



# Energy and Water Efficient Buildings for Climate Resilience

A brief from the Integrated Climate Change Adaptation Strategies (ICCAS) Pilot Programme

## Challenges

Grenada, a small island developing state (SIDS), is especially vulnerable to the effects of climate change. Climate change refers to significant changes in global temperature, precipitation, wind patterns and other measures of climate that occur over several decades or longer. **Greenhouse gases** from human activities are the most significant driver of observed climate variation. The major greenhouse gasses to consider are: **Carbon dioxide, Methane, Nitrous oxide and Fluorinated gases**. Carbon dioxide, for example, is emitted primarily through the burning of fossil fuels (oil – used to produce energy used in homes, gas and diesel used for motor vehicles or to produce electricity, etc.) and other organic materials. Changes in land use also play a role. Deforestation and soil degradation add carbon dioxide to the atmosphere, while forest regrowth takes it out of the atmosphere. One of the impacts threatening Grenada is a reduction in rainfall, leading to potential water shortages. As the climate changes, the construction industry in Grenada should be aware of its potential impact and make changes in the construction culture **to reduce these impacts**. That would entail designs to reduce greenhouse gas emissions and water usage. To accomplish this, better knowledge with respect to materials and practices is imperative; as is improved planning, analysis and supervision in the execution to ensure the plans are implemented as per design requirements. Therefore from the onset we must ask ourselves: How can energy and water efficiency be improved?

## Sustainable Energy

### Use sources of renewable energy

**Install Photovoltaic (PV) system:** Solar energy is a clean and renewable source of energy. Grenada being a tropical country has an abundance of solar energy. Solar technology has drastically improved and prices have decreased within the last twenty years, so that the technology now allows for more homes to be equipped with roof-top Solar PV systems. It is possible to invest in a solar panel system or to use solar energy for individual heating and cooling elements (water heaters & air conditioning) or other appliances such as water or pool pumps.

**Wind Energy:** Wind energy, in addition to being a source of clean renewable energy, has the added advantage of producing electricity at night as compared with solar PV, when the sun is down, with both domestic and commercial applications.



Fig 1- Wind and Solar energy used at Morne Rouge Beach

### Recommend Energy Efficient Equipment

#### Energy Label and Eco-design

Energy efficient equipment should be recommended to clients, especially the equipment that is fitted during the construction phase of the project such as lighting, AC, and some in-built kitchen appliances. Some of the most popular energy efficient items include refrigerators, solar water heaters, LED motion-controlled lighting system, and inverter air conditioning units. To identify products that are energy efficient, buyers can rely on different energy labels affixed to appliances depending on the origin of the goods. “The Energy Star” (Fig 2) is used on goods originating from the United States of America, while “ENERG” (Fig 3) logo is used by the European Union (EU). The EU energy label grades the efficiency of the product.



Fig 2 – Energy Star Logo – United States of America



## Promote the use of energy efficient cooling appliances

Air conditioning is an example to consider. AC Units on the market offer some level of energy efficiency, however, there is a big energy consumption difference between inverter and non-inverter units. The biggest difference between inverter and non-inverter AC is the fact that the motor of the inverter compressor has a variable speed. The speed of the non-inverter compressor is fixed. This means that it operates either at maximum or minimum speed. A sensor in the inverter adjusts the power according to the temperature in the room, lowering the electrical consumption and saving energy. Other advantages of the inverter units are: they are quieter, have a longer life and have a faster cooling time.

In addition to energy efficient inverter-type AC units, the new generation Natural Refrigerant (NR) AC units will be available on the Grenadian market in 2019. These inverter-type NR AC units will offer even better energy efficiency with the added benefit of being climate friendly. These units do not use fluorinated gases that have a very high global warming potential (GWP). Appliances using Natural Refrigerants such as fridges and freezers are already widely available in Grenada and can be identified in stores with a special sticker developed by the National Ozone Unit (Fig 4) or by looking for the refrigerant R-600a (Isobutane) on the information sticker affixed on these appliances.

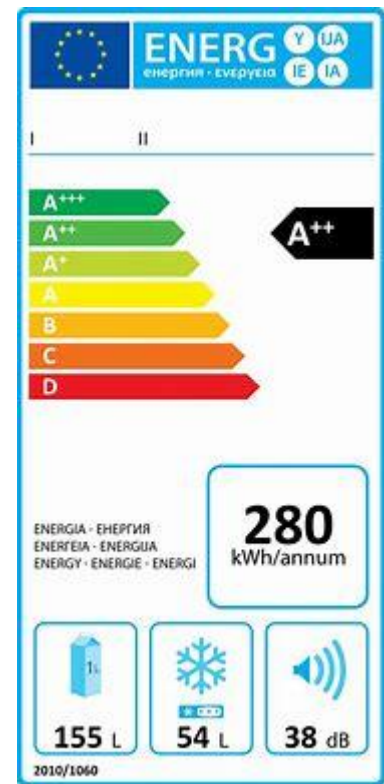


Fig 3 – European energy label

Other energy efficient strategies include the sole use of appliances that are rated for Grenlec's electricity supply: 230V at 50Hz. Transformers should only be used when it is absolutely necessary on appliances rated at 110V. This should be done instead of providing a dual voltage (110V/220V) system throughout the house by using a large sized transformer. Finally, properly sized appliances - especially for cooling systems - can lower electricity consumption and also reduce the costs of maintenance for these appliances.

### Windows

The available window technology has also improved and is capable of reducing heat gains. With higher quality frame construction and material, this allows for lower maintenance, heat transfer and better insulation. Double pane glass windows insulate much better than a single pane glass. Windows imported from the USA may also be branded with the energy star.

Alternatively, the application of heat control window film (Anti-UV tint) may be considered. These films reflect the sun's heat and ultraviolet rays, and reduce glare without obscuring the view. The more direct sunlight coming through the window, the more the film will help.

### Insulation

Insulating surfaces in the building can help to reduce heat gain. This may be achieved by using of special heat-reflective paints on walls and heat-reflective roof sheeting as well as the use of insulation material under the roof. Insulation can help reduce heat stress to children and the elderly caused by excessive heat.

### Recommend Natural Cooling Strategies

In tropical climates like Grenada solar heat can result in high energy consumption from cooling, driving up greenhouse gas emissions. Natural cooling techniques may be used as an alternative. These methods do not rely on mechanical systems to maintain a comfortable indoor temperature. Natural cooling can be achieved by using designs with proper layout and orientation of buildings.



Fig 4 – The sticker developed by the National Ozone Unit makes it easy to identify Natural Refrigerant units.



## House location and orientation

Buildings should be oriented to take advantage of the prevailing Northeastern trade winds entering Grenada. The orientation of the building with longer facades facing South and North, and the shorter facades to West and East is the most effective measure to avoid unnecessary heating from sunlight. The natural ventilation can be maximized by taking the direction of the North East trade winds into consideration. An example of a basic design concept is to locate the bedrooms on the western side of the building to reduce excessive heating at the end of the day. This would reduce the need for additional cooling during the night period.

## Passive Cooling

The use of passive cooling regulates the indoor climate by a controlled air flow through windows and other vents that are purposely provided. As compared to mechanical ventilation, natural ventilation uses only a small amount of energy when the windows/vents are opened and closed. Buildings can benefit from the use of natural ventilation and shading. In order to provide natural ventilation, locate and orient the building to take advantage of the prevailing Northeastern trade winds. This allows for the maximum/efficient use of openings to capture prevailing winds. To allow airflow for natural ventilation, provide openings on opposite sides of the building to facilitate cross ventilation. Fig 5 illustrates how the airflow may be maximized by orienting vents towards the prevailing winds; creating openings throughout the structure, and installing vents higher in structure at the ceiling level. As the hot air rises through the higher vents the void is filled with cooler

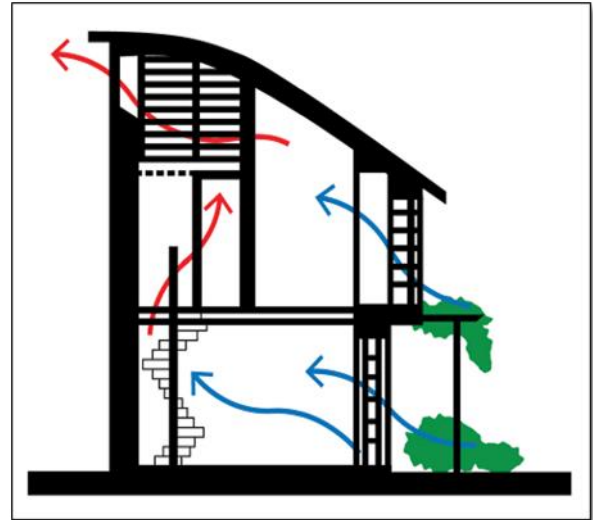


Fig 5 – Natural ventilation air flow

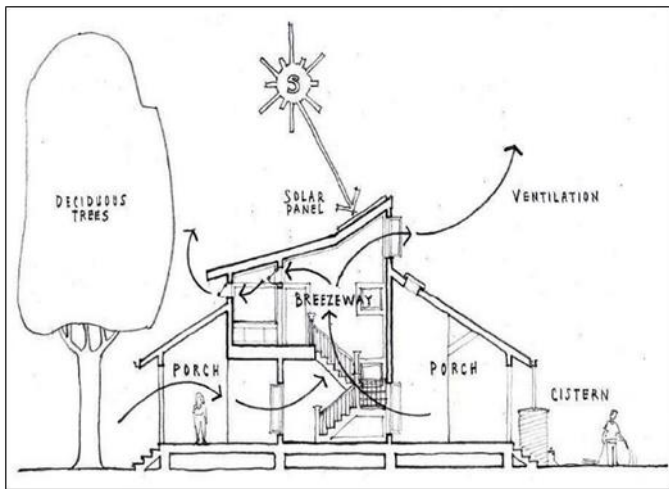


Fig 6 – Passive cooling system – shading to reduce solar intrusion

## Further information

2018 - CARICOM Regional Energy Efficiency Building Code: <https://codes.iccsafe.org/content/chapter/13911/>

## Sustainable Water

The availability of water is another climate change risk which is already greatly affecting Grenada. With changes in the rainfall patterns, the overall quantity of annual rainfall is already decreasing, and the rainfall events tend to be more intense, making water less likely to infiltrate the soil or be retained in reservoirs. This drastically increases the risks of water shortages for the public water supply systems. It is therefore imperative that we develop habits that would support for water efficiency and conservation. To be water efficient and climate smart, a building should collect rainwater, support the infiltration of water in the soil and reduce its overall water usage.



## Rainwater Harvesting Systems

Rainfall is projected to decrease overall for the Southern Caribbean, with an anticipated 26-53% decrease in precipitation by 2050<sup>i</sup>. With lower annual rainfall expected, more intense dry spells are also predicted. This prediction is expected to result in water becoming more expensive and less available in the years to come, making the investment in rain water harvesting systems more attractive to homeowners.

A rainwater harvesting system includes drainage equipment, such as gutters, downpipes and storage water tanks. Water tanks can be either built-in, for instance as underground cistern, just like those used in Carriacou, or external plastic tanks. Despite their higher initial cost, built-in cistern have the added advantage of a higher potential storage capacity and to provide natural cooling to the household.

Collected rainwater can be used for outdoor use (gardens, pools, etc.) and indoor use such as toilets and washing machines. It is generally not recommended to use untreated rainwater for drinking or bathing/showering.

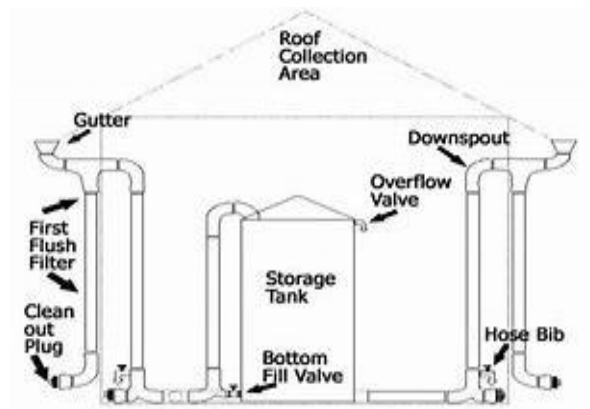


Fig 7 – Rainwater harvesting system

## Water Conserving Fixtures

Technology has allowed for the development of low water consumption equipment. Consultants and contractors should recommend these water conserving fixtures to home owners to reduce consumption, save money on water and design more environmentally friendly buildings.

Toilets can account for up to 30% percent of water consumed in homes. Toilets that carry the 'Watersense' label, for example, require as little as 1.28 gallons per flush. Dual flush system toilets should also be recommended to clients.

Water efficient showerheads and faucets use less water as compared to standard models without sacrificing the water pressure.

## General Recommendations

- ✓ Install Solar PV systems or wind turbines.
- ✓ Energy efficient equipment: Help your client choose energy efficient appliances from solar water heaters, LED light fixtures and inverter AC units, as well as energy efficient rated appliances.
- ✓ Location: Avoid building homes that are facing west. This will keep your home cool since it minimizes the sun exposure. Orient the building to take advantage of northeastern trade winds.
- ✓ Passive cooling technique include correct orientation of the building. This facilitates creating the environment for cross ventilation and using shading techniques (vegetation, awnings, etc.)
- ✓ Insulation: Reduce energy consumption and improve the environmental health conditions with roof, windows and walls insulation techniques.
- ✓ Rainwater Harvesting: Recommend installing rainwater harvesting systems in new houses and renovations to reduce vulnerabilities to water shortages.
- ✓ Water Conserving Features: Recommend low-flow fixtures and 'Watersense' toilets to homeowners.

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<sup>i</sup> <https://www.weadapt.org/knowledge-base/small-islands-and-climate-change/construction-of-rainwater-harvesting-and-waste-water-recycling-facility-at-the-coconut-bay-beach-resort-and-spa-vieux-fort-st-lucia>