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ADAPTING OUR BUILT ENVIRONMENT FOR A WARMER, WETTER WORLD

ON THE GREEN AGENDA

KEY TAKEAWAYS

The built environment may be threatened by climate change, and adaptation is necessary to ensure resilience.

A combination of thoughtful design, sustainable materials, effective planning and supportive policy frameworks can help buildings and cities withstand the impacts of climate change.

Changes in the global climate caused by ongoing temperature rises mean that most places are expected to be hotter and wetter. Over time, climate change threatens the integrity of physical assets and the ability to provide reliable accommodation and services, unless steps are taken to make the built environment more resilient.

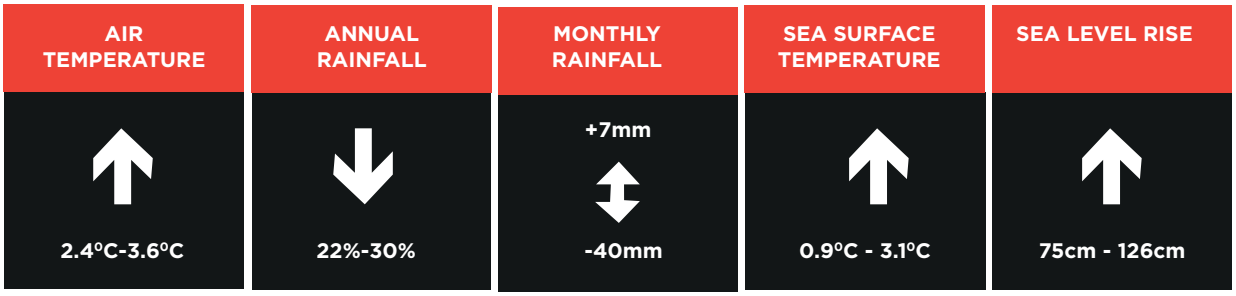
The built environment refers to any physical space designed or constructed by humans, including buildings, roads, cities and countries.[1] For small island developing states, warmer weather contributes to sea level rise, hurricanes, floods, droughts and other weather phenomena, which can compromise built infrastructure such as cities, roads and pipelines, inter alia. Some of the efforts to mitigate the impacts of climate change will involve humans adapting their built environment for greater resilience.

THE **CARIBBEAN** CONTEXT

Despite the many differences among Caribbean nations, climate change poses a serious threat to them all. According to the Intergovernmental Panel on Climate Change (IPCC), average temperatures in the region have increased by 0.1° to 0.2°C per decade over the past three decades. Rainfall patterns have also shifted in the region, with the number of consecutive dry days expected to increase. Additionally, sea level rise has occurred at a rate of about two to four centimetres per decade over the past 33 years, presenting a risk to the region's freshwater resources and to its largely coastal population.[2] Figure 1 lists climate projections for 2100 for Trinidad and Tobago.

For small island developing states (SIDS) of the Caribbean, avoiding the worst effects of changing temperatures and mitigating the effects of flooding will be among the most critical challenges faced in the coming decades. This involves mitigation and adaptation against several weather-related phenomena, including hurricanes, sea level changes, flooding and changing rainfall patterns. Adapting the built environment is considered under the global sustainable development goals (SDGs) and the Caribbean core sustainable development indicators.

Figure 1: Key Climate Projections for 2100 for Trinidad and Tobago[3]



[1]https://www.constructionplacements.com/built-environment/
[2]https://www.iadb.org/en/ove/climate-change-caribbean-small-island-states
[3]Particip "Vulnerability and Capacity Assessment (VCA) Report: Trinidad and Tobago – Technical assistance for the Environment Programme" (2019) Accessed at (planning.gov.tt)

Caribbean architecture has historically been adapted to local conditions, with features such as verandas and stilts

Adaptation to climate is not a new phenomenon in the Caribbean. Caribbean people have historically adapted their built environment for maximum utility, with European architecture being adapted for Caribbean weather conditions — whether as a protective mechanism or to maximise the use of wind or water. In Bermuda, for example, the Bermuda Roof (in conjunction with a potable water holding tank) has been used for harvesting rainwater for the past four centuries as a practical response to the lack of lakes or rivers in Bermuda. In Trinidad and Tobago, adaptations made for heat include verandas for shade and shelter of pedestrians, atriums with clerestory windows for ventilation and architectural pivots around terrain (such as houses built on stilts in areas prone to flooding or in swampy areas).

In the context of climate change, building adaptation will assume new dimensions. Climate change can impact both the structural features of the building and indoor conditions within the building. The inability to properly regulate indoor temperatures may lead to thermal discomfort for users, potentially resulting in negative impacts on health, well-being and productivity.

Future weather and climate changes may potentially bring about degradation of construction materials and even reduced structural integrity of buildings, significant loss of value, deteriorating indoor climate and reduced building lifetime. New and existing buildings need to be assessed for resilience to current risks and future climate changes and planned or upgraded accordingly.

ON THE GREEN AGENDA

Without adaptation of infrastructure, islands can face mounting costs associated with adverse weather events

While there is only embryonic research on the cost of not adapting built infrastructure to climate change, some global studies imply that every dollar spent on climate adaptation (including to the built environment) results in just under four dollars of net benefit.[4]

Other studies indicate these adverse trends will be especially strong in Africa and Asia and that in general, agriculture will have the largest losses due to lower yields and that losses due to sea level rise will continue to increase.[5]

Data from the Caribbean suggests that the net impact of such adaptation is heavily dependent on the country's location relative to potential hurricane tracks, with benefits being much greater in hurricane-prone countries.

Estimates around investing in structural resilience suggest that they can boost the level of GDP in the long run between **2 and 6 per cent** for Caribbean islands. Moreover, the level of output would be around 1/4 per cent higher three years after a natural disaster in the Caribbean on average, once resiliency is achieved.[6]

Assessing the benefits of adaptation requires accounting for the reduced impact of natural hazards, and their contribution to overall economic development. Assessments also need to consider net benefits to biodiversity, air quality, water management, greenhouse gas emission reductions, and health and well-being.[7]

[4]The Global Commission on Adaptation "Adapt Now: A Global Call For Leadership On Climate Resilience" (2019), Pg.3.
[5]What Are the Costs of Not Adapting to Climate Change? | Global Climate Change (climatelinks.org)
[6]Climate Change in Latin America and the Caribbean: Challenges and Opportunities (imf.org)
[7]European environmental agency "Assessing the costs and benefits of climate change adaptation" (March 2023).

ADAPTING BUILDINGS

FUTURE CONSIDERATIONS FOR BUILDINGS (NEW AND RETROFITTED) SHOULD INCLUDE:

Adopting renewable energy technologies

Passive design measures for buildings (building location and orientation on the site; building layout; window design; insulation (including window insulation); thermal mass; shading and ventilation)

Energy saving in heating, ventilation and air-conditioning systems (for adequate cooling, air ventilation and air filtration)

Building adaptations can include:

- The use of **resilience-based measurement frameworks** and reporting standards, calling for users to assess climate risk and adopt resilient and adaptive strategies based on future scenario modelling of likely climate impacts
- The incorporation of **materials** that are better able to with-stand the impact of likely future weather events, once the materials prioritise circularity principles and the use of low-embodied carbon materials
- The use of **off-grid electricity,** distributed microgrids and other sources of decentralised and resilient energy supply
- Implementing **passive design** and retrofit techniques to mitigate extreme heat or installing passive systems, including rooflights and reflective surfaces to increase solar gain

- Implementing **designs** to protect, collect and efficiently utilise natural resources such as rainwater collection apparatus, e.g. water wells and tanks, grey-water reuse systems, low-flow amenities, water-saving devices, building green and blue roofs or installing rain gardens to manage rainwater runoff with adaptive and native vegetation. Some of these measures have been implemented in the Caribbean, notably the Bermuda roof for potable water collection and the use of grey water in Barbados.

ADAPTING CITIES

IN RECENT YEARS, CITY PLANNERS HAVE ALSO BEGUN TO TAKE STEPS TO ADAPT URBAN SPACES TO CLIMATE CHANGE.

- **Urban microclimate interventions** (the addition of green spaces; changes to the albedo of the urban surfaces and water-based techniques as well as a combination of them)
- Setting **building regulations or guidelines** to target specific climate risk, e.g., guidelines to reduce storm damage
- Adopting **renewable energy systems**

- **Policies and financial incentives**/penalties to increase resource efficiency (water conservation) and to avoid unnecessary risks (regulation for woodburning, campfires and behaviour around flammable substances to reduce fire risk)
- The implementation of a **responsive regulatory toolbox** for gradual and extreme weather change events that enables adaptation activities across different scales and levels

- **Integrated and sustainable spatial planning** (urban development strategies and approaches used to design and plan the distribution of people, facilities, infrastructure, spaces and activities in set regions)

- A shift towards **sustainable behaviours** through campaigns and initiatives (buy-in at the local level)
- Support of **sustainable and circular economy interventions** through public procurement and regulation of building and construction services

- Building **climate-resilient coastal infrastructure,** including the adaptation of drainage systems/seawalls and erosion-resistant roads. This can be useful in ensuring that communities such as those along the North Coast in Trinidad and Manzanilla are not cut off from the remainder of the country due to adverse weather.
- **Land use policies and regulations** to reduce/prevent development in high-risk areas and incentivise development in lower-risk ones
- **Resilient and decentralised systems** to improve data reconciliation, reduce points of weakness and optimise resource distribution

PROGRESS

Overall, while there has been some movement to address the issue of adaptation of the built environment, there is still much more to be done. Within CARICOM, there is a framework for implementing adaptations to the built environment through national policies, but tracking of the relevant indicators as a basis for policy is still a work in progress. While gathering the data can be difficult for SIDS, if countries have the right data, risk models and decision-making methods available, the incremental cost of building the resilience of new infrastructure assets is small — and far outweighed by the benefits.

Governments also need to set priorities for actions to make them consistent with available resources and capacity as well as set up robust institutional and legal frameworks and a consistent monitoring and evaluation system for measuring progress. ■