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## **THE ECONOMICS OF CLIMATE CHANGE**

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## **Executive Summary**

This paper focuses on several key economic issues relevant to climate change. Given the fact that changes in climate are projections using the best available data, it examines the economic principles of uncertainty and the precautionary approach, and then continues to address the key drivers of climate change. Climate change is expected to result in negative impacts and, in this regard, the consequences of anticipated rising temperatures and sea levels as well as changes in precipitation that may result in flooding and/or drought are addressed. However, the situation is not all negative and, as such, the opportunities that are likely to arise through adaptation and mitigation are discussed especially with respect to the Caribbean. In this regard and recognizing that it would be useful to Caribbean policymakers to utilize these opportunities and to address the negative impacts, the Economic Commission for Latin America and the Caribbean (ECLAC), through its subregional headquarters for the Caribbean, is spearheading a review of the economics of climate change in the Caribbean with a view to providing quantitative information to stakeholders in dealing with climate change. The paper makes recommendations for the Caribbean to address climate change at the national level. These include macroplanning; promotion of energy efficiency; creation of incentives to obtain support for implementation of alternative energy technologies; maintaining the will among stakeholders on a sustained basis for addressing climate change; and the conduct of relevant research into varieties of plants and animals that could adapt to changing climatic conditions. Finally, it must be recognized that to successfully combat climate change, the threats and opportunities must be properly assessed as part of an ongoing region-wide system of risk management, which should not be incidental, but integral, to national and regional planning and forecasting for the future.

## I. THE NEED FOR ACTION IN THE FACE OF UNCERTAINTY

Global warming that occurs as a result of the levels of greenhouse gases (GHG) in the atmosphere is a naturally occurring phenomenon that is essential for maintaining the balance of nature and for life on earth to prevail. However, the Industrial Revolution more than 200 years ago brought a new dimension to climate as a result of man's contribution to the pursuit of industrial activities. It is proposed that such activities have resulted in increases in GHG concentrations that are intensifying the greenhouse effect thereby magnifying global warming and causing temperatures on earth to reach higher than normal levels. It is also being argued that these higher temperatures will disrupt, at significant costs, life on earth (plants, animals and humans) with such devastating consequences that appropriate urgent responses are needed at national, regional and international levels.

It is important to note that the climate system is uncertain and, as such, is thought to exhibit threshold or tipping point behavior in which small changes can create large cumulative effects and that beyond an optimum temperature, the planet can shift drastically from one stable climatic pattern to a noticeably different one (Alley *et al.*, 2003). However, it is also apparent that in predicting the future, there is a key element of uncertainty that may sometimes complicate climate forecasting and, therefore, the foreseen impacts.

### A. UNCERTAINTY

In predicting future climate, uncertainty may arise in the following ways:

- (a) Scientific uncertainty related to the portion of GHG that remains trapped in the atmosphere; the amount needed to create changes in global climate; the speed with which GHG can create changes in climate and; the distribution of global climate change around the world and by regions<sup>1</sup>;
- (b) Scientific uncertainty on the quantitative impacts of GHG emissions on the carbon cycle and its feedback effects on climate; uncertainty in the interactive effects between increased GHG concentrations and the climate and ecosystems; and uncertainty as to the magnitude of increases in GHG concentrations that can produce threshold effects on the climate system and cause it to vacillate from one pattern to a drastically different one<sup>2</sup>;
- (c) Uncertainty at an economic level in terms of appropriate economic decision-making; choice of economic policies; costs and impact of policies; and size of economic losses and gains, such as uncertainty about future GHG emissions induced by population and economic growth; uncertainty about future increased demand for energy and fossil fuel use; uncertainty over technological development in the future and its impact on GHG emissions and energy use; and uncertainty over preferences of future generations regarding preserving the environment<sup>3</sup>.

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<sup>1</sup> US Congressional Budget Office, 2003

<sup>2</sup> US Congressional Budget Office, 2003

<sup>3</sup> US Congressional Budget Office, 2003

In addressing the challenge of changing climate, two approaches have been identified<sup>4</sup>:

**(a) Wait and see and do nothing for now as there is too much uncertainty, in other words, do Business as Usual (BAU)**

One school of thought mentions that climate change is the result of the natural variability in climatic patterns, while another attributes it to the results of man's activities on the environment. With regard to the latter, it is proposed that it is impossible to ascertain which components of climate are mainly responsible for current observed increases in the earth's temperature. However, even if the increase in earth's temperature is mainly anthropogenic in origin, its impact in the long term is uncertain as the climate system is highly unpredictable. In addition, the costs of curbing the GHG emissions responsible for man-made global warming may exceed the benefits. In the face of such uncertainty, the best option is to do nothing and continue BAU.

**(b) The cost of inaction in the face of uncertainty is too high**

The United Nations and the Inter-Governmental Panel for Climate Change (IPCC) posits that there is enough credible scientific evidence to suggest that anthropogenic activities are causing an incremental increase in GHG emissions, that are subsequently resulting in increasing temperatures that may have tremendous environmental, economic and social consequences. Although the scientific evidence can only be reported within confidence intervals and carries a margin of uncertainty, the IPCC report states that the costs of inaction in the face of uncertainty will be high. In other words, the inter-generational cost-benefit analysis on climate change indicates that society stands to gain by addressing climate change. Also, the Stern Report<sup>5</sup> indicates that adapting to, and mitigating against, changes in climate may only cost 1% of Gross Domestic Product (GDP). If action were to be taken to address these anticipated changes for which evidence is already apparent it would require coordinated responses by the international community.

A third approach involves adopting the precautionary principle.

**(a) The precautionary approach in the face of uncertainty**

The international community has adopted the precautionary approach based on Principle 15 of the Rio Declaration on Environment and Development<sup>6</sup>, which states:

- Precautionary measures must be adopted to curb an activity if that activity raises the risk of harm to human health or the environment even if scientific cause and effect relationships are not yet fully established. This implies taking a proactive, preemptive stance towards curbing threats on human health and the environment and anticipating future developments using scientific evidence
- The burden of proof regarding lack of harm should be shifted towards those undertaking the activity

<sup>4</sup> See <http://www.bbc.co.uk/climate/evidence/sceptics.shtml> for the arguments put forward by climate change skeptics.

<sup>5</sup> [http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/independent\\_reviews/stern\\_review\\_economics\\_climate\\_change/stern\\_review\\_report.cfm](http://webarchive.nationalarchives.gov.uk/+/http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/stern_review_report.cfm)

<sup>6</sup> "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation".

- The opinions of those whose lives may be affected by the decisions made during the course of the activity need to be taken into account
- It is important to set goals, monitor scientific evidence, heed early warnings and adopt corrective measures

The international community has endorsed the use of this approach that amounts to erring on the side of caution when dealing with preserving and protecting life forms and the environment<sup>7</sup>.

## II. THE DRIVERS OF CLIMATE CHANGE

Climate change is undoubtedly a multidimensional issue encompassing environmental, social, cultural, economic, financial, technological and political aspects. The basis of the climate change challenge lies in the tragedy of the commons. This means that air is a natural resource on which all countries depend, but is not owned by any specific country and no country is willing to pay to maintain its quality since it is a global resource that transcends political boundaries and territories. The absence of a clearly defined property rights system over the global resource allows for unregulated use and, moreover, over-exploitation and degradation.

To understand the causes of climate change, there is need to understand the fundamental economic drivers that influence the process. Some of these drivers are:

Driver 1: Lack of a market for pricing earth's clean atmosphere. Whenever an economic resource is not transacted through a market and its use is not priced, it is likely to be subject to over-utilization.

Driver 2: The non-existence of markets for transacting atmospheric pollutants that are classified as public goods and for utilizing the clean atmosphere can, in turn, occur as a result of the absence of certain economic conditions that are necessary for markets to arise, such as:

- Excludability in consumption. Markets for the consumption of private economic goods arise because it is possible to exclude consumers who do not pay to consume the good from the market, while those consumers who pay to have access to the good are the only selective end-users of the good in question. It is not possible to prevent countries or manufacturers from access to the clean atmosphere or its benefits
- Rivalry. For private economic goods transacted in a market, their consumption may be rivaled, that is, one unit of the good consumed by one economic agent reduces the amount of the particular good available for other agents to consume. In the case of the atmosphere, it is clear that the amount of air (polluted or clean) breathed by one person does not diminish the amount of air available to others. Consumption of clean air is "non-rivalrous", thereby making it difficult to value

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<sup>7</sup>. There are subtle differences between the precautionary principle and the precautionary approach. See [http://en.wikipedia.org/wiki/Precautionary\\_principle](http://en.wikipedia.org/wiki/Precautionary_principle) for more details. It is to be noted that the application of the precautionary principle remains to be more effectively enforced in many countries and spheres of decision-making.

Driver 3: A fundamental characteristic of a global public good, such as a clean atmosphere, is the absence of property rights over its ownership and use that leads to a problem of under provision. Alternatively, in the case of global public “bads” such as polluted air, the absence of property rights leads to a problem of over-provision. Clearly the absence of property rights over the earth’s atmosphere is a key driver of global climate change.

Driver 4: Associated with global public goods subject to missing markets and undefined property rights is the issue of externalities. In the case of the earth’s atmosphere, as in all other global public goods or public “bads”, there is a strong interdependency among economic agents in the outcomes of their actions and decisions. Such interdependency is reflected in externalities. Externalities are spillover effects imposed on third parties arising from the production or consumption of a good and for which no compensation is made to these third parties. In the case of the earth’s atmosphere, any activity undertaken by a consumer or producer that releases pollutants to the atmosphere or impacts on the climate system imposes an effect on others who may be dependent on the earth’s climate system, but at no additional costs to those undertaking the activity. The existence of these externalities drives a wedge between the social costs and private costs of consuming or producing any good that, in the course of its production or consumption, impacts on the earth’s atmosphere and this leads to an over-provision of that good in relation to what is socially optimal. At the same time, there are no extra benefits to those who may use technologies which help to create better atmospheric outcomes, thus the incentives for non-polluters are also missing although others benefit from such practices.

Driver 5: Coordination challenges arising from collective action could be an economic driver of climate change. Even if utilization of the earth’s atmosphere cannot be regulated through a market price mechanism, the climate change problem can still be mitigated if all countries were to agree on exercising deliberate restraint in their emissions of atmospheric pollutants and any other economic activity that may negatively change the climate. This will require countries to place the collective interest above their own individual national interests, or to value the social optimum above their own individual optimum. This is complicated by the fact that countries are at different levels of development and the cost of researching more appropriate greener technologies is often interpreted as being an additional burden on poor countries.

Driver 6: Another economic driver of climate change that relates directly to the sustainability dimension of the climate change problematic is myopic behavior and the associated high social rate of time preference of current generations. In this context, it is important to understand the concept of discounting and the discount rate. Usually people value present consumption (or income) more than future consumption (or income), that is, a dollar today is worth more than a dollar tomorrow<sup>8</sup>. The discount rate allows the calculation of the net present value of a dollar which is essentially how much a dollar tomorrow is worth today. The higher the discount rate, the lower is this net present value.

Driver 7: Since a considerable amount of convincing evidence and information about the effects of climate change and global warming is now only being made available to the general public, businesses and institutions have been lethargic in incorporating these issues in their strategy of risk management. This would also impact on climate change.

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<sup>8</sup> The (social) discount rate or social rate of time preference is the pure rate of time preference (PRTP) plus the product of the income elasticity of the marginal utility of consumption and the growth rate of per capita real consumption.

### III. CLIMATE CHANGE - ECONOMIC LOSSES AND DISTRIBUTIONAL IMPACT

Climate change is expected to result in negative impacts and, in this regard, the consequences of anticipated rising temperatures and sea levels as well as changes in precipitation that may result in flooding and/or drought are addressed.

#### Mountainous regions at risk

Global warming is likely to cause glaciers to melt in some parts of the world, thereby increasing the risk of glacier lakes overflowing thereby creating floods, landslides and avalanches. Communities living in such mountainous areas will be vulnerable to increased disaster risk. This would necessitate a response by governments for increased infrastructural works, such as building of dams and drainage systems, and through expenditure on disaster prevention and mitigation.

#### Winter tourism and revenues from skiing will be affected

Global warming is likely to impact on the revenues of countries that have a significant winter tourism-based economy such as Austria, Chile, Switzerland and New Zealand. According to an Organization of Economic Cooperation and Development (OECD) study (OECD, 2007), 1994, 2000, 2002 and 2003 recorded the warmest temperatures in the European Alps in the past 500 years. The report notes that while currently about 609 out of the 666 Alpine ski areas are naturally snow-reliable, this number will decrease to fewer than 500 for a 1°C increase; 404 for a 2 °C increase; and fewer than 202 for a 4°C increase in temperature. Areas in high latitudes that are least climate sensitive and have more resources for adaptation may actually gain as an increased number of winter tourists may visit their resorts. However, low-lying areas, that are more climate sensitive, will suffer economic losses as their winter tourists seek alternative resorts. There is likely to be a loss and a redistribution of income and jobs across winter-based economies.

#### Increased risk of drought in dry regions and effects on crop production, food prices and poverty

The IPCC report notes that the Sahelian region in Africa is likely to experience warmer and drier conditions that will impact on the length of the growing season for crops and, therefore, affect crop production. The Caribbean subregion is expected to experience higher temperatures and lower precipitation with Cuba and Hispaniola becoming wetter (Taylor *et al.*, 2007). Drier seasons that impact negatively on crop production will drive up food prices worldwide and this would be exacerbated especially if production in countries that control a large share of the world food production is affected. The increase in wheat prices in 2008 as a result of potentially climate change-related droughts in Australia is a case in point (Lawrence, 2008). Rising wheat prices in 2008 even caused riots in some countries and led the Caribbean Community (CARICOM) to revise its import food policy. Cattle and livestock production will also be affected. The shift towards biofuels as part of an adaptation strategy for climate change will further add mounting pressures on food prices, as farmers convert their livestock and crop lands to growing feedstock for the biofuel industry. This may be particularly apparent in the United States and Brazil which are key international suppliers of staple crops such as wheat, maize and corn. The International Fund for Agricultural Development (IFAD) has predicted that “the number of food-insecure people in the world would rise by more than 16 million for every percentage point increase in the real prices of staple foods, meaning that 1.2 billion people could be chronically hungry by 2025” (Raswant *et al.*, 2008).



### Rising sea levels, rising ocean temperatures and coastal flooding will affect livelihoods of coastal and fishing communities and marine life

The IPCC has estimated a sea level rise between 0.18 m and 0.6 m in the next century and this is likely to contribute to flooding and destruction of coastal areas inclusive of sea grass beds and mangroves. With rising ocean temperatures, it is projected that the intensity of hurricanes may increase while the geographical areas over which cyclones form could extend, thereby putting more coastal areas at risk. Anticipated increases in sea surface temperatures of about 1-3°C will increase the incidence of coral bleaching events, affect the distribution range of fish species and threaten the viability of fish stocks. Coastal and fishing communities will become increasingly vulnerable to disasters and destruction of their livelihoods, especially in the mega deltas of Asia and Africa and small islands of the Caribbean.

### Inequalities in water supply and water availability may deepen

The IPCC projects that water availability is likely to increase by 10%-40% at high altitudes and decrease by 10%-30% in some dry regions such as the Middle East, southern Africa and Australia inclusive of areas that are already water stressed. Glaciers store water in winter and melt at predictable rates in the summer, feeding water systems that allow communities and economies to thrive. Their current increased rates of melting may jeopardize the availability of water to such communities in the future thereby affecting around one sixth of the world's population. In dry areas where rainfall may become even scarcer, the water crisis will deepen with the possibility of increased conflict as countries and communities compete for water. Agriculture will be affected with consequent food shortages and further increases in food prices.

### Increased incidence of costly disasters and implications for the insurance industry

The increased probability and actual occurrence of large-scale disasters may well endanger the viability of insurance companies as increased claims on most forms of insurance (property, liability, health and life) may need to be met. Under these circumstances, insurance premiums are expected to rise as companies struggle to cover deeper losses, thereby causing some segments of the population to fall out of the insurance safety net. The insurance industry has been raising alarms about the risks posed by climate change to its viability and affordability and has been urging governments and the private sector to consider new forms of risk transfer. The insurance industry is also encouraging stakeholders to invest more in risk reduction and disaster prevention. One such initiative, The Climate Wise Initiative,<sup>9</sup> was launched by a group of leading organizations and companies in the insurance industry covering Europe, North America and southern Africa to stimulate work in the area of climate –change risk analysis and risk reduction. In the Caribbean, the Caribbean Catastrophe Risk Insurance Facility (CCRIF)<sup>10</sup> which is a regional facility has been implemented in order to provide compensation for disaster losses.

### Impact on health and spread of diseases

Climatic factors impact on various vector-borne diseases, many enteric illnesses and some water-related diseases. There will be positive effects from climate change on health such as a reduction in the seasonal winter-time peak in deaths in temperate countries due to influenza as a result of milder winters. However, scientists project that most of the health impacts from climate change will be adverse. In its 2002 report, the World Health Organization (WHO, 2002) estimated that climate change was responsible in 2000 for 2.4% of diarrhoea cases and 6% of malaria, worldwide. Examples of adverse health impact

<sup>9</sup> <http://www.climatewise.org.uk/>

<sup>10</sup> <http://www.ccrif.org/>

will include: (a) increased heat-related mortality and morbidity; (b) greater frequency of infectious epidemics as a result of climate-related disasters and extreme weather, such as floods and storms; (c) increased risks of diseases and illnesses for populations displaced due to rising sea levels and disasters; (d) increased risks of illnesses associated with proliferation of insects, bacteria, viruses and pathogens in warmer climate; and (e) nutritional deficiencies from potential disruptions in global and local food production and food prices. There will also be negative implications on human productivity and household income and savings.

#### The special case of small islands: environmental vulnerability and impact on tourism

The 51 Small Island Developing States (SIDS), including 12 Least Developed Countries (LDCs), may be among the most affected by the threat of climate change despite the fact that they contribute less than 1% to GHG emissions. A few of these SIDS have been among the first to experience the effects of climate change as two uninhabited islands of Kiribati disappeared under water in 1999. Increases in ocean surface temperatures around SIDS have already been reported, and are projected, to rise causing increased precipitation and heavy rainfall, sea level rise, destruction of sea grass beds and mangroves, bleaching of corals, saline intrusion that is harmful to agricultural lands and deadlier cyclones/hurricanes. Economic losses for SIDS are not limited only to losses from tourism and agriculture, but also encompass real and serious threats of disappearance of these islands.

### **IV. CLIMATE CHANGE - ECONOMIC GAINS AND DISTRIBUTIONAL IMPACT**

Despite the documented challenges associated with climate change, the picture is not all negative as there is potential for opportunities in the following sectors:

#### Investment and reform

Climate change is likely to generate incentives for substantial investment in clean technologies, in more resilient infrastructure and in disaster prevention and mitigation facilities as well as incentives for innovation in several sectors ranging from industry to agriculture and biotechnology. Such investments could generate increased aggregate demand for a new range of goods and services, create new jobs, as well as generate increases in productivity. Climate change may also provide the economic and environmental shocks that can allow countries to reform their legislation, policies, and institutions in order to veer from a path of low sustainable development towards a long-term path of high sustainable development. Of importance here is to ensure that such opportunities do not only benefit the private sector but also the wider stakeholder community.

#### Agriculture and tourism

Climate change will alter patterns of comparative advantage in the production of several goods and services due to changes in climatic conditions and due to variations in the magnitude and distribution of global warming across regions. Shifts in comparative advantage across regions are likely in agriculture, tourism, shipping and oil drilling. As temperatures increase, more moisture will evaporate resulting in increased short-term precipitation in some areas. Some dry regions may experience an increase in rainfall which will benefit their agricultural sector. Other countries will gain as the crops they currently produce experience increases in yields or as crops that hitherto they could not grow are now fit for plantation. According to the IPCC 2007 Report, crop productivity may actually increase in mid to high latitudes depending on the range of anticipated temperature increase (1°C - 3° C). Similarly, it may be expected

that regions closer to the equator are likely to experience losses in their GDP as a result of warmer climates that may be too hot. However, regions closer to the Poles may benefit from cooler climates that are attractive to tourists. Big projected winners include the United States (+13.7 % in tourism arrivals by 2100), Canada (+220 %), Russia (+174 %) and Mongolia (+122 %) and big losers will include Mauritania (-60 %), Mali (-59 %), Bahrain (-58%), Macau (-48 %), Aruba (-42 %) and Jamaica (-30 %) (Morin, 2006).

#### Savings/increases in energy consumption

Climate change is likely to be accompanied by changes in the pattern of energy demand worldwide. Areas close to the North Pole are likely to be able to reduce their energy demand in winter as temperatures rise. However, such gains might be offset by accrued energy needs in summer for air cooling. Caribbean countries, on the other hand, may experience an increase in energy demand due to warmer summers (Taylor *et al.*, 2007).

#### The emergence of “green” technologies, “green” businesses, “green jobs” and “green” economies

An industry segment likely to prosper as a result of the climate change debate is what can be referred to as “green” industries. These will be industries focusing on seeking alternatives to the use of fossil-fuel such as “green energy” industries (biofuel, hydro, solar, wind and geothermal power companies and their suppliers); industries devoting research and development to develop energy-efficient and clean technologies (such as fuel cell suppliers, hybrid car makers, pollution control companies and biotechnology firms) and industries devoted to creating a new range of environmentally-friendly products and services (such as water purification system suppliers, waste recycling companies and organic food companies). These businesses are likely to benefit from increased policy support from governments that are eager to combat climate change in the form of subsidies, tax concessions, environmental regulations and mandated legislation. They are also likely to benefit from increased consumer awareness about the need to promote sustainable practices. As governments encourage the build-up of “green” economies and creation of “green” jobs, the “green” industry sector stands to gain in the form of profits and enlarged market sizes. However, populations also stand to gain in the form of availability of new jobs.

Overall, however, the size of the economic gains is unlikely to exceed the losses. Moreover these gains will tend to be located in specific regions, especially the northern hemisphere. Countries will need to position themselves early to be able to benefit economically from climate change, for example, by encouraging the development of “green” industries through the provision of incentives and the forging of strategic alliances among business, labour and governments. It must also be borne in mind that climate change can be a window of opportunity for economic gains and national and global transformation. However, taking advantage of these opportunities will demand the development and implementation of appropriate economic and environmental policies especially fiscal, energy, technology and industrialization policies.

## V. THE NEED FOR ECONOMIC SOLUTIONS

Any sustainable solution to addressing the impacts of climate change will need to involve the stabilisation of GHG emissions in the future within a clearly-defined international climate change policy. Current levels of CO<sub>2</sub> and other greenhouse gases (in terms of CO<sub>2</sub> equivalents) in the atmosphere amount to 430 parts per million (ppm) and are set to increase to 550 ppm by 2035, if current rates of growth in GHG emissions persist (Arrow, 2007). This compares to 280 ppm before the industrial revolution, placing them at levels not reached over millions of years (IPCC)<sup>11</sup>. Given that such emissions are irreversible and removing them from the atmosphere will take centuries, the best course of action now is to stabilize atmospheric concentration of GHG at levels that will contain future increases in global temperatures. The stabilization of GHG emissions can involve several components:

- (a) Reducing GHG emissions by limiting their production through man-made activities (via “command and control” measures such as quotas, technical or emission standards and regulation) and/or through increasing the costs for the emitters to emit GHG (via price or market-based measures such as pollution taxes and creation of carbon markets);
- (b) Removing GHG emissions from the atmosphere through adaptation, such as the spread of carbon sinks and the use of the Reducing Emissions from Degradation and Deforestation (REDD) initiative, as is being proposed by Belize and Guyana;
- (c) Limiting GHG emissions from industrial and manufacturing processes through research, scientific and technological development and carbon sequestration policies that lead to low emissions or emissions-removal technologies. This is in keeping with the Low Carbon Development Strategy that is also being proposed by Guyana.

## VI. THE CARIBBEAN SITUATION

Like other regions, the Caribbean will be impacted by climate change both in terms of economic gains and economic losses. Economic losses are likely to accrue mainly in the costs imposed by stronger hurricanes and from disruptions to agriculture and tourism<sup>12</sup>. Further research on the socio-economic impacts of climate change is needed both at a regional and national level along with research on the cost-effectiveness of proposed mitigation and adaptation measures. However, there is a need to formulate national adaptation and mitigation plans in non-Caribbean Community (CARICOM) countries in the Caribbean subregion, especially the Dutch-speaking Caribbean and Haiti, as well increasing implementation in countries where such plans already exist. These initiatives have been addressed under the Caribbean Planning for Adaptation to Climate Change (CPACC), Adapting to Climate Change (ACC) and the Mainstreaming Adaptation to Climate Change (MACC) activities<sup>13</sup>. Such plans should be accompanied by a diagnosis of national capacity constraints in terms of implementation and national

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<sup>11</sup> The United Nations Development Programme in its Human Development Report 2007/08 argues that emissions should be stabilized to 450 ppm to control global average temperature increase to 2°C and that any increases above this threshold imposes serious disaster risks and “tipping point” effects.

<sup>12</sup> According to a study by the Stockholm Environment Institute at Tufts University released in 2008, the costs to the Caribbean region for failing to take action on climate change could amount to losses of 5% of the region’s 2004 GDP by 2025 and 10% by 2050. These calculations are based on three types of effects: damages from hurricanes; losses from tourism and damages from infrastructure. The costs of inaction calculated as a percentage of 2004 national GDP by 2025 were between 10%-15% for Anguilla, Antigua and Barbuda, Jamaica, Montserrat, Saint Lucia and Saint Vincent and the Grenadines; between 15%-20% for Dominica, Saint Kitts and Nevis and Turks and Caicos and above 20% for Grenada and Haiti.

<sup>13</sup> <http://www.caricom.org/jsp/projects/macc%20project/cpacc.jsp>

capacity-building strategies and accompanied by well-defined resource mobilization strategies for financing their implementation. In this regard, the CARICOM Secretariat is currently elaborating a regional climate change adaptation strategy for the Caribbean subregion. There will also be a need to integrate the policy recommendations of that regional strategy into the existing policy frameworks of the CARICOM countries of the subregion.

Given that in a post-2012 Kyoto Protocol world, developing countries may be expected to contribute to reductions of GHG emissions, the Caribbean will need to focus both on mitigation and adaptation policies. So far, though, greater efforts have been laid mainly on adaptation. It is to be noted that 11 Caribbean countries are among the top 90 carbon dioxide emitters per capita in the world<sup>14</sup>. Mitigation should focus on transitioning Caribbean countries to low-carbon based economies structured on well-defined national energy policies. The promotion of energy-efficiency and use of alternatives to fossil fuels need to become regional and national priorities. Public policy should be aimed at:

- Supporting the development and use of renewable sources of energy in the energy sector including biofuels, hydro, solar, wind and geothermal energy systems
- Supporting the development of public transport systems to promote energy savings in the transport sector
- Mandating energy efficiency requirements in various industries including the automotive industry
- Supporting research and innovation in energy-efficient technologies at knowledge centres;
- Providing incentives for the transfer and adaptation of clean technology from developed countries to the Caribbean
- Introducing incentives for households and the tourism sector to switch to energy saving habits (for example, encouraging the use of solar-heaters and phasing out of incandescent bulbs)
- The conduct of energy audits in various industries

There is a need to promote integration of disaster preparedness, disaster prevention and risk reduction in existing national and regional programmes. The Caribbean Disaster Emergency Management Agency (CDEMA) has a key role to play here in facilitating the adaptive response of the subregion to climate-change related disasters. Efforts should be geared towards implementing CDEMA's Strategy for Comprehensive Disaster Management (CDM). The ongoing CDEMA project "Adaptation for climate change and disaster mitigation" specifically aims at assisting Caribbean countries in developing adaptation strategies to deal with the impact of climate change-related natural disasters and weather events, and strengthening capacities for such adaptation.

Micro-level and macro-level insurance initiatives, such as the issue of catastrophe bonds and the pooling and transfer of risks and losses at a national and regional level, need to be encouraged to provide safeguards both for households and for economic and productive sectors against losses from climate-change disasters. Participation of Caribbean countries in the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR) will need to be consolidated. In terms of tourism, the subregion may need to fast track in implementation of the "Regional Policy Framework for a more Sustainable Development of Tourism in the Caribbean" which is being spearheaded by the Caribbean Tourism Organization (CTO). Economic diversification away from tourism and agriculture and towards less climate-sensitive sectors needs to be encouraged.

Economic opportunities may arise for the subregion if the right economic and environmental policies are put in place. In the context of the Caribbean, new "green" sectors such as organic agriculture,

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<sup>14</sup> Based on 2004 data for carbon dioxide emissions in metric tons per capita for 206 countries. See [http://en.wikipedia.org/wiki/List\\_of\\_countries\\_by\\_carbon\\_dioxide\\_emissions\\_per\\_capita](http://en.wikipedia.org/wiki/List_of_countries_by_carbon_dioxide_emissions_per_capita).

biotechnology, carbon neutral tourism and renewable energy should be identified for development through foreign direct investment, if needed. The subregion could also seize the opportunity offered by climate change to start the building of “green” national economies. Barbados has already taken the lead in that respect. It has identified the building of a green economy as one of its five main development pillars over the next 20 years. Regional initiatives in sustainable development need to be fostered.

## VII. ECLAC AND CLIMATE CHANGE IN THE CARIBBEAN

In 2008, ECLAC, in collaboration with the Caribbean Community Climate Change Centre (CCCCC) and with support from the Department for International Development of Great Britain and Northern Ireland (DFID), embarked on an initiative entitled a “Review of the Economics of Climate Change” (RECC) in the Caribbean. The overall objective of the project is to provide policy advice to Caribbean Development and Cooperation Committee (CDCC) member countries of the costs of adapting to, and mitigating against, the impacts of climate change and comparing these costs with the activities that countries are currently conducting, that is the BAU scenario. This project comprised three phases as follows:

Phase I: A scoping study to obtain background information on the national situation with respect to adaptation and mitigation in CDCC member countries was conducted. A subset, comprising nine of these countries, participated in national consultations from which information was used to inform national reports. This phase also examined various Global Economic Models to determine their suitability and applicability for use in the Caribbean economic assessment. It was determined that the Caribbean assessment would be better informed through the use of relevant mathematical formulae that would capture the specialties of the subregion. This information from the first two activities was then utilized in preparation of a project document that would inform Phases II and III of the RECC.

Phase II: This phase would comprise the preparation of regional, sectoral<sup>15</sup> reports focusing on the costs of the BAU scenario as well as projections to 2100 utilizing a baseline that would be facilitated by available data. The studies would cost adaptive and mitigative measures utilizing the IPCC A2<sup>16</sup> and B2<sup>17</sup> scenarios. Phase IIa would comprise studies on the macroeconomy, agriculture, energy, tourism and water, while Phase IIb would address the other sectors. The reports from Phase IIa would be compiled into a single Caribbean position paper that would be available to policymakers in time for the 15<sup>th</sup> Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC) that would take place in Copenhagen in December 2009. This paper would also be compiled into a report on Latin America and the Caribbean. To date, preliminary results indicate that changes in temperature and precipitation would, indeed, result in reduced economic growth in the Caribbean subregion (figure 1); decreased tourist arrivals (figure 2); and lower agricultural productivity as water becomes scarce (figure 3). Detailed analyses are being conducted using the A2 and B2 scenarios as outlined in the 4<sup>th</sup> Assessment Report of the IPCC.

Phase III: This would comprise the conduct of national, sectoral studies focusing on building institutional and technical capacity to conduct future studies. The objectives would be to determine the

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<sup>15</sup> Macroeconomy, agriculture, water, tourism, energy, coastal, marine and terrestrial resources, biodiversity, land use, health, extreme events.

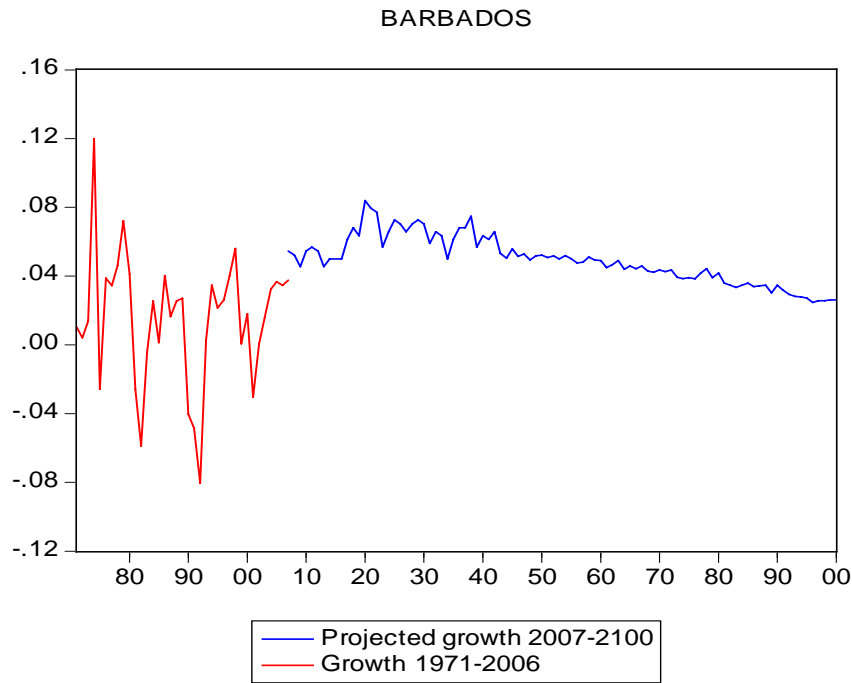
<sup>16</sup> Heterogeneous world; Self-reliance and preservation of local identities; Increasing populations; Economic development regionally oriented; Per capita economic growth fragmented; Technological change fragmented.

<sup>17</sup> World with emphasis on local solutions to economic, social and environmental sustainability; Increasing global population but at a rate lower than A2; Intermediate level of economic dev.; Less rapid and more diverse technological change than in the A1 and B1 storylines; Focus on local and regional initiatives towards environmental protection and social equity.

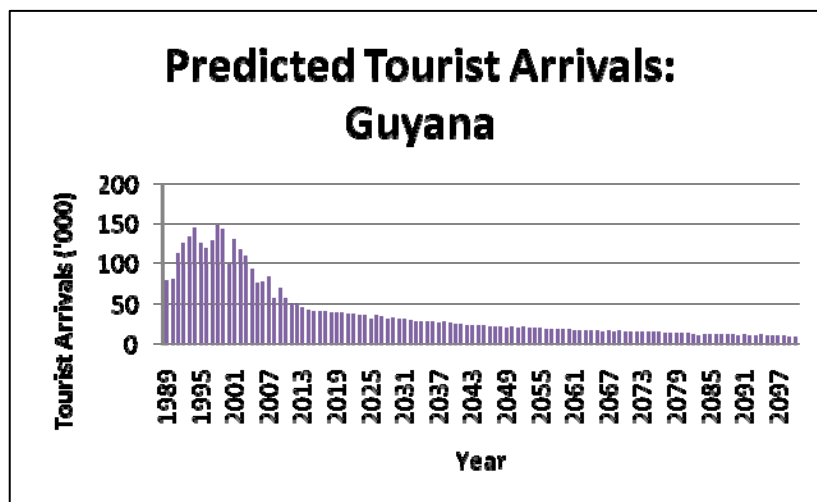
BAU costs, the projected adaptive and mitigative costs as well as to build national capacity to conduct the studies.

It is expected that at the end of the project in 2011, the costs of BAU as well as adaptive and mitigative strategies would be determined and the national and regional capacity to conduct the studies would have been increased.

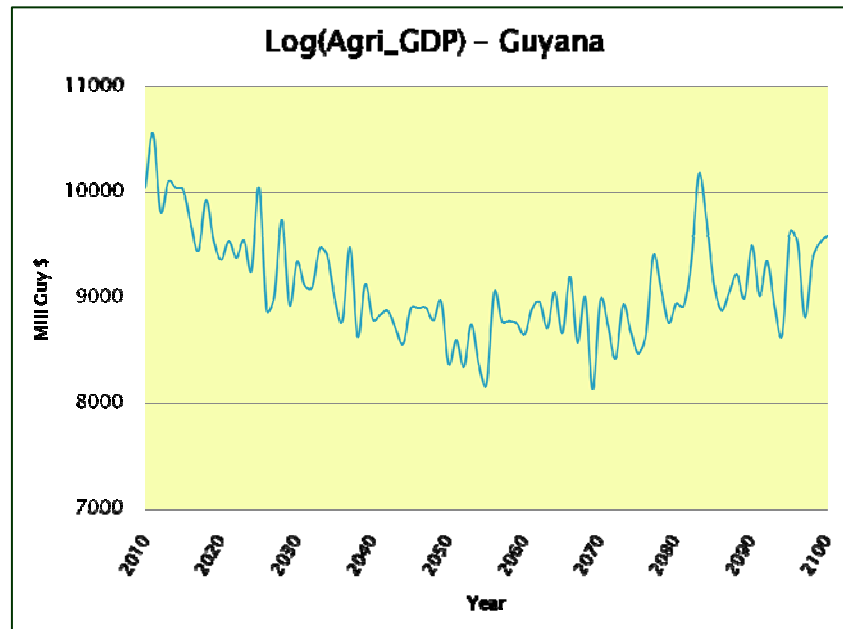
**Figure 1**  
**Economic Growth in Barbados – past, present and projected**



**Figure 2**  
**Tourist arrivals in Guyana – past, present and projected**



**Figure 3**  
**Water and agriculture in Guyana – projected impacts**



## VIII. RECOMMENDATIONS AND CONCLUSION

Climate change requires an adjustment to the way that business is done and, in this context, the following recommendations are made:

### A. AT THE NATIONAL LEVEL

- (a) Countries would need to embark on macroplanning that would ensure, in the years ahead, that their economies would be “climate-proofed”. This requires the implementation of initiatives to mainstream climate change adaptation and mitigation programmes into national, strategic development planning and budgetary frameworks; policymakers would need to offer incentives to stakeholders in obtaining support for climate-friendly technologies. These may take the form of subsidies on equipment and tax incentives. The incentive strategies and policies should be accompanied by careful monitoring and evaluation exercises to ensure that they are effective and do not create adverse unintended outcomes. In concert with economic incentives, public awareness campaigns and capacity-building initiatives should be pursued to encourage stakeholders to support the introduction of alternative energy technologies
- (b) The pursuit of sustainable programmes will, on the part of all stakeholders, need to be apparent and not only on a short-term basis, but on a sustained basis so as to ensure that this forms part of national thinking that would be passed on to future generations
- (c) The movement towards energy efficiency and alternative energy should be pursued in a participatory manner involving especially civil society, as this would encourage and support ownership of the decision-making process and, therefore, support for it



- (d) There is considerable evidence that the new wave of alternative energy will open tremendous economic opportunities for investors, and the Caribbean stands to gain considerably by a proactive approach to developing alternative energy policies and strategies
- (e) Caribbean countries would need to come to terms with the fact that even if they are not high emitters of GHG they are indeed negatively impacted by the climatic changes that facilitate such emissions, and that national action still needs to be taken in support of global initiatives
- (f) In parallel with adaptation strategies, greater focus on mitigation by Caribbean economies should be promoted. Promotion of energy-efficient technologies should also be a large part of any adaptive and mitigative strategy. Research into the use of biofuels should continue, and the links with biotechnology need to be made in support of crops and livestock that are tolerant of changing climatic conditions
- (g) In light of the commonality of the problems of climate change, a regional approach in collaboration with extraregional, like-minded parties should be pursued to allow the Caribbean to operate at the frontier of knowledge in identifying and developing possible mitigating strategies. The costs and benefits of various strategies must be carefully evaluated in a risk management framework which would allow for transparency and the best possible outcomes
- (h) Businesses will need to adjust their processes in response to climate change so as to create opportunities for investment in ‘green’ and efficient technologies.

## **B. AT THE INTERNATIONAL LEVEL**

- (a) The international donor community will need to integrate support for climate change actions into their aid assistance packages and determine how climate change will affect aid effectiveness
- (b) Developed countries would need to support the flexibility mechanisms of the Kyoto Protocol and work in conjunction with developing countries in the drafting of the post-2012 Protocol that would reflect the economic, social and environmental interests of developing countries
- (c) Climate change will also require an adjustment in how success and progress are measured and how economic welfare is valued
- (d) So far, economic and business models have emphasized the pursuit of pecuniary profits and the pursuit of economic growth. This means that traditional economic thinking, model building and forecasting will need to incorporate the risks and effects of climate in a genuine way and not as an appendage to their existing results

Climate change requires a shift to a development paradigm that values not only economic growth and the augmentation of financial assets but also one that values environmental assets that cannot be transacted through markets. The use of “green” national accounting methods needs to be encouraged. Economists need to integrate environmental considerations in their welfare maximization calculus and optimal decision-making. Sustainable development models need to replace economic growth models. The world, as a whole, needs to start paying attention to sustainable development indicators in addition to conventional economic and financial indicators. To successfully combat climate change, a departure from BAU approaches is needed in analysis and policymaking in all major economic spheres.

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