 100 or more people reported affected, declaration of a state of emergency and/or call for international assistance (Figure 3). However, it is floods and wind damage that most contribute to the hazard Average Annual Loss of USD 93.73 Million in Belize (Figure 4), an indicator of the expected loss per annum associated to the occurrence of future perils assuming a very long observation timeframe.

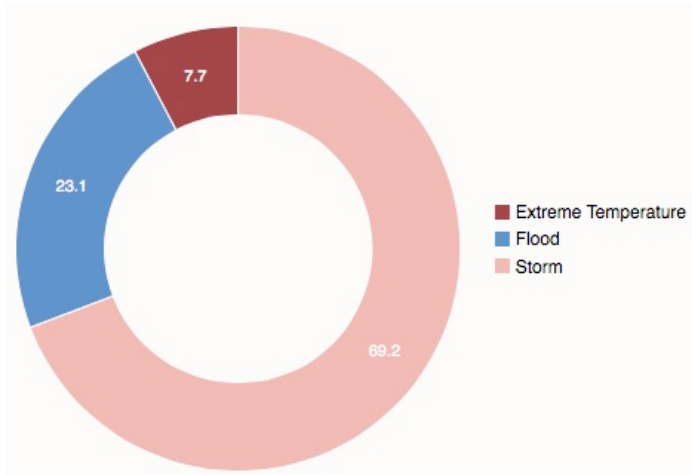


Figure 3 Frequency of International Reported Losses 1990-2014
 Source: OFDA/CRED International Disaster Database
www.emdat.be Université Catholique de Louvain Brussels

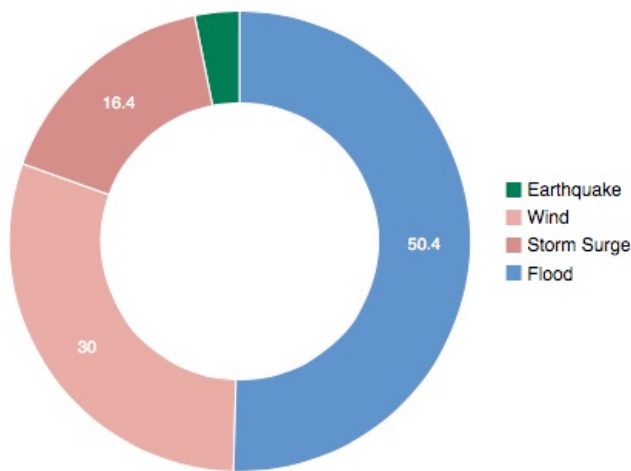


Figure 4 Hazard contribution to Average Annual Loss
 Source: Preventionweb¹⁴ (United Nations Office for Disaster Risk Reduction)

¹⁴ <http://www.preventionweb.net/countries/blz/data/> extracted 10 May 2015

2.3. Projections

It is outwith the remit of this report to provide an exhaustive account of climate projections for the region in general or Belize in particular, which can be consulted in the 2nd National Communication to the UNFCCC by Belize (Gordon, 2011) and more recently CCCRA (2012), Chatenoux (2013) and IPCC (2014). However, to frame the context for the recommendations made in subsequent Sections, the following summarized projections are provided, following the Regional Climate Models and Global Circulation Model projections described in the Climate Change Risk Profile for Belize (CCCRA, 2012) with the caveats of uncertainty mentioned in 2.4, below.

Synthesis of Climate Modelling Projections for Belize

Temperature: Regional Climate Model (RCM) projections indicate **increases between 3.5°C and 3.6°C** in mean annual temperatures by the 2080s, in the higher emissions scenario.

Precipitation: Global Climate Model (GCM) projections of rainfall span both overall increases and **decreases, ranging from -34 to +13 mm per month** by 2080 under a higher emissions scenario. Most projections tend toward decreases. The RCM projections, driven by HadCM3 boundary conditions, indicate large decreases in all seasons (-26%) and decreases of (-32%) with ECHAM4.

Sea Surface Temperatures (SST): GCM projections indicate increases in SST throughout the year. Projected **increases range from +0.8°C and +2.7°C** by the 2080s across all three emissions scenarios.

Tropical Storms and Hurricanes: North Atlantic hurricanes and tropical storms appear to have increased in intensity over the last 30 years. Observed and projected increases in SSTs indicate potential for **continuing increases in hurricane activity** and model projections indicate that this may occur through **increases in intensity of events** but not necessarily through increases in frequency of storms.

Box 3 Synthesis of Climate Modelling Projections for Belize

Source: Caribsave Climate Change Risk Atlas (CCCRA, 2012)

Sea level rise is a very important climate change factor for small island states, Belize included. Consecutive IPCC reports have indicated that not only is the level of the sea rising, the increase is accelerating. CCCRA, 2012 refers to a series of projections for sea level rise from the IPCC 4th Assessment Report. However, these are superseded in the very recent 5th Assessment Report (IPCC, 2014). Even under intermediate-low emissions scenario, sea level is expected to rise 0.5 – 0.6m for 2081-2100 relative to 1986-2005 (CDKN, 2014). But these modelling scenarios are considered too conservative by some scientists; Rahmstorf (2007) forecast, based on models corrected for the accelerated melting of the large ice sheets, that sea level could increase by up to 1.45m by 2100, for the Caribbean, relative to 1980-1999.

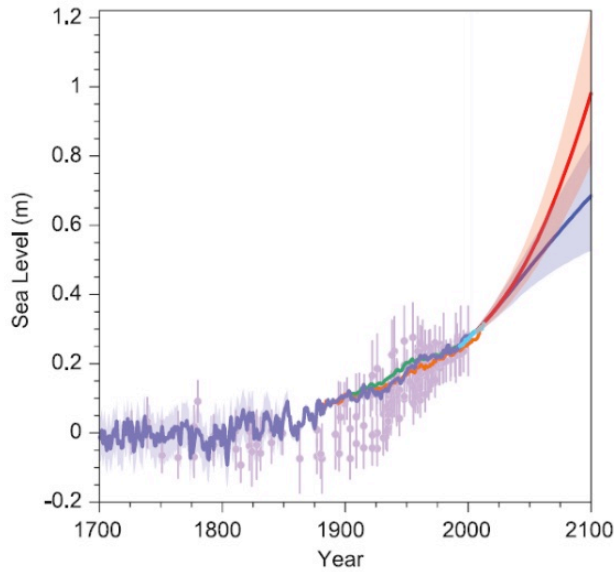


Figure 5 Projected global sea level rise according to the IPCC report of 2013, for 2 scenarios (RCP8.5 (red) and RCP2.6 (blue))

Source: IPCC 5th Assessment Report, Fig 13.27

2.4. Uncertainty

The degree of uncertainty about future climate projections constitutes a challenge for the determination of adequate and cost-efficient measures of adaptation to climate change. Global Circulation Models (GCM) process enormous quantities of data according to complex algorithms in order to generate climate projections in accordance with certain assumptions or hypothetical scenarios. But GCMs do not have sufficient resolution to take into consideration small areas, such as many of the islands of Belize, they have a larger “footprint” and the margin of uncertainty increases as we decrease the spatial scope of the GCM analysis. Accordingly many projections are done on the ocean surface and do not consider the physical influences of the earth’s surface (Christenson et al, 2007). Projections may diverge, although they commonly point in a single direction to a particular trend, as can be seen from forecasts for the increase in temperature or sea level rise to 2100. In some cases, uncertainty is significant, and it renders the interpretation of degree of vulnerability of a particular system, sector or community, and identification of adaptation measures, particularly difficult.

Therefore, it is important when considering measures to support adaptation or resilience to climate change that concepts such as “no regrets policies” and “precautionary principle” are understood and integrated. Climate science, and in particular the models which simulate and project future climate conditions, are in continuous development, subject to improvements in the algorithms as well as in the number of datasets, therefore increasing their complexity and accuracy.

The projections considered in this report (2.3 above) rely on an ensemble of 15 Global Circulation Models and a Regional Climate Model (PRECIS) which step-down the climate projections to a finer spatial scale, for a number of variables based on IPCC standard “marker” scenarios (A2, A1B and B1), published in the CCCRA.

2.5. Sensitivity and Vulnerability

Sensitivity to various hazards and environmental risks gauges the for min which nature and humans (if considered separately) are impacted by climate change. Sensitivity should not be considered exclusively as a function of climate factors, as it is interconnected and exacerbated by other factors, such as environmental degradation and poor management of environment and natural resources, thereby exposing systems to increased vulnerability.

There are various definitions of vulnerability in the literature, depending on the perspective of the user. Vulnerability can be described in different forms by persons or agents interested in Climate Change Impacts, Hazards and Disasters, or more generically, in terms of Sustainable Development (Malone, 2009). The most recent IPCC definition is suitable: “the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.” (CDKN, 2014). It is a function of the characteristics, magnitude and the rhythm of climate change to which a system is exposed, its sensitivity and capacity to adapt (IPCC, 2007).

The most recent reports by the IPCC (Intergovernmental Panel on Climate Change) were published in late 2014 (Fifth Assessment Report). The volume, “Climate Change 2014: Impacts, Adaptation, and Vulnerability” (IPCC, 2014) has an abundant information from the most up to date science about the matter, including as applicable for the Caribbean. The Climate & Development Knowledge Network provides an accessible summary of this major compendium, focussed on SIDS including in the Caribbean: “The IPCC’s Fifth Assessment Report: What’s in it for Small Island Developing States?” (CDKN, 2014).

Sector-specific issues of climate sensitivity and vulnerability for the Fisheries, Coastal Zone and Tourism sectors are addressed in Sections 4 – 6, below. Major “external stressors” to the Caribbean SIDS were identified in a recent UNIGE/GRID-Genève report (Chatenoux, 2013) as being:

- Sea level rise;
- Elevated sea surface temperature;
- Tropical cyclones;
- Ocean acidification;
- Coral bleaching;
- Overfishing;
- Anthropogenically-derived pollution of coastal zones.

All but the last 2 of these stressors are clearly climate related, though Coral bleaching is a likely result of climate change impacts and not a climate stressor itself.

3. Methodological approach – UNDP Quality Standards

There are various methodologies, approaches and tools to help identify and assess climate risks to development processes, as well as opportunities for adaptation, building resilience, and avoiding maladaptation¹⁵ (Olhoff & Shaer, 2010). The recommendations for climate mainstreaming, adaptation and mitigation (through promotion of eco-efficiency) in this study have been arrived at following the methodological approach entitled “UNDP Quality Standards for the integration of adaptation into development programming”, still in a draft phase, but which has been used in a few cases of climate screening exercises. Developed to assist the assessment and integration of climate change risks and opportunities into development cooperation through UNDP, the “Quality Standards” can also be applied to projects, programs or national (or sectorial) Strategy documents.

The UNDP Quality Standards offers a simple, logical way to organize the risk screening process and communicate results. There are 4 basic steps to the Quality Standards (Figure 5), though a quick screening process (such as that used in this study) usually considers only the 1st and 4th. The 2nd and 3rd steps are considered for more in-depth analysis of climate change risks, where other assessment processes, such as Environmental Impact Assessment, can also be incorporated.

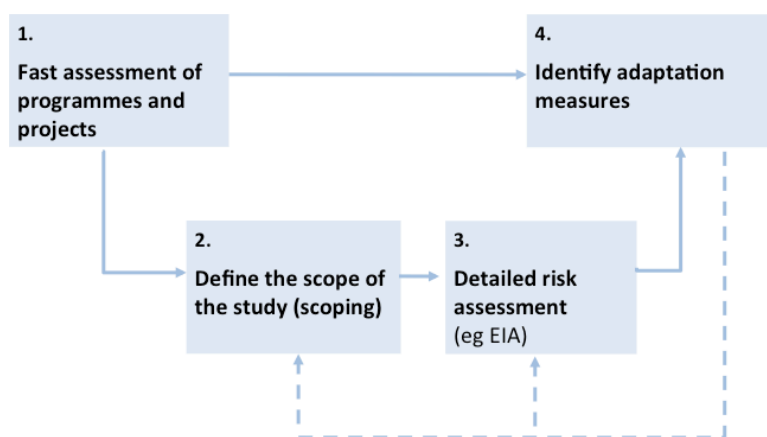


Figure 6

Conceptual model of the UNDP “Quality Standards for the integration of adaptation to climate change into development programming”

Source: UNDP, 2011

There are 4 “Quality Standards” in this methodology:

- 1. Identification of climate risks to the strategy, plan, program or project**
Climate change risks to viability and sustainability of the object of study;
- 2. Identification of mal adaptation risks;**
Identify instances and preventive measures to avoid the strategy, program or project increasing sensitivity or vulnerability to climate change;
- 3. Identification of adaptation opportunities**
Including facilitation of adaptation through synergies with existing or planned initiatives;
- 4. Identification and assessment of potential adaptation measures**
Activities which have the potential to adapt development to climate change, reinforcing sustainability of measures and avoiding mal adaptation.

¹⁵ The UNDP publication “Screening Tools and guidelines to Support the Mainstreaming of climate Change Adaptation into Development Assistance – a Stocktaking Report” presents a comparative analysis of different approaches and tools to assess or diagnose risks and integration of climate change into development processes.

The results are considered according to the following matrix, which, depending on the communication style, will anyway focus on the most relevant aspects (risks, adaptation opportunities, mal adaptation avoidance, etc).

Climate Change Risks	Adaptation Opportunities
Sensitivity to climate change	Feasibility in light of climate change
Climate hazards	Opportunities for adaptation and to reduce vulnerability
Climate risks	Identification of risks of mal-adaptation of the policies or strategies that were proposed, or of the adaptation measures themselves
	(Costs of proposed measures, prioritization, monitoring & evaluation protocol....)

Table 1 Matrix of climate risk and opportunities, adapted from the UNDP Quality Standards

Climate change does not always bring negative impacts – positive opportunities, such as favourable conditions for new crops, reduction of conditions of pests and disease carrying agents, improved conditions for harnessing renewable energy resources - may also arise and competitive advantages can accrue for those prepared to take advantage of the new conditions.

Although not a component of this particular study, there may also be subsequent analysis of available instruments to support adaptation initiatives. For instance, climate finance through the Clean Development Mechanism or other carbon markets, can support the viability of mitigations measures such as demand-side energy efficiency or production of electrical from renewable sources. Mitigation measures may themselves contribute directly to an improvement in adaptation to climate change. Enhanced thermal insulation of buildings, in particular for the tourism sector which is an intensive user of energy, can be considered both a mitigation as well as adaptation measure. Human-powered or even solar-powered pumps for irrigation in rural areas is another example. Carbon finance may have a role to play in supporting some such activities, especially, but not exclusively, in energy, tourism, domestic and road transport projects.

4. Coastal Zone Management

4.1. Climate risks

Sensitivity	The coastal zone can be generally considered to be highly sensitive to climate change impacts and hazards; these are amply presented in the Belize Integrated Coastal Zone Management Plan 2013 (CZMAI). While beach erosion, water supplies, coral health and other issues are highly sensitive to climate change and vulnerability, mangrove and sea grass are, in fact, quite resilient and can over time adapt to climate change, offering natural protection to the coastal area from various climate impacts. Key vulnerability to these specific natural resource assets are primarily from development pressures, as opposed to climate change factors.
Hazards	Hurricanes and tropical storms, storm surges, strong winds, increased sea surface temperature, acidification of sea, sea level rise are all relevant hazards, discussed in the Belize Integrated CZMP.
Risks	Belize is significantly dependent on its coastal zone for economy and biodiversity, through tourism, fisheries and agriculture. A significant proportion of the population live on or next to the coastal zone and are at risk of intense storm events, especially given the lack of attention to building codes and minimum required standards or of flooding events (especially Belize City). Damage to quality of the coral reef system, which is difficult to avoid from the effects of water acidification and projected increase in sea surface temperature, will bring significant risks to tourism and fisheries by affecting the whole biodiversity system which the reefs sustain.

4.2. Opportunities for adaptation

Feasibility	The Coastal Zone Management Plan sets out an assessment of risks, management options and institutional responsibilities, which are well considered. Its success will be determined by the level to which it can clarify and enforce guidelines and regulations (see Section on Recommendations), especially in face of the push from very strong Tourism growth promotion as well as development sites along the coastal zone.
Adaptation opportunities	<p>The Coastal Zone Management Plan presents and discusses various adaptation approaches already. More emphasis on mapping of sea level rise and impacts to low lying coasts, obliging planning guidelines for licensing new housing and tourism developments would relieve pressure on coastal resources and reduce risks to lives and livelihoods as well as investments.</p> <p>Promotion and support of the development of a strong tourism base inland is both an interesting opportunity for the Tourism sector (hedging risks by diversifying attractions and facilities) as well as a defensive strategic orientation for the Coastal Zone Management sector.</p>

4.3. Climate integration in sector strategy document

The key Strategy document for this sector is the Belize Integrated Coastal Zone Management Plan 2013 (CZMAI, 2013) published by the Coastal Zone Management Authority and Institute (MFFSD). Under the motto “Promoting the Wise, Planned Use of Belize’s Coastal Resources”, the document provides an extensive characterization of Belize’s coastal zone (Section 1), its value for different interests such as tourism, coastal development and fishing (Section 2), and coastal issues for national action (Section 3). The Plan dedicates considerable attention to Section 4: Vision for a Sustainable Coast, which includes encouraging sustainable coastal resources use and integrated development planning.

The Integrated Coastal Zone Management Plan acknowledges climate change throughout. It addresses climate change adaptation as a coastal issue for national action (Section 3) and dedicates a part of Section 4 - Vision for a Sustainable Coast, to socio-ecological vulnerability and resilience, socio-economic adaptation capacity (including generalist recommended adaptation strategies for each sector Ministry) and prioritization of eco-systems based adaptation.



Figure 7 Coastal zone management is faced with aggravating challenges from climate change, including more frequent storms and sea level rise, damaging natural and infrastructural coastal defences.

5. Tourism sector

Tourism is the most important economic sector in Belize and the largest earner of foreign exchange. The Belize destination marketing strategy has wisely taken advantage of the country's natural capital as its unique selling proposition, focussing primarily, though not exclusively, on its Barrier Reef System and the biodiversity that it generates. The National Sustainable Tourism Masterplan 2012 -20130 identifies 100 main tourist sites, of which nearly half are natural attractions (natural parks, caves, wildlife sanctuaries, marine areas), 45% are cultural attractions (mainly Mayan heritage sites) and the remainder are entertainment facilities. Yet most of the tourism facilities and infrastructure are located very close to the coast and have sub-optimal energy efficiency conditions, rendering them exposed to climate factors and running higher operational costs than necessary, affecting competitiveness of the units, sector and destination itself.

5.1. Climate risks

Sensitivity The tourism industry is largely developed along the low-lying coastal zone; about 60% of tourism in Belize is directed to San Pedro, resulting in a high sensitivity and vulnerability of tourism infrastructure to sea level rise and storm effects (Belizean tourist clusters are mostly situated in the path of hurricanes and tropical storms). Other threats are from flooding, storm surge and high winds, but also beach erosion. Belizean tourism capitalizes on its natural asset base for tourism; while there is not much evidence of particular sensitivity of inland tourism sites to climate change, the coral system is sensitive and one of the key attractions sustaining Belizean tourism.

Hazards Sea level rise is a major threat to Belize, as with other Small Island Developing States, resulting in significant risks to infrastructure which is straddling the coast in low lying areas. Increased sea surface temperature and acidification threatens the health of coral reef systems. Storms and strong winds can hamper access to port facilities by incoming passenger ships. Between 1980-2010 Belize suffered 13 events (9 storms, 3 floods and 1 extreme temperature event¹⁶). Storm events are registered approximately every 2 years. Poor accessibility over land in some areas decreases capacity to manage disaster response.

Risks The following risks to tourism attractions and infrastructure, as well as beach area losses, are projected from sea level rise according to CCCRA models (CCCRA, 2012):

		Tourism Attractions		Transportation Infrastructure		
		Major Tourism Resorts	Sea Turtle Nesting Sites	Airport Lands	Major Road Networks	Seaport Lands
SLR	1.0m	73%	44%	50%	4%	40%
	2.0m	86%	60%	-	6%	-
Erosion	50m	95%	100%	-	-	-
	100m	100%	-	-	-	-

¹⁶ <http://www.preventionweb.net/english/countries/statistics/?cid=18>

SLR Scenario	Caye Caulker		Rocky Point		San Pedro	
	Beach Area Lost To SLR (m ²)	Beach Area Lost (%)	Beach Area Lost To SLR (m ²)	Beach Area Lost (%)	Beach Area Lost To SLR (m ²)	Beach Area Lost (%)
0.5m	723	17%	6112	75%	7375	19%
1.0m	3424	96%	1251	90%	10147	45%
2.0m	180	100%	788	100%	18662	93%
3.0m	-	-	-	-	2596	100%

Adverse impacts due to extreme climatic events and sea level rise (such as coastal erosion, reef degradation, mangrove loss, and inundation) in existing vulnerable locations are likely to increase, and new areas, both coastal and inland, will be affected (IDB, 2015). The Integrated Coastal Management Plan identifies a series of risks from climate change to the coastal zone, including impacts which are relevant to the tourism sector.

5.2. Opportunities for adaptation

Feasibility Belizean tourism, overwhelmingly concentrated and dependent as it is on the coastal zone, beach and reef, may eventually suffer with the health

- Adaptation opportunities**
- Subsidization of energy efficiency products (appliances, double glazed windows, etc) or retrofits (insulating solar-exposed walls, roofs)
 - Tourism sector services curriculum development by Ministry of Education, including climate impacts and adaptation responses;
 - Reinforcement of Inland tourism options in Belize’s tourism promotion. This will hedge the present dependency on coastal tourism in the case / when the health of the coral reef system shows signs of damage. The country has an excellent natural resource base and historic/cultural offering. An adequate offering of tourism facilities such as hotels and B&Bs, as well as other commercial establishments such as restaurants and bars, will be necessary to support new visitor influxes. Some high quality hotels are already providing a good offering. Though investment will be made by private sector there are various ways in which public institutions and policy can be supportive: a) incentives for tourism investments in the interior (fiscal, licensing, etc) (facilitates market entry), b) increasing the promotion of inland tourism in international campaigns and publicity (increases market)



Figure 8 The San Ignacio Resort, San Ignacio
Photo courtesy Sérgio Teixeira Santos

Avoidance of maladaptation

There are several maladaptation concerns for the tourist sector:

- Intense growth in tourism offerings along the coastal zone (13000 or more beds in the next 15 years) will put pressure on coastal resources, and reduce the pristine nature of Belize's coastline, which is a clear differentiating factor relative to other key Caribbean states, i.e. it undermines the exclusivity which differentiates the country from regional tourist powerhouses like Cancun.
- Unclear, inexistent or unenforced laws or guidelines on building distances from the shoreline will risk infrastructure non-performance over time due to storm damage and sea level rise. This results in at least 2 consequences which are against the country's interest: a) abandoned or damaged infrastructure damages the aesthetic quality of Belize's tourism destinations, shows poor planning and hurts the country's image, and erodes real estate and investment value; b) increases maintenance and report costs by facility owners, leading to increasing prices and an overall reduction in competitiveness of the sector relative to other regional destinations.



Figure 9 Resort in San Pedro, still in construction, straddling the coastline
Leaves little more than one metre between the high water tide mark and the infrastructure limit.

Photo courtesy Sergio Teixeira Santos

5.3. Climate integration in sector strategy document

The National Sustainable Tourism Master Plan (BTB 2011) acknowledges Belize's vulnerability to natural hazards and climate change (hurricanes, storms, flooding...), however there is little emphasis on climate integration at the strategic or operational level throughout the document. Sub-programs are identified that deal with fresh water supply and management (1.1.2) and awareness raising and training (1.1.3). While these are undoubtedly positive, much more needs to be done to ensure that the tourism sector is resilient to climate change, both with regard to present infrastructure, and especially at this juncture where many new developments (private – hotel infrastructure – and public – cruiseship landings) are planned. It is highly recommended that the Tourism authorities, namely Ministry and BTB, consider the Integrated Coastal Management Plan and its recommendations, as well as the various recommendations and highlights of the Caribsave & Partners research and reports.

6. Fisheries sector

Fisheries sector authorities (Fisheries Department) can only maintain a passive function with regard to the management of its sector and interaction with communities in light of climate change; that is to say, it cannot influence key climate impacts such as sea level rise and increase in sea surface temperature. Rather, the onus is on forecasting and anticipating such factors and how they impact key success factors in the coastal zone (such as health and abundance of seagrass and mangrove) and the availability of commercially relevant species, and adapt management practices and policies accordingly.

6.1. Climate risks

Sensitivity	The fisheries sector is primarily composed of small-scale, artisanal fishers who fish in the shallow waters off the barrier reef and the three atolls (FAO, 205). Therefore there will likely be less awareness of climate change and how it will impact livelihoods, and capacity to overcome vulnerabilities.
Hazards	The most relevant climate hazards include wind and storm events, which may be increasing in intensity, heavy rains, increased sea surface temperature, acidification of the ocean, and changes in current patterns and strength.
Risks	Alteration in the temperature and acidity of the sea surface will change the makeup of biodiversity and the trophic structure, eventually affecting species abundance and composition, including with the encroaching of invasive species (whether commercially interesting or not). Key risks are indirect, i.e. resulting from changes to the overall health of the coral reef system, as well as maintenance of seagrass and mangrove resources.

6.2. Opportunities for adaptation

Feasibility	There is presently no specific Strategy or Planning document for the Fisheries sector to assess feasibility in light of climate change.
Adaptation opportunities	Research and monitoring of fisheries stocks is very important, in order to pro-actively manage allowable catches and licensing. Identification of new commercial species entering fishing areas due to climate factors directly or indirectly affecting the sea and trophic structures could generate new opportunities to substitute for species which migrate out of reach of the majority of fishermen's reach, or which stocks decrease to below commercial viability and are therefore permitted to catch.

6.3. Climate integration in sector strategy document

There are various Statutory Instruments governing Fisheries in Belize, as well as the Fisheries Act¹⁷, which dates to 2000, and is by MFFSD's account now "old and outdated"¹⁸. The Fisheries Act does not refer to climate change. There is presently no Planning or Strategy document for the Fisheries sector, though a sectorial Plan or Policy document projecting to the next 5 – 10 years is presently being developed¹⁹. This constitutes an excellent opportunity for the NCCO to accompany the policy drafting process and ensure that climate change is duly mainstreamed *ex-ante* in the document. There appears to be significant enthusiasm about the Managed Access collaborative fisheries approach in Belize, wherein commercial fishing licences are granted exclusively to traditional fisherman for specific areas under management, starting with Port Honduras Marine Reserve and Glover's Reef Marine Reserve, thereby creating a more narrowly delineated, shared "commons" where stakeholders (fishermen) have a collective responsibility and, theoretically, shared interest in the sustainable management of fisheries stocks in the designated zones. The Managed Access programme could also be a good entry point to inform and engage participating fishermen about climate impacts to coastal waters, encouraging them to also participate in monitoring efforts concerning commercial fish stocks and marine mammals siting, for instance.

¹⁷ Fisheries Act, Chapter 210 of the Laws of Belize Revised Edition 2000.

<http://faolex.fao.org/docs/pdf/blz1045.pdf>

¹⁸ http://www.rareplanet.org/sites/rareplanet.org/files/fisheries_act.pdf

¹⁹ Pers. Comm., Fisheries Administrator (MFA), 11/02/2015

7. Recommendations

The following recommendations are made as contributions to steps to mainstream climate change into Belize's development process, as pertains to the sectors involved or in general. Where recommendations can be elaborated into concrete project ideas, these are provided at the end of this section, in particular for mitigation / resource use efficiency projects.

- **Island transport:** Usual transport to the Cayes and islands in Belize involves motorized boats of different sizes, and more formal transport systems require moorage infrastructure, such as to San Pedro. Such moorage must be made sturdy but flexible to accommodate storms, swells, but also sea level rise over time. There are companies offering air transport using small planes, but landing strips can be established on very low lying land next to the coast, resulting in high maintenance costs to make up for damage caused by flooding, salt, etc. Seaplanes offer fast, safe, low-impact transportation to remote and sensitive areas. Research into the effects of this mode of transport indicate there are not significant impacts on the environment. Seaplanes compare very favorably to conventional motorized boats in areas of air and water pollution, wakes, and disturbance of plants, wildlife, and sediments. Noise generated by seaplanes is similar in amplitude to that generated by large speedboats, but unlike motorboats, noise from a seaplane is brief and transitory. Seaplanes also compare favorably to automobiles, primarily because seaplanes do not require an intrusive or extensive infrastructure. There is no factual basis for the restriction of seaplanes for environmental reasons at locations where motorized boats are permitted. Further, seaplanes are acceptable modes of transportation even on many waterways that are inappropriate for use by motorized boats (SPA).

The establishment of seaplanes as a flexible transport mode would of course be led by the private sector, however public policy could assist by facilitating regulatory requirements for this new entrepreneurial niche. In addition to the obvious potential market in the tourism sector, seaplanes could also be very important for the health sector and search and rescue operations, where boat transport may not be possible or timely.



Figure 10 Landing strip in Belize City
Photo courtesy Sérgio T. Santos

- **Enhancing the Environmental Assessment framework: SEA and ex-ante assessment:** This is relevant in particular for the Tourism sector. Presently, EIA are required of new tourism resorts and formal facilities (see below). New infrastructure is only to be licensed with satisfaction of the EIA Report. The development of a more sustainable tourism resort is a good thing. However, the development, in a given area, of 20 or 30 new resorts may no longer be sustainable, regardless of each having gone through and passed individual EIA processes. Tourism planning foresees the construction of tourism infrastructure supporting 13 000 new beds in the next 15 years, though this is considered by tourism authorities to be a conservative estimate²⁰, so the timing is crucial. This is where SEA can be an important strategic planning instrument.

This should be an area where the EU can take a lead role in supporting Belize. Addressing environmental opportunities and vulnerabilities is one of the areas of the EU’s 2012 Strategy for the Caribbean. The EU stepped up its support for environmental management and mainstreaming of disaster prevention, putting the emphasis on climate change adaptation and mitigation, as well as on ex-ante disaster risk reduction measures such as risk identification, assessment, management and financing, early warning systems and communications and integration of DRR into recovery²¹.

EIA and SEA

Environmental Impact Assessment (EIA) and **Strategic Environmental Assessment (SEA)** are two important systematic processes for incorporating environmental diligence into planning and decision-making. Both consider a variety of environmental factors (soil, water, health, biodiversity, etc) including climate change, and both follow the basic principles of EIA (transparency, participation, etc). But there are key differences as to how they are applied and respective timescale and scope.

Differences between EIA and SEA

EIA is aimed at achieving a good design of well described objective of the assessment, which is an **Action** or **Project**. As such, it normally deals with actions dealing with Construction or Operations – over a medium to short time scale. It involves quantitative assessments of specific impacts on the local state of the environment, and emphasizes minimization and mitigation of the negative impacts.

SEA, on the other hand, deals with Strategy, Visions and Concepts. Instead of “good design”, as with an EIA, the objective is “good strategy”. SEA are used in the Policy, Planning and Programming levels of decision-making, and therefore have much larger boundaries than EIA in terms of time and space and the coverage of the subject of the process. Accordingly, because of the usually longer temporal horizons of strategies and plans, climate change and variability considerations, including assessments of risks and adaptation opportunities, take on an important significance.

In Belize, EIA are required of “Housing large scale housing developments Resort and Recreational Development (a) construction of coastal resort facilities or hotels (b) development of tourist or recreational development in national parks (c) development of tourist or recreational facilities on small islands”, and “resort facilities or hotel complexes” (Schedule 11, Statutory Instrument No. 107 of 1995, on Environmental Impact Assessment Regulations). However there is presently no requirement for SEA.

The EU has issued [Guidance on Integrating Climate Change and BioDiversity into Strategic Environmental Assessment](#).

Box 4 Environmental Impact Assessment (EIA) and Strategic Impact Assessment.

²⁰ CEO, Ministry of Tourism and Culture, pers. comm, 02/2015

²¹ https://ec.europa.eu/europeaid/regions/african-caribbean-and-pacific-acp-region/acp-multi-country-cooperation/environment_en

- **Institutional map:** an “institutional map” of entities which are relevant to climate change in Belize should be carried out, if not already available. This would identify all the organizations which can be considered information resource creators or providers (Ministries, Departments, international organizations but also academic units and NGOs), as well as entities which direct or govern sectors or activities which are sensitive to climate change and are potential “beneficiaries” of information and guidance. There are already some good information and data resources available, but more is needed (for instance, to guide policy-making in fisheries). Coordination, transfer of knowledge and information and capacity building of service managers have been identified as needs including by the trans-sector stakeholder representatives at the 02/2015 Seminar on Mainstreaming Climate Change into Development organized by NCCO/UNDP.
- **Establishment of Building Codes/Guidelines:** Belize has presently either no formal building code or guideline, or at the very least it appears to be effectively inaccessible even through official channels²², , though Belize is in a risk zone of tropical storms, strong winds and storm surge. Building codes generally include²³: standards for structure, placement, size, usage, wall assemblies, fenestration size/locations, egress rules, size/location of rooms, foundations, floor assemblies, roof structures/assemblies, energy efficiency, stairs and halls, mechanical, electrical, plumbing, site drainage & storage, appliance, lighting, fixtures standards, occupancy rules, and swimming pool regulations. Specifically, the recommendation is for a proper study on international standards applicable to areas of tropical storm risk, as well as seismic activities, in order to establish minimum standards for building design. The study would result in recommendations for legislation on Building Code or Guidelines to be established in legislation, as a licensing requirement for new housing estates, condominiums or hotel infrastructure, to be imposed and enforced through the Central Building Authority or other designated agency.



Figure 11 New housing development straddling water in Ambergris Caye
Photo courtesy Sérgio Teixeira Santos

²² Own internet-based research and also requests for information on official building codes/guidelines from the National Climate Change Office revealed no results.

²³ http://en.wikipedia.org/wiki/Building_code#Types_of_building_codes extracted April 2015

- Climate Finance Action:** There are presently various sources of international institutional finance for climate action, both for the adaptation as well as mitigation “sides” of responses to climate change. These may be from multi-lateral donor agencies (such as the EU and World Bank), Development Banks and other IFIs (International Financial Institutions) (ex IDB) and bi-lateral agencies. Belize, through its natural resource asset base, established institutions, peace and rule of law, but also the fact that it is considered a highly sensitive to climate change Small Island Developing State, can be very well positioned to negotiate and acquire climate finance to support specific actions, projects, capacity-building, awareness raising and other projects in particular to harness clean energy potential and manage water optimally (mitigation) as well as build resilience (adaptation). This would require a review of present “needs assessment” which is not only organic and based on de facto priority needs of Belize, but also to be attentive to trends and sectoral financing opportunities by lead development partners (“follow the money” strategy). The recommendation is to a) identify concrete, attractive “sponsorable” projects / actions, b) support Belizean institutions in institutional / diplomatic representation at COPs or alignment with Major Groups (AOSIS, etc), and c) prepare and follow up candidatures for project financing.
- Integrating Mainstreaming into Planning:** Mainstreaming climate change ought to be requirement for new legislation or when existing Plans or Strategies come up for review (ex ante approach), though it is also useful through an ex post approach whereby opportunities for improvement of existing and applicable Policies, Plans or Strategies are studied and put forward. All future plans / actions / policies can pass through a specific consultative body for “quality processing”, to ensure there is no repetition, conflicts or inconsistencies with other strategy documents or the overall planning process. This can be done in different ways in different countries: in Moldova, an Eastern European country, it is the “State Chancellery” which analysis new Strategy documents proposed by the different Ministries and Agencies, and approves or sends back for improvement, before endorsing for consideration by Parliament. In such a process, it makes sense to have a “Rapid Action Force on Climate Risk Screening”. This Rapid Action Force, a small expert group comprising national and/or international experts, could be called upon for fast analysis of existing or proposed Strategy or Planning documents, producing initial screening / scoping / climate risk assessment and providing results to the appropriate body for due processing – that public body could be the Belize Climate Change Committee. The recommendation is for a pragmatic solution to climate risk screening through a small group, a Rapid Action Force, of national/international consultants at service and on call to the Climate Change Committee or other coordinating body (National Climate Change Office?) as necessary.
- Clarification of legal dispositions, and compliance:** Capacity to monitor compliance and enforce the conditions set in environmental licenses for tourism developments is limited. Gaps relevant to the tourism sector include limited capacity to (i) monitor compliance and enforce the conditions set in environmental licenses for tourism developments; (ii) prevent conflicts with other non-compatible uses; and (iii) deal with cumulative impacts in environmentally sensitive areas (IDB, 2015). Personal communication with persons representing various sector institutions and also private sector expressed that some “regulations” (such as on building requirements, bylaws governing distances from coastline where it was possible to build, etc) were understood to be existing, but not explicitly stated in legal dispositions, “spoken” laws as opposed to “written” laws, or simply not enforced. This sustains a culture of non-compliance and “acquired rights” where, for instance, developments which do not clearly conform to explicit regulations, once built, are permitted to remain. A review of existing as well as desirable legislation, as well as a campaign to inform tourism developers and operators, making the regulations and other legal dispositions easily accessible, would be important to shape legal clarity and enforcement into this Belizean tradition.

(This is but a very general insight, based on observation and consulting national professionals, but a strategy recommendation never-the-less.)

Adaptation measure / strategy: Supporting Tourism	Establishing minimum Standards for Energy Efficiency: - Energy Labelling of Appliances - Energy Performance of Buildings
<p>The construction of new buildings has the potential to “lock in” inefficient use of energy (as well as other resources, such as water) over the lifetime of the building. In the case of tourism infrastructure, this problem is exacerbated by the intensity of energy use, resulting in a less competitive tourism industry and reliance on imported fuels for power generation, which is the norm on the islands. However, the field of energy efficient building design is now very well explored and the establishment of minimum performance of buildings subject to licensing approval is commonplace in developed economies. Unfortunately, it is outside the OECD countries that these are less common, in spite of often higher costs of energy and reliance on imports.</p> <p>Energy efficiency standards and labels prescribe the minimum energy performance of manufactured products, and indicate products’ energy performance, respectively. The objective is to assist the market to recognize energy efficiency, the economic (marginal purchase) costs and (operational cost) benefits, and to act on it or legislate minimum standards which remove obsolete technologies from the market place.</p> <p>This recommendation is for an advanced study into the opportunity, including the economic costs and benefits and legislation, for establishing an Energy Efficiency Standards programme including Energy Labelling of electric appliances and Energy Performance Rating of Buildings, at least for the Tourism and Services sectors. The study would include existing standards to which Belize could adhere to quickly absorb and emulate, such as from the US or EU (Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings, and Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products).</p>	
Climate risk addressed	Increased air temperature
Urgency	Depends on the existence of political prioritization of an energy efficient economy / National Energy Policy
Efficacy (considering different climate scenarios)	This is clearly a “no regrets” project activity, which makes sense under any future climate scenario.
Budgetary effort	As an initial phase, this project would involve a consultancy study, and therefore is not capital intensive. Part of the study would be to identify wider public and private sector costs involved and economic benefits, but also institutional financial support to take forward this measure as a specific program.
Coherence with other policies	Promotion of Energy Efficiency of Buildings and Appliances would contribute to a more competitive national and sectoral (tourism, residential, services, industrial) economy, reduce reliance on fuel imports, reduce pollution from fossil-fuel based power generation, and contribute to mitigating reportable carbon emissions, as well as creating new market opportunities for an efficiency based economy.
Coherence with other adaptation measures	Coherent with measure to demonstrate effectiveness and cost effectiveness of a “low carbon tourism project”

Adaptation measure / strategy: Supporting Tourism	Green Economy Pilot Project for a tourism cluster
<p>There is much potential for improving the eco-efficiency, and thereby competitiveness, of hotels in Belize, and in particular in the islands like Ambergris Caye. Electricity is produced by imported fossil-fuel fired generation and is therefore very expensive, and used inefficiently. This is due to use of inefficient appliances, lack of appropriate use and management policies which is predicated on information, awareness and a culture of energy efficiency, and failure to harness economic renewable energy resources. Sanitary and service waters, as well as drinking water, are produced through energy intensive reverse osmosis systems, resulting in high cost, but are also inefficiently used due to lack of generalised use of water saving taps, showers and toilets, and lack of an ambitious awareness raising program. Grey water systems could re-use waters with simple treatment, avoiding the use of precious produced drinking water for flushing toilets. According to authorities at the Municipality of San Pedro, solid waste is not adequately managed, and space for the tip is becoming scarce. However, a waste to energy system would resolve the accumulation of waste, while generating a locally produced power supply. This would require a proper waste management plan and system.</p> <p>The proposed project would demonstrate the rationality of public sector support in facilitating green development in the tourist sector. It would offer a concrete contribution to adaptation to climate change as well as mitigation efforts. Such a project would involve the training of municipality specialists, hotel operators and technical maintenance staff, and naturally would generate a market for local clean technology equipment and maintenance services, thereby developing a green economy cluster. It would serve both demonstration and implementation purposes. Such a project could then be publicised as part of high end communication and promotion strategy for San Pedro as a Green, or Low Carbon, tourism destination.</p> <p>Such a project would be easy to support through international institutional finance, and could connect well with other proposed activities which optimize energy resource use.</p>	
Climate risk addressed	Increased air temperature, optimizing use of 2 climate sensitive resources: energy and water.
Urgency	Medium: water and energy use are becoming more expensive and if use is not optimized, will aggravate with climate change, rendering the sector and destination less competitive. Space for waste accumulation is becoming limited.
Efficacy (considering different climate scenarios)	This is clearly a “no regrets” project activity, which makes sense under any future climate scenario.
Budgetary effort	As an initial phase, this project would involve a consultancy study, and therefore is not capital intensive. Part of the study would be to identify wider public and private sector costs involved and economic benefits, but also institutional financial support to take forward this measure as a specific program. Depending on outcomes, investment could also be sought to establish infrastructure such as a waste to energy facility for Ambergris Caye.
Coherence with other policies	Promotion of Energy Efficiency of Buildings and Appliances would contribute to a more competitive national and sectoral (tourism, residential, services, industrial) economy, reduce reliance on fuel imports, reduce pollution from fossil-fuel based power generation, and contribute to mitigating reportable carbon emissions, as well as creating new market opportunities for an efficiency based economy.
Coherence with other adaptation measures	“Establishing Minimum Standards for Energy Efficiency”, “Establishment of a Clean Energy Technology Fund”.

Adaptation measure / strategy: Supporting Tourism	Establishing minimum Standards for Energy Efficiency: - Energy Labelling of Appliances - Energy Performance of Buildings
<p>The construction of new buildings has the potential to “lock in” inefficient use of energy (as well as other resources, such as water) over the lifetime of the building. In the case of tourism infrastructure, this problem is exacerbated by the intensity of energy use, resulting in a less competitive tourism industry and reliance on imported fuels for power generation, which is the norm on the islands. However, the field of energy efficient building design is now very well explored and the establishment of minimum performance of buildings subject to licensing approval is commonplace in developed economies. Unfortunately, it is outside the OECD countries that these are less common, in spite of often higher costs of energy and reliance on imports.</p> <p>Energy efficiency standards and labels prescribe the minimum energy performance of manufactured products, and indicate products’ energy performance, respectively. The objective is to assist the market to recognize energy efficiency, the economic (marginal purchase) costs and (operational cost) benefits, and to act on it or legislate minimum standards which remove obsolete technologies from the market place.</p> <p>This recommendation is for an advanced study into the opportunity, including the economic costs and benefits and legislation, for establishing an Energy Efficiency Standards programme including Energy Labelling of electric appliances and Energy Performance Rating of Buildings, at least for the Tourism and Services sectors. The study would include existing standards to which Belize could adhere to quickly absorb and emulate, such as from the US or EU (Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings, and Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products).</p>	
Climate risk addressed	Increased air temperature
Urgency	Depends on the existence of political prioritization of an energy efficient economy / National Energy Policy
Efficacy (considering different climate scenarios)	This is clearly a “no regrets” project activity, which makes sense under any future climate scenario.
Budgetary effort	As an initial phase, this project would involve a consultancy study, and therefore is not capital intensive. Part of the study would be to identify wider public and private sector costs involved and economic benefits, but also institutional financial support to take forward this measure as a specific program.
Coherence with other policies	Promotion of Energy Efficiency of Buildings and Appliances would contribute to a more competitive national and sectoral (tourism, residential, services, industrial) economy, reduce reliance on fuel imports, reduce pollution from fossil-fuel based power generation, and contribute to mitigating reportable carbon emissions, as well as creating new market opportunities for an efficiency based economy. Promotion of the objectives of the Belize Sustainable Tourism Action Plan.
Coherence with other adaptation measures	Coherent with measure to demonstrate effectiveness and cost effectiveness of a “low carbon tourism project”

Adaptation measure / strategy: Supporting Tourism	Establishment of a Clean Energy Technology Fund for Belize
<p>This would involve the preparation and creation of a significant fund for the wholesale, centralized procurement of simple, efficient energy technologies which can easily be purchased retail by SMEs at reasonable cost, together with correct information about their use and benefits. As a target sector, tourism facilities are appropriate given their high intensity of energy use and need for competitiveness with regional tourism industries and destinations.</p> <p>Items should be those that can be centrally procured to the advantage of various potential SME beneficiaries, avoiding specialized products which would require bespoke characterization. All procured technologies should be certified to conform with EU (or other) standards for quality and performance, to establish credibility. Examples include:</p> <ul style="list-style-type: none"> • Efficient lighting: CFL and LED applications substituting conventional light bulbs (ex: replacements for conventional 40, 60 and 100 W bulbs) • Solar thermal systems: collector panels, high insulation tanks, control systems • Electric meters and other monitoring devices, for control. <p>Equipment with easy distribution could be procured, shipped in a container and warehoused locally, near the main port for Belize City, for quick commercialization and delivery / installation with SMEs. Some facility for storing the materials would be needed, as well as a structure for commercializing the materials.</p> <p>The fund could initially be endowed with a seed amount – example USD 500 000, to demonstrate the proof of concept, and test the procurement, storage, commercialization, and uptake by SMEs familiar to UNDP / NCCO / other relevant partners, if the results are encouraging, then could be leveraged to more significant endowment of funds.</p> <p>The reporting on this clean energy technology fund would indicate, on the basis of the technology deployed, the cost savings realized by SMEs, reduction in fuel costs, and reduction of greenhouse gases.</p> <p>Insight: UNDP, NCCO and/or other influential institutions could lobby the Government for a waiver of import duties on this merchandise, destined to support the competitiveness and eco-efficiency of Belizean SMEs, especially in the Tourism Sector. In return for this “in kind” support, the appropriate public body (BTB? MTC?) could be recognized as an affiliated supporting institution to the measure.</p> <p>Objectives include overcoming barriers to the uptake of clean energy technologies, namely:</p> <ul style="list-style-type: none"> • Cost: central procurement means better pricing can be negotiated in bulk quantities for mature technologies such as efficient lighting, insulation, solar applications, meters, etc. Shared shipping costs and possible waiver or reduction of import duties would further contribute to cost reduction. • Quality: all materials would be in conformity with EU or other standards. • Availability: materials would be locally stored and ready for retail commercialization, or, as necessary, installation. • Awareness raising by UNDP, NCCO and/or other relevant agencies on effective, pragmatic campaign to support eco-efficiency of enterprises. 	
Climate risk addressed	Increased air temperature
Urgency	Depends on the existence of political prioritization of an energy efficient economy / National Energy Policy
Efficacy (under different climate scenarios)	This is clearly a “no regrets” project activity, which makes sense under any future climate scenario.
Budgetary effort	Depending on the initial seed capital for the procurement, this project, including design, capacity building for preparation of implementation, establishment of procedures etc could be budgeted at approximately USD 1 – 1.2 Million. This project could be easily financed from institutional sources. Sector-wide economic benefits could be demonstrated to yield a very attractive payback.
Coherence with other policies	Promotion of Energy Efficiency of Buildings and Appliances would contribute to a more competitive national and sectoral (tourism, residential, services, industrial) economy, reduce reliance on fuel imports, reduce pollution from fossil-fuel based power generation, and contribute to mitigating reportable carbon emissions, as well as creating new market opportunities for an efficiency based economy. Promotion of the objectives of the Belize Sustainable Tourism Action Plan.
Coherence with other adaptation measures	Coherent with measure to demonstrate effectiveness and cost effectiveness of a “low carbon tourism project”; Establishment of Minimum Standards for Energy Efficiency.

Adaptation measure / strategy: Supporting Tourism	Establishment of a Clean Energy Technology Fund for Belize
<p>This would involve the preparation and creation of a significant fund for the wholesale, centralized procurement of simple, efficient energy technologies which can easily be purchased retail by SMEs at reasonable cost, together with correct information about their use and benefits. As a target sector, tourism facilities are appropriate given their high intensity of energy use and need for competitiveness with regional tourism industries and destinations.</p> <p>Items should be those that can be centrally procured to the advantage of various potential SME beneficiaries, avoiding specialized products which would require bespoke characterization. All procured technologies should be certified to conform with EU (or other) standards for quality and performance, to establish credibility. Examples include:</p> <ul style="list-style-type: none"> • Efficient lighting: CFL and LED applications substituting conventional light bulbs (ex: replacements for conventional 40, 60 and 100 W bulbs) • Solar thermal systems: collector panels, high insulation tanks, control systems • Electric meters and other monitoring devices, for control. <p>Equipment with easy distribution could be procured, shipped in a container and warehoused locally, near the main port for Belize City, for quick commercialization and delivery / installation with SMEs. Some facility for storing the materials would be needed, as well as a structure for commercializing the materials.</p> <p>The fund could initially be endowed with a seed amount – example USD 500 000, to demonstrate the proof of concept, and test the procurement, storage, commercialization, and uptake by SMEs familiar to UNDP / NCCO / other relevant partners, if the results are encouraging, then could be leveraged to more significant endowment of funds.</p> <p>The reporting on this clean energy technology fund would indicate, on the basis of the technology deployed, the cost savings realized by SMEs, reduction in fuel costs, and reduction of greenhouse gases.</p> <p>Insight: UNDP, NCCO and/or other influential institutions could lobby the Government for a waiver of import duties on this merchandise, destined to support the competitiveness and eco-efficiency of Belizean SMEs, especially in the Tourism Sector. In return for this “in kind” support, the appropriate public body (BTB? MTC?) could be recognized as an affiliated supporting institution to the measure.</p> <p>Objectives include overcoming barriers to the uptake of clean energy technologies, namely:</p> <ul style="list-style-type: none"> • Cost: central procurement means better pricing can be negotiated in bulk quantities for mature technologies such as efficient lighting, insulation, solar applications, meters, etc. Shared shipping costs and possible waiver or reduction of import duties would further contribute to cost reduction. • Quality: all materials would be in conformity with EU or other standards. • Availability: materials would be locally stored and ready for retail commercialization, or, as necessary, installation. • Awareness raising by UNDP, NCCO and/or other relevant agencies on effective, pragmatic campaign to support eco-efficiency of enterprises. 	
Climate risk addressed	Increased air temperature
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Efficacy (under different climate scenarios)	This is clearly a “no regrets” project activity, which makes sense under any future climate scenario.
Budgetary effort	Depending on the initial seed capital for the procurement, this project, including design, capacity building for preparation of implementation, establishment of procedures etc could be budgeted at approximately USD 1 – 1.2 Million. This project could be easily financed from institutional sources. Sector-wide economic benefits could be demonstrated to yield a very attractive payback.
Coherence with other policies	Promotion of Energy Efficiency of Buildings and Appliances would contribute to a more competitive national and sectoral (tourism, residential, services, industrial) economy, reduce reliance on fuel imports, reduce pollution from fossil-fuel based power generation, and contribute to mitigating reportable carbon emissions, as well as creating new market opportunities for an efficiency based economy. Promotion of the objectives of the Belize Sustainable Tourism Action Plan.
Coherence with other	Coherent with measure to demonstrate effectiveness and cost effectiveness of a “low carbon

8. Conclusions

Belize is well endowed with natural resources and a geographic setting which enables strong and thriving agriculture, tourism and fisheries sectors and related services economy. However, it is also highly sensitive to climate change impacts, both in terms of gradual changes (ex sea level rise, acidification and increased surface water temperatures affecting coral reef systems) as well as climate variability and extreme events (ex hurricanes, cyclones, strong winds) causing damage to infrastructure, interruption to livelihoods and economic activities (transport, fisheries, tourism) and in extremis, tolling human lives.

The tourism sector is an important economic sector and driver of the Belizean economy; with the main focus being on coastal resorts, the sector is naturally sensitive to climate change. However, the sector's vulnerability can largely be reduced by attention to correcting present lacks in planning requirements, clarification of legal dispositions and more demanding standards for building resistance to storms. Both the Tourism and Fisheries sectors can gain much by careful attention to information, risk screening and recommendations laid out in the Coastal Zone Management Strategy document.

Due in part to Belize's economic situation, there is little own capital to invest in significant projects to improve resilience to climate change. However, this report makes the case that there are several initiatives that can be taken which are at a Strategic, Policy or Programmatic level, not requiring intensive capital and, where capital is required, demonstrating that this may be possible to obtain from institutional climate finance donors, if Belize is sufficiently well prepared to identify, develop and promote its climate resilience propositions.

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Acronyms

BTB	Belize Tourism Board
CARICOM	Caribbean Community
CCCCC	Caribbean Community Climate Change Centre
EU	European Union
GCCA	Global Climate Change Alliance
GCM	Global Circulation Models
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GNI	Gross National Income
UNDP	United Nations Development Program
MAF	Ministry of Agriculture and Fisheries
MFSSD	Ministry of Forestry, Fisheries and Sustainable Development
MNRA	Ministry of Natural Resources and Agriculture
NCCO	National Climate Change Office
NEMO	National Emergency Management Organization
UNDP	United Nations Development Program
WB	World Bank
WTTC	World Travel & Tourism Council