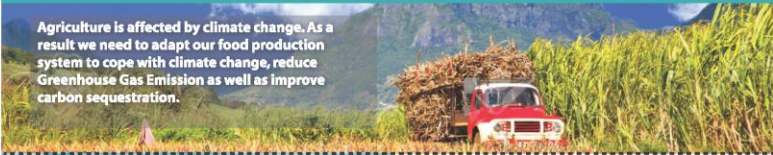




## Agriculture

Agriculture is affected by climate change. As a result we need to adapt our food production system to cope with climate change, reduce Greenhouse Gas Emission as well as improve carbon sequestration.



### Emission from Agriculture

Main GHG emitted from agricultural activities are:

- Nitrous Oxide (N<sub>2</sub>O) - from the use of organic and mineral nitrogenous fertilisers
- Methane (CH<sub>4</sub>) - from livestock digestion processes and animal manure
- Agricultural practices in Mauritius (both crop and livestock sector) emitted 127,000 tonnes CO<sub>2</sub>eq in 2013 (TNC report, 2016)
- Sugarcane cultivation alone emits an average of 83000 tonnes of CO<sub>2</sub>eq yearly

### Impacts on the crop sector

- Higher temperatures affect flowering and fruiting, growing seasons, cropping calendars, crop cycle and bulking in vegetable crops
- High temperatures and mild winters favour higher pest and disease incidence
- Water scarcity and droughts affect production and yield
- Extreme weather events (torrential rains, cyclones) destroy crops and degrade soil, for example through flooding, erosion and sedimentation
- Coastal land are affected by storm surge (destroy crops and affect soil quality)



### How can agriculture adapt to climate change?

- Using efficient irrigation systems (drip, micro-sprinkler)
- Promoting sustainable agricultural practices (soil and water conservation, composting, minimum tillage, mulching and so on)
- Introducing locally adapted varieties (e.g. drought and heat tolerance, disease resistance)
- Crop production under protected culture, such as shade house, greenhouse and mini-tunnel
- Adjusting farm operations (planting dates, treatments, irrigation schedule etc)
- Optimising the use of fertilizers to minimize leaching and N<sub>2</sub>O emissions
- Using Integrated Pest Management or chemicals free pest control methods
- Adopting bio farming systems



## Biodiversity

At least 40% of the World's Economy and 80% of the need of the poor are derived from biological resources. The richer the diversity of life, the greater the opportunity for medical discoveries, economic development, and it also provide adaptive responses to climate change. Conserving and sustainably managing biodiversity is critical to addressing climate change.

### Facts

- Climate change can alter species habitats, how they interact, and the timing of biological events, which could fundamentally transform current ecosystems and food webs
- Climate change can overwhelm the capacity of ecosystems to mitigate extreme events and disturbance, such as wildfires, floods, and drought
- Projected warming could greatly increase the rate of species extinctions, especially in sensitive regions



Increased extreme weather events

Increased vulnerability of ecosystems to climate variability

Higher incidence of wildfires



Warming ocean temperatures

Coral bleaching

Changes in species distribution

Reduction in maximum body size of warm water species



Changing precipitation and melting snow / ice

Increased water stress

Reduction in water quality

Increased vulnerability



Changes in air temperatures and seasonal patterns

Changes in timing of life events

Shifts in migration patterns

Increased tree mortality in some areas

### Observed Impacts in Mauritius

- Change in rainfall pattern on the East coast of Mauritius over a 40-year period may have affected the breeding success and productivity of Mauritius kestrels
- Increasing frequency of storms of tropical cyclone strength or higher may have affected the hatchability and chick survival of Round Island petrels
- Frequent fish mortality suspected to be linked to climate change and occurrence of coral bleaching which could reduce coral biodiversity

### Adaptation options

- Proper management and establishment of protected areas
- Coastal and wetland maintenance and restoration
- Adaptive forest management
- Ecotourism activities
- Promote Bio farming and agro forestry
- Adoption of integrated land use planning





## Agriculture, Forestry and other Land Use (AFOLU)

Globally AFOLU is the largest emitting sector after energy. It represents **20-24%** of total Global Emissions. In Mauritius: Agriculture (Livestock and Crop) contribute to 2.5% of total Greenhouse Gas Emissions (2013)

### How to reduce Greenhouse Gas Emissions?

#### Agriculture

- Minimising the use of fertilisers
- Adopting Integrated Plant Nutrition System (IPNS) in soil fertility management
- Promoting bio farming systems (e.g. organic farming)
- Increasing soil carbon content by using compost and crop residues
- Reducing burning of crop residues in field
- Promoting Agroforestry systems
- Improved breeds with higher productivity (lower emissions per unit of product)
- Improving the quality of livestock feed and feeding strategies
- Efficient management of livestock waste through composting and biogas production



#### Forestry

About 25% of the total land area of Mauritius is under forest cover. Removal of carbon emissions by forests is estimated to be around 7% of the total emissions.

##### Forest Protection

- The State Forest Lands, River Reserves and Mountain Reserves are protected under the Forests and Reserves Act (1983) and are regularly patrolled
- Native species are legally protected by the Native Terrestrial Biodiversity and National Parks Act (2015) and are not commercially logged

##### Sustainable forest management and enhancing tree cover

- Timber exploitation is gradually being phased out and exotic species plantations are gradually being replaced by native species
- Reforestation/afforestation of previously logged forest lands, bare lands and creation of green spaces outside of forest areas
- Creation and maintenance of firebreaks in fire-prone areas
- National tree planting campaign which include free issue of plants to school, sociocultural organisation, etc.

##### Sensitization and awareness

- Ongoing sensitization campaign about importance of forests and biodiversity in schools and Community centres

Globally forestry mitigation options could sequester 1,270-4,230 million tonnes of carbon dioxide equivalent per year in 2030

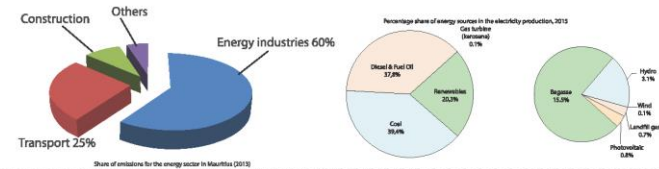


## Energy Sector

The energy sector contributes to about 45 percent of global emissions of Greenhouse Gas. Without additional mitigation global mean surface temperature in 2100 will increase from 3.7°C to 4.8°C compared to pre-industrial levels

### Sectoral energy emission for Mauritius

The energy sector accounts for 77% of overall greenhouse gas emission. Biggest emitter is energy industries



### How to reduce Greenhouse Gas Emissions?

#### Energy Efficiency

Improving Energy Efficiency of homes, businesses and industries



#### Renewable Energy



#### Biomass



In Mauritius, biomass covers majority of biogas and contributes about 13% of the primary energy supply.

#### Waste to Energy





## Industry

Greenhouse gas (GHG) emissions from industry represents almost **30% of global GHG emissions and around 75% of that is energy-related**

With energy efficiency improvement, industrial energy use can be reduced by 40%

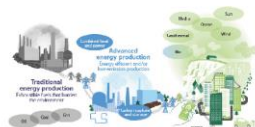
### Mitigation Options

**Increasing energy efficiency** of products and production e.g. steam systems, process heating systems (furnaces and boilers), and electric motor systems (e.g. pumps, fans, air compressor, refrigerators, material handling).

Adoption of **new energy production technology** e.g. carbon capture and storage



### Transition to low energy sources



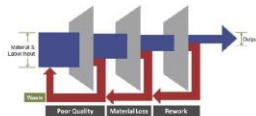
Emissions related to industrial energy use can be reduced by around 90% through transition to low carbon fuels

### Reuse, recycling and energy utilization of waste



Approximately one tenth of all paper, a quarter of all steel, and a half of all aluminum produced each year is scrapped

### Reducing yield losses in materials production, manufacturing and construction.



## Transport

Transport accounts for about a quarter of global energy-related carbon emissions. This contribution is rising faster than for any other energy end-use sector. Without aggressive and sustained action, direct transport carbon emissions could double by 2050.

In Mauritius Transport contributes to 20 percent of Greenhouse Gas Emissions

## How to reduce Greenhouse Gas Emissions?

### Reduce

#### Reduce amount of GHG produced by vehicles:

- Electricity, hydrogen, compressed natural gas and biofuels
- Fuel efficient vehicle
- Innovative vehicle technologies
- Advanced engine management systems
- Efficient vehicle powertrains



### Improve

Improved infrastructure and transport infrastructure together with Intelligent Transport Systems (ITS) to avoid traffic congestion and to foster the use of intermodal transport (road and waterways)



### Avoid

Avoid unnecessary journeys using motor vehicles where possible e.g. internet shopping, restructuring freight logistics systems, and utilizing advanced information and communication technologies (ICT)



### Shift

Shift to lower-carbon transport systems - such as public transport, walking and cycling and carpooling

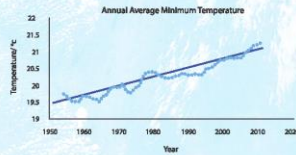




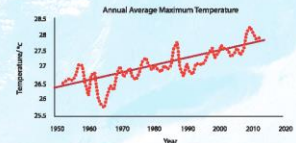


# Climate Trends in Mauritius

## Temperature <sup>1</sup>

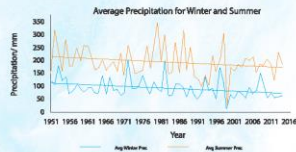


The annual minimum air temperature has increased by 1.89°C (0.030 °C/year) over the 1951 to 2014 period.



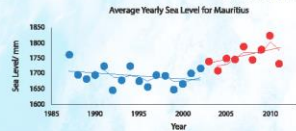
The annual maximum air temperature has increased by 1.24°C (0.020°C/year) over the 1951 to 2014 period.

## Precipitation <sup>2</sup>



Climate records over the period 1951-2014 show a decreasing trend in rainfall amount of about 8%.

## Sea Level Rise <sup>3</sup>



An analysis of sea level record available indicates an accelerated rise of 5.6 mm/yr for Mauritius since 2003, much higher than the global average of 3.2 mm/yr.

1. Data recorded at Plaisance

2. Data recorded at Port Louis

3. Data recorded at University of Hawaii Sea Level Centre



# Coastal Zone

Climate change threatens coastlines ecosystems, infrastructures and people living in the coastal areas



- Sea level rise (SLR) is considered as one of the main impacts of climate change in the coastal zone and is happening due to thermal expansion of water and increased melting of glaciers and ice sheets.
- Sea Level Rise has been observed to be accelerating in Mauritius at a rate of 5.6mm per year, much more than the global average which is 3.2 mm per year.
- Global sea level is projected to rise by at least 1m by the year 2100.

Major potential consequences related to sea level rise include the following:

- Aggravated floods on low-lying coasts
- Accelerated erosion of cliffs and beaches
- Increased salinization in estuaries
- Reduction in the amount of fresh water aquifers



An increase in intense events associated with climate change (such as sea level rise and storm surge) will have direct physical impacts on the coast, exacerbating coastal erosion. Extreme weather events will damage many vital ecosystem services provided by coastal ecosystems.



## Coral bleaching

Climate change is causing abnormally high sea-surface temperatures. When water is too warm, corals will expel the algae (zooxanthellae) living in their tissues causing the coral to turn completely white. This is called coral bleaching. The intensity of coral bleaching increases as temperature rises.

## Adaptation Policies

- Coastal adaptation works (hard and soft measures)
- Restoration of coastal vegetation and coral vegetation
- Coral rehabilitation and mangrove plantation
- Promote Eco-tourism

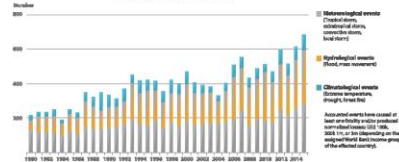




# Extreme Climatic Events

Climate related disasters include floods, storms, tropical cyclones, local storms, heat/cold waves, droughts and wildfires. These disasters are increasing in number and magnitude.

## Weather-related loss events worldwide 1980-2015



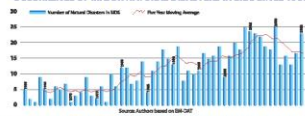
According to the Intergovernmental Panel on Climate Change, increasing temperatures of the Earth's oceans and atmosphere contribute to the severity and rising rates of the various types of storm. Rapid urbanization has accentuated impacts of flash floods, landslides, mudslides, rockfall and subsidence.



According to The World Bank and the Global Facility for Disaster Reduction and Recovery, the impact of extreme natural disasters is equivalent to a global \$520 billion loss in annual consumption, and forces some 26 million people into poverty each year.

Small Island Developing States (SIDS) account for two-thirds of the countries in the world that suffer the highest relative losses due to natural disasters on an annual basis - between 1 to 9 percent of their GDP each year.

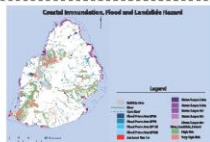
## OCCURRENCE OF MAJOR NATURAL DISASTERS IN SIDS SINCE 1960



Since 2000, 335 major natural disasters have occurred in SIDS resulting in an estimated US\$22.7 billion in direct damages.



According to World Risk Report 2015, Mauritius is ranked 13th, with the highest disaster risk index (DI) as most exposed to natural hazards.



Mauritius is at risk from flash floods, storm surges, tropical cyclones, heat waves, droughts and landslides.



# Fisheries

Climate change amplifies existing threats to the Ocean. In the tropical and temperate regions fishing yield is expected to decrease by 40% to 60%. This is alarming as the Fisheries sector provides three billion people with around 20% of their average intake of animal protein while 400 million depend solely on fish for food.

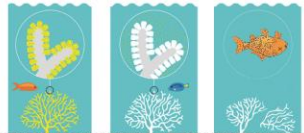


## Why do corals bleach?

**Healthy coral:** They absorb solar energy through their animal polyps through photosynthesis on the coral. Interactions between the two generate coral's vibrant colours.

**Bleached coral:** If high water temperatures persist for a week or more the polyps reject their green partners and the coral appears 'bleached'. If the heat persists the loss keeps on till the

**Dead coral:** An entire die-off of fish species that rely on them for food and shelter also fall.



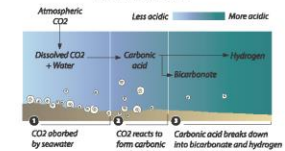
## Factors affecting fisheries sector

- Increased sea surface temperature
- Sea level rise
- Drastic change in weather patterns
- Ocean Acidification

## Impacts on Marine Ecosystem

- Climate change impedes the health of the mangroves, seagrasses and corals ecosystems which subsequently hinders their ability to nurture our marine resources
- There is a marine species distribution shift with warm-water species migration towards the poles while the induced change in seasonality of biological processes further hinders food webs
- The sustainability of the fisheries sector, including aquaculture, is at stake threatening the livelihoods of the communities and global food security
- Coral bleaching as a result of ocean acidification and increase in sea surface temperature

## Ocean Acidification



## Adaptation Options

- Use Smart Fishing Practices
- Avoid overfishing and promote Ecosystem-Based Management (EBM): Sustainable exploitation of natural resources by balancing the social and economic needs of human communities with the maintenance of ecosystems
- Promote aquaculture
- Improve the capacity of institutions and fishers in understanding and managing the marine ecosystems





## Gender

### Climate change impacts women differently and disproportionately than men



women and children are 14 times more likely to die or be injured during a disaster than men



### Gender-based vulnerability to climate change: Facts

- Women are hit first and worst by the effects of climate change:
  - In 1991, the cyclone in Bangladesh killed 140,000 people. Within the age group 20-44, the female death rate was 71 per 1000, compared to 15 per 1000 for men (Mushtaque 1993)
  - More than 70% of the fatalities from the 2004 tsunami in Sri Lanka and Indonesia were women (UN ESCAP 2013)
  - Of those killed by Cyclone Nargis in Myanmar in 2008, 61 percent were women and girls
  - The death toll for women and girls following the devastating earthquake in Nepal in 2015 was 55% (UN Women 2015)
- Women are not well represented in decision making processes, which constrains their ability to meaningfully participate in decision on adaptation and mitigation
- About 70% of the 1.3 billion people living in the deepest levels poverty worldwide are women
- Two thirds of the world's 743 million illiterate adults are women
- A global gender gap in earnings and productivity persists across all forms of economic activity
- Burning biomass fuel indoors leads to 2 million deaths per year (mainly women and children)

### Women are key agents, leaders and champions of climate change adaptation and mitigation

*"Women were adapting to climate change long before scientists gave it a name"*

- The women's group APEDED (Association Pour l'Education des Enfants Defavorises) worked with Small Grant Programme on developing an organic herbal tea enterprise to empower poor, unemployed women
- Project implemented by the Grand-Sable Women Planters in Mauritius used women's skills and knowledge to strengthen the overall capacity of the community to adapt to climate change
- Rodrigues Association Feminine Pecheurs Gravieres: alternative livelihoods for the Fisher Communities in the South East Marine Protected Area



## WASTE

Globally, the total amount of Municipal Solid Waste generated has been estimated at about 1.5 Gt per year and it is anticipated to increase to approximately 2.2 Gt per year by 2025. Around 44% of solid wastes is landfilled, 26% is recovered through either composting or recycling, 15% is converted to energy through waste-to-energy technologies while the remaining 15% is either anaerobically digested, dumped or illegally burnt.

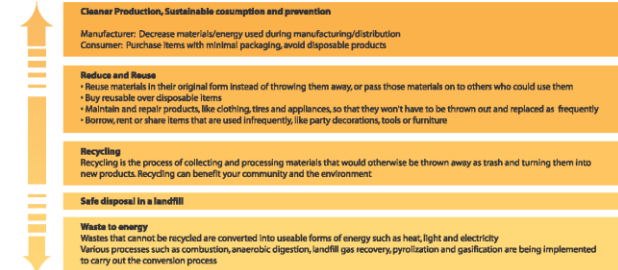
### Composition of municipal solid waste in Mauritius



In Mauritius, the average amount of solid waste generated has increased steadily from 0.7 kg/capita/day in 2000 to about 1.1 kg/capita/day in 2015. Municipal solid waste constituted 96% of the total solid waste landfilled in 2015.

### Integrated Waste Management

Most Preferred



Least Preferred



## Household

Final energy consumed by households (excluding transport) represent around 14% (129.9 ktoe) of the total energy consumption. The two main sources of energy for households are electricity and LPG, representing 55% and 41% respectively of the total energy consumed by households.

Between 2014 and 2015, household consumption of electricity and LPG rose by 3.2% and 3.1% respectively.

### Energy Saving at Home

Use energy efficient lighting. LEDs (light emitting diodes), CFLs (compact fluorescent lamps) and halogen incandescents use up to 80 percent less energy and last as much as 25 times longer than traditional incandescent light bulbs



### Use renewable energy

Use solar water heaters  
Use natural light and ventilation



### Switch off and unplug your appliances when they're not in use

- Switch off lights, air conditioning, computers, TVs and electrical appliances when they are not in use
- Do not leave your appliances like cell phone chargers and MP3 players on standby mode. They STILL consume energy



### Buy appliances with a good energy rating

Refrigerators is probably among the biggest energy users in the home. Take special care to operate it efficiently:

- Clean the condenser coils on your refrigerator to keep them operating efficiently
- Reduce the number of trips you make to the refrigerator/freezer and do not leave the door open unnecessarily



### Use Water Efficiently

- Install a low-flow showerhead
- Use water faucet aerators
- Fix damaged faucets and look for leaks
- Rainwater harvesting



### Compost organic wastes



### Choose climate-friendly transportation

- Walk or ride your bike
- Car share or use public transport
- Buy an electric vehicle



## Infrastructure Sector

A country's economy heavily depend on the resilience of its infrastructure systems. Essential infrastructure systems such as housing, buildings, water and energy supply, and transports network will be increasingly compromised by interrelated climate change impacts.



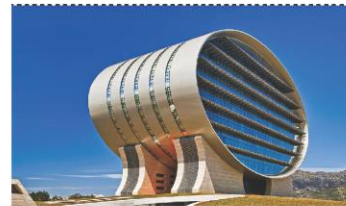
### Key Infrastructures likely to be affected by:

- Extreme weather
- Floodings
- Landslides
- Storm surges

Feature(s) affected	Area/length exposed by flood hazard	Area/length exposed by coastal inundation
Built-up land	5 to 70 km <sup>2</sup>	12.2 km <sup>2</sup>
Agricultural land	19 to 30 km <sup>2</sup>	
Motorway	2.4 to 3 km	
Primary roads	18 to 29 km	60 km
Secondary roads	68 to 109 km	80 km

Source: Disaster Risk Reduction Framework and Action Plan, 2013 and Second National Communication, 2015

According to Disaster Risk Reduction Framework and Action Plan, 2013, the extent infrastructures could be affected varies



### Adaptation Options

- New infrastructure can be climate resilient by ensuring that an asset is located, designed, built and operated with the current and future climate in mind
- Infrastructure in the energy, ICT, transport and water sectors should be planned and commissioned, designed, built and maintained taking climate change into consideration





# Livestock



Livestock refers to domesticated animals intentionally reared in an agricultural setting to produce food or other products. The sector is a major global emitter of Greenhouse Gases



### Main greenhouse gas emitted by the Livestock sector

- Animals like cows, sheep and goats are examples of ruminant animals. During their normal digestion process they create large amounts of methane
- Methane is emitted out of anaerobic (without oxygen) decomposition of the organic matter from the animal waste. Nitrous Oxide is also emitted from manure

### Impacts on the livestock sector

- Heat stress results in a significant financial burden to livestock producers through decrease in milk component and milk production, meat production, reproductive efficiency and animal health
- Risk of increased spread of existing vector-borne diseases and micro-parasites
- Shortage of feed due to rise in temperature and changing rainfall pattern

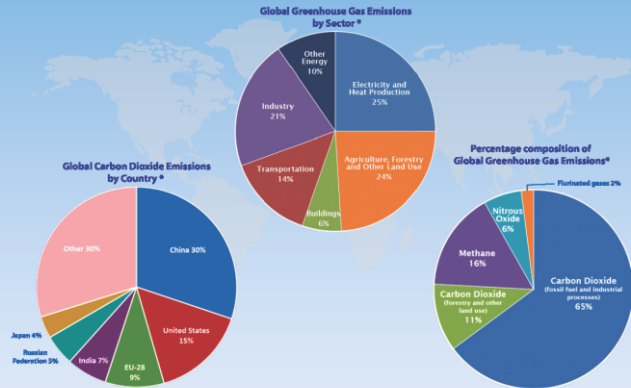


### Adaptation Options

- On farm water storage and management to manage periods of water scarcity
- Construction of shed – Optimise air circulation for minimum heat retention (better materials for construction of the shed, positioning with regards to sun and setting up of proper ventilation system)

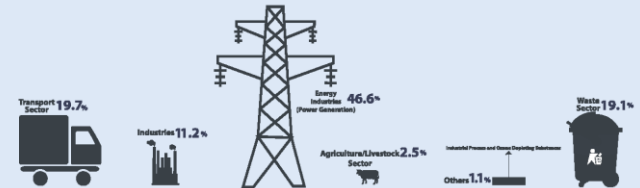


# Main Sources of Anthropogenic Greenhouse Gas Emissions



# Main Emission Sources in Mauritius

Mauritius contributes about 0.01% of Global Greenhouse Gas Emissions





## Youth

Children and youth account for nearly 40 percent of the world's population and they are the most vulnerable to climate change

### Impacts of Climate Change on Youth

**Employment:** Young people, especially those facing structural disadvantages, suffer disproportionately in labour markets in times of crisis, and these impacts are likely to be exacerbated by climate change.

**Education:** Extreme weather events have been shown to reduce participation, especially female, in education since the burden of schooling costs becomes higher and the need for adolescents and young people to contribute economically to households becomes greater.

**Health:** Climate crises can increase malnutrition among adolescents – through food shortages resulting from lower agricultural yields or loss in livelihoods opportunities.

**Social wellbeing:** One of the principal adaptations to climate change is migration. Unskilled migrants are often the first to lose jobs in times of crisis.

88% of the existing global burden of disease due to climate change affects children under the age of five  
600 million children live in the 10 countries most vulnerable to climate change



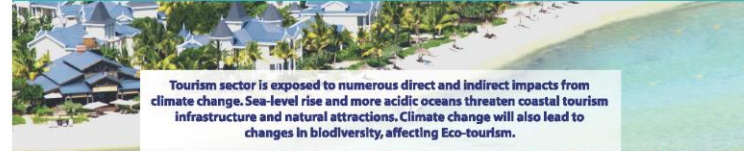
### Young people are potentially the greatest agents of change

#### What you can do

- **Get to know about climate change**
- **Spread the message by talking about climate change**
- **Share information on sustainable lifestyles with family and friends**
- **Adopt environmentally friendly practices**
  - Turning the lights off when leaving a room
  - Installing compact fluorescent lighting (CFL)
  - Unplugging idle electronic items
  - Purchasing environmentally friendly products, including recycled goods and items that are easily recyclable and biodegradable
  - Using public transportation, biking or walking
  - Planting a tree
- **Change consumption patterns for more sustainable ones**  
Take into consideration these recommendations before buying new products.
  - **Rethink** – Do you really need it?
  - **Reduce** – Could you have or use less of it?
  - **Repair** – Could it be mended or maintained?
  - **Re-use** – Can it be used for other purposes?
  - **Recycle** – Can it be recycled to avoid dumping underground?



## Tourism



Tourism sector is exposed to numerous direct and indirect impacts from climate change. Sea-level rise and more acidic oceans threaten coastal tourism infrastructure and natural attractions. Climate change will also lead to changes in biodiversity, affecting Eco-tourism.

### Importance of Tourism Sector

- Tourism is one of the world's largest industry, accounting for some 9% of global GDP. It provides livelihoods to more than 255 million people worldwide
- In Mauritius, the tourism industry accounted for 12% of the total GDP in 2014, and is expected to rise
- However tourism also contributes to global carbon dioxide emissions ranging from 3.9% to 6% of human emissions



### Impacts

- Decrease in tourist arrivals due to changing weather conditions and patterns, degradation of pristine natural attractions and damage to infrastructure
- Disruption of land, sea and air transport to facilities
- 2°C of global warming by 2050-2100 and ocean acidification will cause reef structures to degrade
- Rising temperatures will affect biodiversity

- ### Adaptation Options
- Ensure coastal protection
  - Implement non-structural (e.g. shore and beach management) and structural interventions (e.g. hard shoreline protection structures like groynes and detached breakwaters)
  - Promote eco-tourism
  - Promote public awareness and sensitization:
    - Corals should not be removed from the lagoon and the beaches
    - Do not litter on the beaches and in the lagoon
    - Do not destroy habitats of the marine fauna





# Climate Modeling and Projections

Global Climate Models (GCMs) are used to predict how Earth's Climate will change in response to different scenarios of emission of Greenhouse Gases.

Global Climate models are computer programs with mathematical equations.

### How models work?

Models are tested against historical conditions, for example a model can be fed with observed conditions from the year 1900 to 1930. It is then ran forward to year 2000. It is then noted whether the climate model recreates matches up with observations from the real world.

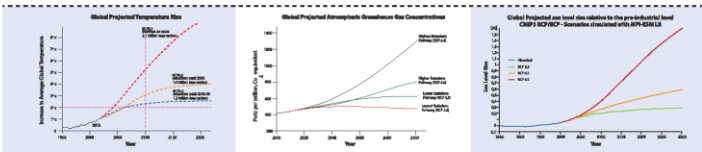


### What is a Climate Scenario?

A climate scenario refers to a plausible future climate that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change. A standard set of scenarios are used to ensure that starting conditions, historical data and projections are employed consistently across the various branch of climate science so that research between different groups can be complementary and comparable.

The Intergovernmental Panel on Climate Change (IPCC) developed a new set of scenarios called Representative Concentration Pathways (RCPs). They describe possible climate futures, all of which are considered possible depending on how much greenhouse gases are emitted in the years to come. There are four scenarios: RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5.

Scenarios	Characteristics
RCP 2.6	An extremely low scenario that reflects aggressive greenhouse gas reduction and sequestration efforts
RCP 4.5	A low scenario in which GHG emissions stabilize by mid century and fall sharply
RCP 6.0	A medium scenario in which GHG emissions increase gradually until stabilizing in the final decades of the 21st century
RCP 8.5	A high scenario that assumes continued increase in greenhouse gas emissions until the end of the 21st century



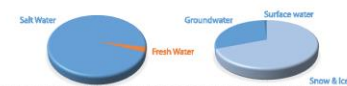
# WATER

Fresh water is crucial to human society – not just for drinking but also for farming, washing and many other activities

### Distribution of water on the planet:

- 97.5 % of our water is salty
- 2.5 % only is fresh water of which:
  - 69 % is snow and ice
  - 30 % is Groundwater
  - 1% is surface water (lakes, rivers and so on)

### DISTRIBUTION OF FRESH WATER



### Various climate change-related impacts have been observed in the water sector in Mauritius:

- a decreasing trend in annual precipitation of about 8% when comparing 1951-1960 and 1998-2008 figures
- an increase in rainfall variability with heavy rainfall events on the rise
- the duration of the transitional dry months between winter and summer is becoming longer



### Projections in Mauritius indicate that the utilizable water resources may decrease by up to 13% by 2050 if no action is taken

The impacts of climate change on water availability and water quality will affect many sectors including:

- Agriculture
- Ecosystems
- Human Health
- Energy
- Tourism
- Industrial



### Adaptation Policies

- Increase water use efficiency at household and other level
- Protection of water sheds
- Expand water storage by constructing new dams
- Avoid water wastages

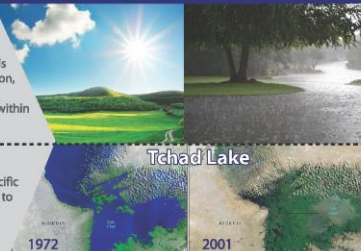




# Weather and Climate

## Do you know the difference between weather and climate?

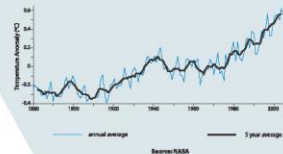
**Weather** is the day-to-day conditions at a particular place. It is the short-term changes in temperature, clouds, precipitation, humidity and wind in a specific area. Weather can vary greatly from one day to the next, or even within the same day.



**Climate** is the weather averaged over many years in a specific area. Climate takes tens, hundreds and thousands of years to change.

## Is Earth's Climate changing?

Earth's climate is always changing. In the past, Earth's climate has gone through warmer and cooler periods, each lasting thousands of years. However since 1880 observations show that average global temperature has increased by about 0.8 °C. Small changes in Earth's average temperature can lead to big impacts.



## What is causing Earth's Climate to change?

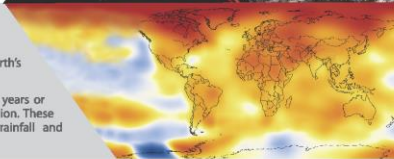
- **Natural causes:** these include changes in Earth's orbit and in the amount of energy coming from the Sun. Ocean changes and volcanic eruptions are also natural causes of climate change.
- **Human activities:** burning of fossil fuels, oil and gas.



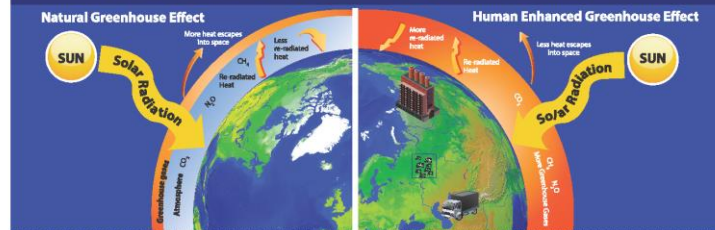
## What is the difference between 'Climate change' and 'Global warming'?

Global warming refers to the long-term increase in Earth's average temperature.

Climate change refers to any long term change (30 years or more) in Earth's climate or in the climate of a region. These include warming, cooling and changes such as rainfall and flowering patterns.



# What is Greenhouse Effect?



ATMOSPHERIC CONCENTRATION OF CARBON DIOXIDE MEASURED AT MAUNA LOA\* HITS NEW HIGH IN 2017

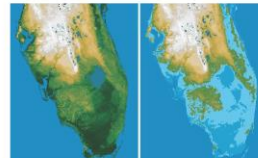


Greenhouse Gas	Chemical Formula	Anthropogenic Sources	Atmospheric Lifetime (Years)
Carbon Dioxide	CO <sub>2</sub>	Fossil fuel combustion, Land-use conversion, Cement Production	~100
Methane	CH <sub>4</sub>	Fossil fuels, Rice paddies, Waste dumps	12
Nitrous Oxide	N <sub>2</sub> O	Fertilizers, Industrial processes, Combustion	114
Trifluoromethane	CF <sub>3</sub>	Fossil fuel combustion, Industrial emissions, Chemical solvents	hours-days
Perfluoromethane	CF <sub>4</sub>	Liquid coolants, Foams	100
Hexafluoroethane	C <sub>2</sub> F <sub>6</sub>	Refrigerants	12
Sulfur Hexafluoride	SF <sub>6</sub>	Dielectric fluid	3,200

\*The Mauna Loa Observatory is the world's oldest continuous CO<sub>2</sub> monitoring station situated on the island of Hawaii.

## Global Evidence of Climate Change

- Global Temperature Rise
- Shrinking Ice Sheet
- Increase Frequency of Extreme Events
- Warming Oceans
- Accentuated Coral Bleaching
- Ocean Acidification
- Increasing Sea Level
- Water Scarcity
- Decreased Snow cover

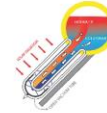
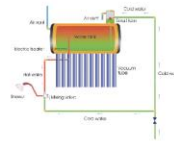




## Solar Water Heater

### The Working Principle of the Solar Water Heater

- The solar collector consists of open vacuum tubes which absorb the solar energy from the sun rays, converting it into heat energy. When in contact with the cold water the energy produced heats up the water inside the vacuum tubes.
- As the water inside the tubes heats up, its density decreases and the hot water rises into the hot water storage tank. Due to its greater density, the cold water in the tank will flow down into the tube.
- The whole process is repeated and the hot water will circulate continuously until its temperature inside the hot water tank reaches that of the water inside the vacuum tube.
- This natural phenomenon is known as thermosiphon process.



## Photovoltaic Panel

### The Working Principle of the Photovoltaic Panel

The word Photovoltaic is a combination of the Greek word for Light and the name of the physicist Alessandro Volta. It identifies the direct conversion of sunlight into energy by means of solar cells. The conversion process is based on the photoelectric effect discovered by Alexander Bequerel in 1839.

Semi-conductive materials exhibit a photoelectric effect that causes them to absorb photons of light and release electrons. Through the manipulation of small amounts of different compounds, the electrical behaviour of semi-conductive materials can be adjusted to be electrically stable with either a slight positive (p-type) or negative (n-type) charge.

