CLIMATE CHANGE TECHNOLOGY TRANSFER

NEEDS ASSESSMENT FOR

THE COMMONWEALTH

OF DOMINICA

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The following Climate Change Technology Needs Assessment was carried out during the course of the first six months of 2004. The activity forms a part of the climate change enabling activity being implemented by the Government of Dominica with support from the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP). The activity is aimed at facilitating the fulfillment of reporting and other commitments under the United Nations Framework Convention on Climate Change (UNFCCC).

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1. BACKGROUND

1.1. Initial National Communication

In March 1994, the Government of the Commonwealth of Dominica ratified the United Nations Convention on Climate Change (UNFCCC) and joined the community of nations committed to combating global climate change.

Under Article 12 of the UNFCCC, countries must submit National Communications to the Conference of Parties (COP) on a periodic basis. Dominica, cognizant of its obligations under this Article, submitted its Initial National Communication (INC) in December 2001. This INC was developed as part of an Enabling Activity, financed by the Global Environmental Facility (GEF) and implemented in collaboration with the United Nations Development Program (UNDP).

The main components of the INC were:

- An inventory of greenhouse gases following the guidelines adopted by the Conference of Parties (COP);
- An assessment of the potential impacts of climate change in Dominica;
- An analysis of potential measures to abate the increase in greenhouse gas emissions and to adapt to climate change; and
- Preparation of a National Action Plan to address climate change and its adverse impacts.

The INC process enhanced the general awareness and knowledge of climate change-related issues in Dominica and strengthened the dialogue, information exchange and cooperation among all relevant stakeholders including Government, non-government, academic and private sector agencies.

1.2. Climate Change Adaptation Policy

The INC process was followed by the development of a National Climate Change Adaptation Policy which was adopted by the Cabinet in 2002.

This National Climate Change Adaptation Policy include provisions "to foster the development of processes, plans and strategies to avoid, minimize, adapt or mitigate to the negative impacts of climate change on Dominica's natural environment … on economic activities …to human settlements and infrastructure …on human health …"[1]

The policy is guided by seventeen (17) Policy Principles, which include:

- Integrate climate change development policies, plans and projects and incorporating appropriate adaptive responses;

[1] Dominica National Climate Change Adaptation Policy

- Ensure that adaptive responses are consistent with national social, economic and environmental development goals;

- Take adaptive action where State property, resources and services are likely to be adversely affected by climate change;

- Ensure that society, at all levels, and in all sectors is adequately informed on climate change issues and their implications for the nation.

It also contains a listing of Policy Directives for a range of socio-economic sectors including Coastal and Marine Resources, Agriculture, Human Settlements, Forestry and Terrestrial Resources, Water Resources, Health, Tourism, and the Financial Sector.

The policy is intended to guide the work of all Governmental, Statutory, Non-governmental and Civil entities which are involved in or which may seek to become involved in addressing Climate Change issues and their impacts in Dominica[2]. Responsibility for its implementation has been assigned to the Ministry of Agriculture and the Environment through the Environmental Coordinating Unit (ECU).

The Policy includes a provision for a public review to determine its effectiveness, which should be conducted on its fifth anniversary.

1.3. Scope of Phase II Project

The Phase II Enabling Activity is a capacity building project intended to build upon the activities completed in the context of Dominica's INC. The overall goal is to allow Dominica to extend current knowledge to facilitate the emergence of national networks and promote the integration of climate change concerns in the developing national dialogue.

The Phase II project was designed to generate the following outputs:

- Identification and submission of technology needs;

- Capacity building to assess technology needs, modalities to acquire them and absorb them, design, evaluate and host projects;

- Capacity building for participation in Systematic Observation networks; and

- Preparation of programs to address climate change improvement of emission factors.

1.4. Methodology

Project implementation focused on:

- Describing the current state of national programming in each of the specified areas (technology needs, systematic observation, emission factors);

[2] Dominica National Climate Change Adaptation Policy

- Analysis of the strengths and weaknesses in programming; and

- Definition of priority needs for building capacity.

The project was implemented by a team of consultants – one for each of the three (3) areas, coordinated by an International Consultant – working in collaboration with the Environmental Coordinating Unit. Separate detailed reports were prepared for each thematic area and form the basis for this consolidated report.

The implementation methodology was very participatory and included consultations with stakeholders at the start of the project, upon completion of the draft thematic reports and upon completion of the draft national report. These consultations proved very useful in ensuring the integrity of the data collection and analysis, and in ensuring that the final outputs were owned and accepted by the national stakeholders.

2. CLIMATE CHANGE IN DOMINICA

2.1. Overview of Dominica

2.1.1. Physical Features

Dominica is located at 15 degrees North and 61 degrees West occupying a central position in the eastern Caribbean archipelago. The country is bordered by the French territories of Guadeloupe and Martinique to the north and south respectively. The island is approximately 750.6 square kilometers and is the largest in the Windward and Leeward groups of the eastern Caribbean.

Dominica is virtually solely volcanic in origin and is characterized by very rugged and steep terrain with approximately ninety miles of coastline. The northern half of the island is dominated by the country's highest summit, Morne Diablotin. A chain of mountains extends from the islands center to the south and the topography is characterized by a number of ridges and steep river valleys with flatter lands being restricted to narrow coastal strips, particularly in the center and northeast of the island. The islands volcanic natural history remains evident in continuing seismic activity and in areas such as the Valley of Desolation and the Boiling Lake.

Dominica has rich volcanic soil and is well watered by numerous streams and rivers. The high mountains and deep ravines are covered in rich tropical forests. Since 1975, an extensive system of national protected areas has provided some protection for approximately 20% of the national territory. Protected areas include one (1) marine park, two (2) forest reserves (Central and Northern) and the Morne Trois Pitons National Park, a UNESCO World Heritage Site.

2.1.2. Biodiversity

Notwithstanding its small size, Dominica possesses an extensive range of terrestrial and marine biodiversity. In terms of terrestrial flora, some 155 families, 672 genera and 1226 species of vascular plants have been identified on the island. A number of plant species are considered endemic to the island. Seven (7) distinct vegetation communities are present ranging from montane rainforest to coastal swamp and dry scrub woodland. Fumarole vegetation associated with volcanic activity is also present. In terms of terrestrial fauna Dominica contains the most diverse stock of wildlife species in the eastern Caribbean. This includes some 175 species of birds, 18 species of wild mammal, 15 reptile species, amphibians, and various species of freshwater and estuarine fish and crustaceans.

Biodiversity is equally spectacular in the marine and coastal environment as the country's underwater topography and estuarine areas provide habitats for a large number of species. Marine and coastal ecosystems include beaches, river estuaries and wetland areas, rocky foreshores, and coral reefs. Among the main threats to biodiversity in Dominica are deforestation, pollution, overexploitation of resources, unregulated development, natural disasters, and impacts from climate change.

2.1.3. Climate

Dominica's climate is characterized as tropical maritime with dominant influences being the Atlantic Ocean, the Caribbean Sea, and the northeasterly trade winds. As a result of **its**

mountainous terrain the island possesses a number of micro-climates. Rainfall is distributed between a dry season from December to May and a rainy season from June to November. The western Caribbean coast is in the rain shadow of the various mountain ranges and average rainfall along that coast is significantly less than in interior locations. Limitations in measuring equipment have restricted the ability to maintain meteorological records of interior areas. High rainfall makes the island susceptible to landslides particularly in mountainous areas. Dominica's rugged topography results in considerable amount of orographic rainfall.

Table 2.1(a) and Table 2.1(b) below provides rainfall and temperature data. The data provided by both Tables indicates the significant climatic differences that may exist within Dominica, despite the small size of the country**.**

Table 2.1(a): Data Recorded at Melville Hall Airport Temperature[3], Rainfall and Humidity (1994-2003)

Year	**Average Maximum Temperature**	**Average Annual Temperature**	**Total Rainfall (Mm)**	**Average Relative Humidity (%)**
1994	30.5	21.0	1950.6	75
1995	31.6	20.8	2873.8	76
1996	30.8	21.3	2709.0	77
1997	30.9	21.8	2195.1	76
1998	31.8	21.6	3319.5	79
1999	31.2	21.2	2309.1	77
2000	30.5	21.2	2309.1	77
2001	30.6	21.6	2415.8	77
2002	30.4	21.4	2365.9	78
2003	31.0	21.2	2719.0	76

Source: Commonwealth of Dominica Meteorological Office. 2004.

Table 2.1(b): Data recorded at Canefield Airport Temperature, Rainfall and Humidity

Year	Max. Mean Annual Air Temperature	Min. Mean Annual Temperature	Total Rainfall (Mm)	Average Relative Humidity (%)
1994	**32.1**	**21.1**	**1459.6**	**70**
1995	**32.9**	**22.2**	**1707.2**	**72**
1996	**31.9**	**21.8**	**1986.3**	**72**
1997	**32.6**	**21.8**	**1759.9**	**69**
1998	**33.0**	**22.5**	**2204.0**	**72**
1999	**31.9**	**22.5**	**1672.0**	**70**
2000	**32.3**	**21.7**	**1266.1**	**68**
2001	**32.5**	**21.7**	**1573.2**	**67**
2002	**32.3**	**21.8**	**1476.8**	**68**
2003	**32.7**	**22.2**	**1644.0**	**68**

Source: Commonwealth of Dominica Meteorological Office. 2004

The island is located within the Atlantic hurricane belt. Hurricanes are characterized by strong winds and are generally accompanied by heavy rainfall and by storm surges in coastal areas. Impacts of these storms include loss of life, damage to property, and disruptions to the natural environment. Rainfall associated with the passage of tropical weather systems is an important source of freshwater.

[3] Degrees centigrade

2.1.4. Demography

The island was originally populated by Amerindian peoples, known as Caribs and is the only island in the Caribbean still to possess distinct communities of these indigenous people of the Caribbean. The islands vibrant cultural traditions reflect its African, European, and Amerindian heritage.

Population estimates for 2001 indicate that Dominica had a population of approximately 71,000[4] persons. This reflects a decline from 74,750 in 1994. Topographic conditions have forced human settlements onto narrow coastal areas particularly in the south and west with approximately 44,000 persons (62%) living along the coast. Table 2.2 below provides some basic demographic data for Dominica.

Table 2.2: Dominica Population 1980 - 2001

1980	*1991*	*2001*	*% Change 1980-90*	*% Change 1991-2001*	*Net migration rate 1990/91*	*Unemployment rate (1996)*
73,795	**71,183**	**71,242**	**-3.5**	**0.1**	**-9.8**	**Male Female**
						9.8 9.2

Source: OECS Human Development Report 2002

2.1.5. Economy

Dominica's economy has traditionally been dominated by agricultural production and export. Dominica's agricultural sector is composed primarily of a large number of small farmers cultivating less than 10 hectares of land and with minimal technological and scientific inputs. By the 1970s, banana production and export, based on a preferential access regime for bananas in the UK, was the principal source of foreign exchange and employment. The collapse of protected markets for the fruit in the latter half of the 1990s has been catastrophic for the industry in Dominica as well as having major adverse impacts on other sectors of the national economy.

Table 2.3 provides some select economic indicators for Dominica. The information in the Table demonstrates many of the economic difficulties facing Dominica. These are reflected in such indicators as the steadily worsening gap between government revenues and expenditures, the dramatic decline in banana production, and the fluctuations in tourism arrivals.

The structural weaknesses in the economy and the worsening fiscal situation resulted in the Government of Dominica embarking on an economic stabilization programme with the International Monetary Fund (IMF) beginning in 2001. This programme is aimed, among other things, at maintaining fiscal stability and energizing economic growth. The programme emphasizes the role of government as a facilitator of economic activity with only a minimal role in direct provision of non-essential services, and is intended to reduce public sector expenditure to sustainable levels.

[4] *It is believed that recent economic difficulties have resulted in fairly extensive migration from Dominica as well as increased seasonal and other movement*.

Table 2.3: Dominica Select Economic Indicators 1995-2001

	Unit	1995	1996	1997	1998	1999	2000	2001
Value of exports (FOB)	EC$m.	135.71	142.41	145.16	170.34	151.11	150.11	120.60
Value of imports (CIF)	EC$m.	329.80	326.73	345.25	346.29	397.07	417.87	371.21
Balance of visible trade	EC$m.	(194.09)	(184.32)	(200.09)	(175.95)	(245.96)	(267.76)	(248.61)
Government Recurrent revenue	EC$m.	155.03	173.83	188.61	205.00	200.74	209.66	198.14
Government Recurrent Expenditure	EC$m.	155.06	166.50	184.74	194.77	206.49	217.71	225.32
Total stay over visitors	000s	60.47	63.26	65.45	65.50	73.51	69.58	67.65
Cruise ship visitors	000s	134.92	193.48	230.58	244.60	201.94	239.80	207.63
Electricity generated	000kwh	56,227	60,093	65,783	70,300	77,512	77,520	80,970
Bananas exported	Tonnes	33,070	43,012	37,366	28,602	28,515	29,840	20,240
Total external debt	EC$m.	278.19	276.64	240.29	245.42	247.71	267.74	327.92

Source: Eastern Caribbean Central Bank. National Accounts Statistics 2002.

Dominica possesses a relatively small but developing tourism sector based on the country's natural attractions - particularly its forests and marine resources. Government policy envisages nature-based tourism as constituting the principal platform for facilitating private sector led economic growth, alongside a diversified agricultural sector and service industries in such areas as offshore medical and financial services. A number of mid-sized hotels and a growing number of smaller eco-oriented inns and lodges presently characterize the hotel sector. Dominica's tourism attractions include its flora, fauna and other land based natural features, world-class offshore diving and whale watching and cultural festivals and activities.

A primary obstacle to the growth of Dominica's tourism industry has been the lack of adequate facilities for direct international air travel from the major tourism markets in Europe and North America. This is due to the extremely mountainous nature of the island that has served as a barrier to construction of an airstrip capable of accommodating large aircraft. Other problems confronting the sector include high operating costs, competition from other destinations, limited marketing, and the need for development of ancillary services.

Table 2.3 indicates the increasing significance of the cruise ship sector. While resulting in increased numbers of tourists, the growth of mass based cruise tourism also presents challenges for Dominica in terms of issues such as carrying capacity and sustainable use of many of its main tourism attractions.

Dominica's manufacturing sector consists primarily of a number of light industries producing for the domestic and regional market. Manufactured goods include soaps and agro-processed items for regional and international markets as well as beverages, furniture and textiles for the local

market. As with other eastern Caribbean countries, Dominica's manufactured products are faced with high production costs, small markets, and competition from lower cost regional and international producers. Proposals for further liberalization of regional, hemispheric and international trade will present additional competitive challenges for these industries.

2.1.6. Energy Use

Electricity constitutes the primary source of commercial energy for industrial and other uses in Dominica. The country presently has an installed capacity of 21 megawatts consisting of 6MW (28.5%) of hydropower and 15MW of diesel powered units. During the 1960s, approximately 90% of electricity was derived from domestic hydro sources but this source is now believed to be close to its maximum exploitation in terms of economic feasibility and environmental protection concerns. The main end users of electricity are domestic, commercial and institutional customers and the pattern of consumption demonstrates the low energy use of industry and other non-domestic consumption at this time as illustrated in **Table 2.4**.

Table 2.4: Electricity Operating Statistics Generation Sales and Consumers

DESCRIPTION	2003	2002	2001	2000	1999
Peak Demand (Kw)	12,923	13,043	13,866	12,966	13,010
Growth (%)	*(0.9)*	*(0.6)*	*6.9*	*(0.3)*	
Generation (1000kWh)					
Hydro	28,523	35,929	27,036	31,590	32,410
Diesel	48,404	44,203	53,929	45,925	42,226
Energy Purchased	1,507				
Total	*78,434*	*80,132*	*80,965*	*77,515*	*74,636*
Growth	*(2.1)*	*(1.0)*	*4.4*	*3.8*	*6.2*
Sales (kWh X 1000)					
Domestic	32,942	32,856	31,779	30,872	30,023
Commercial	21,669	22,758	17,021	16,052	15,503
Hotel	2,473	2,839	2,796	3,154	3,244
Industrial	4,354	4,607	4,009	4,420	4,553
Lighting	2	9	7,181	6,409	6,202
Street Lighting	1,295	1,125	1,128	1,098	1,069
Total	*62,735*	*64,194*	*63,914*	*62,005*	*60,594*
Consumers					
Domestic	24,333	23,210	23,069	22,802	22,196
Commercial	2,828	2,992	2,440	1,909	1,824
Hotels	60	18	21	23	23
Industrial	35	33	42	41	42
Street lighting	4	3	1,374	1,374	1,297
General lighting	253	239	234	234	223

Source: Dominica Electricity Services Limited.

The other main source of energy use in Dominica is in the road transport sector. As in most other developing countries road transport consumes an increasing amount of petroleum. In the case of Dominica this has economic, environmental and health implications. **Table 2.5** contains the number of vehicles licensed between 1999 and 2004 and shows that there has been a 64% increase during the period. It is significant to note that only 20% of newly registered vehicles are new. The remainder is purchased as re-conditioned/used vehicles from overseas**.**

Table 2.5: Number of Motor Vehicles Licensed 1999-2004

Year	Private Cars	Taxis	Buses	Motor cycles	Trucks	Jeeps	Tractors	Total
1999	5,178	152	1,178	324	1,739	1,315	47	9,933
2000	6,603	180	1,362	437	2,046	1,661	62	12,351
2001	7,245	202	1,485	527	2,187	1,947	68	13,661
2002	7,669	220	1,584	656	2,301	2,130	71	14,631
2003	8,065	230	1,684	775	2,400	2,301	77	15,532
19/10/2004	8,389	247	1,785	833	2,473	2,484	79	16,290

Source: Commonwealth of Dominica Environmental Statistics

More recent years are reported to have seen a large increase in the number of vehicles on Dominica's roads, facilitated by the easy availability through the internet of comparatively cheap reconditioned vehicles from Japan.

2.2. Climate Change in Dominica

The Inter-governmental Panel on Climate Change (IPCC), in its Third Assessment Report (TAR) in 2001, reported on scenarios for climate change in the Caribbean. These are based on computer climate models that simulate the interactions between global atmospheric, oceanographic and other conditions. At this stage the resolution of these models allows for development of regional models on a Caribbean scale but does not provide detailed analysis of small territories such as Dominica and other eastern Caribbean islands. **Table 2.6** and **Table 2.7** below provide IPCC estimates for changes in rainfall and temperature for the Caribbean.

Table 2.6: IPCC Temperature Change (°C) **Projections for the Caribbean – 2050s**

	Annual Mean Temperature Change	Temperature December/ February	Temperature June/August
GHG	2.03	2.00	2.01
GHG + A[5]	1.71	1.68	1.71

Source: IPCC TAR 2001

Table 2.7: IPCC Precipitation Projections for the Caribbean - 2050

	Annual Mean Precipitation Change (%)	Precipitation Change (%) December – February	Precipitation Change (%) June - August
GHG	-5.2	3.4	-14.4
GHG + A	-1.3	5.9	-6.9

Source: IPCC TAR 2001

The IPCC projections indicate an increase in temperature for the Caribbean of just over two degrees centigrade by 2050 with these increases distributed fairly evenly throughout the winter and summer months. This is an important increase given the generally warm temperatures that already prevail in the region and the impacts that even small changes of temperature can have in relation to human health, plant and animal biodiversity, agriculture, and water availability.

[5] This refers to the impacts of greenhouse gas emissions along with emissions of Aerosols, which generally produce localized short term cooling of air temperatures.

Projections for precipitation show the most dramatic impact as being a significant reduction during the summer, traditionally part of the rainy season, and a smaller increase in the winter months. The IPCC TAR points out that there are likely to be reductions in the amount of rainy days, with an increase in the daily intensity of precipitation. This suggests an increase in the probability of occurrence of more severe droughts and floods. IPCC projections also indicate an intensification of El Nino Southern Oscillation (ENSO) events and this can also be expected to affect rainfall patterns and totals in the Caribbean.

The IPCC indicates that available climate change models do not point definitively to any changes in the number of hurricanes and storms. There is however some scientific evidence to suggest that warmer conditions may result in intensification of the strength of storms and hurricanes.

Sea-level rise is likely to be another significant effect of global climate change on the Caribbean with IPCC estimates of 5 mm annual increases by 2050. This will affect storm surge and coastal erosion and is particularly important in Dominica where such a high proportion of human settlements are along the coastline.

2.2.1. Greenhouse Gas Emissions

Dominica's INC described Dominica as a net sink of Greenhouse Gases (GHG) in 1994. The data showed that Dominica had gross emissions of 76.53Gg of CO_2, which were offset by removals from changes in forest and other woody biomass stock and from the abandonment of managed lands, resulting in a net sink of 295.14 Gg of carbon dioxide. There were also small quantities of methane, nitrous oxide and non-methane volatile organic compounds – 2.73 Gg, 0.042 Gg and 6.13 Gg respectively. **Table 2.8** contains the 1994 GHG Inventory for Dominica and shows that the key sources of carbon dioxide emissions were:

- Transport – 50%.
- Energy Industries – 26%.
- Commercial and Industrial Uses – 10%.
- Industry – 5%.
- Residential – 4%.
- Other – 5%

Table 2.8: Initial National Greenhouse Gas Inventories of Anthropogenic Emissions by Sources and Removals by Sinks of All Greenhouse Gases Not Controlled By the Montreal Protocol - 1994

Greenhouse Gas Source and Sink Categories	CO2	CH4	N2O	NMVOC	SO2
Total (Net) National Emission (Gigagrams per year)	**(295.14)**	**2.73**	**0.042**	**6.26**	
1. All Energy	76.53	0.01	0.00		
Fuel Combustion					
Energy and transformation industries	20.21				
Industry	4.10				
Transport	37.68				
Commercial-Institutional	7.33				
Residential	3.41				
Agriculture, Forestry, Fishing	0.10				
Biomass burned for energy	3.70				
Fugitive Fuel Emission					
Oil and natural gas systems	n.a				
Coal mining	n.a				
2. Industrial Processes					
Road paving asphalt				6.13	
Alcoholic beverages				0.06	
Food production				0.07	
3. Agriculture					
Enteric fermentation		0.226			
Leaching of agricultural fields			0.01		
Cultivation of histosols			0.02		
Manure management		0.014			
Grazing animals			0.0015		
4. Land Use Change and Forestry					
Changes in Forestry and other woody biomass stock	(354.92)				
Forest and Grassland Conversion	26.53				
Abandonment of Managed Lands	(43.65)				
Carbon release from agriculturally impacted soils	0.37				
5. Other Sources as appropriate and to the extent possible					
Solid Waste disposal on land		2.73			
Sewage			0.01		

Notes: n.a. – Not applicable.
Source: Dominica Initial National Communication

2.2.2. Vulnerability to Climate Change

Dominica's Initial National Communication contains an assessment of Dominica's vulnerability to global climate change based on expert opinion. That approach was used in the absence of relevant models and data with which to assess the local impacts of climate change.

The projected major manifestations of climate change, as contained in the Initial National Communication, are:

- Increase in temperature;
- Sea Level rise;
- Overall reduction in volume of precipitation, but increase in intensity; and,
- Increased frequency and intensity of extreme events (tropical cyclones, rainfall and drought).

Table 2.9 summarises the potential impacts on the various sectors as described in the Initial National Communication.

Table 2.9: Projected Impacts of Climate Change in Dominica

Climate Change Manifestation	Infrastructure/ Human Settlements	Agriculture	Tourism	Human Health	Water Supply	Ecosystems
Temperature Increase	▪ Stress on forest resources from urban development ▪ Internal Migration ▪ Deforestation ▪ Land Degradation	▪ Crop stress due to higher evapo-transpiration	▪ Decline in visitor arrivals due to increased competition	▪ Heat Stress ▪ Tropical diseases migrate to the north	▪ Reduced water supplies	▪ Alteration in range of species ▪ Coral Bleaching ▪ Loss of fisheries habitats ▪ Increase in forests pests and disease
Sea Level Rise	▪ Higher storm surges ▪ Coastal flooding ▪ Infrastructure damage	▪ Salinity of ground water aquifers near to coast	▪ Beach erosion ▪ Coral bleach	▪ Salinity of drinking water	▪ Salinity of ground water near to coast	▪ Mangrove retreat & loss
Precipitation - More intense	▪ Flood damage from more intense rainfall ▪ Landslides	▪ Flood damage ▪ Landslides ▪ Pests and diseases	▪ Damage to eco-tourist sites	▪ Increased exposure to water borne diseases	▪ Decrease in water quality ▪ Damage to supply lines	▪ Damage from soil erosion and landslides
Precipitation - Reduced volume	▪ Drought	▪ Low yields due to reduced rainfall	▪ Degrade nature tourism sites	▪ Increased Gastro-enteritis and Asthma	▪ Decrease in water supplies	▪ Reduced river volume ▪ Increase in forest fires
Tropical Cyclones	▪ Physical damage from wind, rainfall, storm surges	▪ Physical damage from wind, rainfall	▪ Damage to critical infrastructure, beaches		▪ Physical damage, decrease in water quality, disrupt availability	▪ Physical damage from wind and landslides

2.2.3. Vulnerability to Existing Climate

Since 1979 Dominica has been affected by a number of tropical storms and hurricanes that have resulted in significant social and economic impacts – **Table 2.10**. Costs associated with natural disasters, particularly those arising from weather related events occur at household, community and national levels.

Table 2.10: Tropical Systems (1979-1999)

Year	Type	Name	Number of Fatalities
1979	Hurricane	David	45
1979	Hurricane	Frederick	0
1980	Hurricane	Allen	0
1984	Hurricane	Klaus	0
1988	Hurricane	Gilbert	0
1989	Hurricane	Hugo	0
1994	Tropical storm	Debbie	0
1995	Tropical storm	Marilyn	1
1995	Tropical storm	Luis	0
1995	Tropical storm	Iris	0
1999	Hurricane	Lenny	1

Source: Commonwealth of Dominica Environmental Statistics.

In 1979, Hurricane David devastated the island causing 45 fatalities, injuries to 3000 persons, and resulting in an estimated EC$53 million in damages to property. The hurricane resulted in the complete loss of banana and citrus production and extensive damage to agricultural infrastructure including boxing sheds and feeder roads. Widespread soil erosion also resulted from more than 20 inches of rain that accompanied the storm. Other effects of the devastation were loss of 40% of forest wood volume, hundreds of landslides in forested and mountainous areas, destruction of 75% of the fishing fleet, and extensive though unquantified coastal erosion. Other effects of the hurricane were widespread social dislocation including migration to other countries.

In 1989, Hurricane Hugo resulted in an 18% decline in agricultural output, a 30% reduction in banana exports, and widespread damage to public infrastructure. The 1995 hurricane season resulted in an estimated EC $192 million in losses to the agricultural sector including EC$14.5 million in root crop losses, and substantial losses to forestry and fisheries. Estimated costs for reconstruction of basic infrastructure amounted to EC$174m. The agricultural sector was particularly affected with banana losses estimated at EC$64m and reduction in agricultural export earnings of EC$72m.

In addition to the quantified direct economic costs of these weather events, there are a number of other costs. Routine maintenance of roads and other infrastructure damaged by heavy rains constitute major financial burdens in the Dominica context and compete with urgent needs in areas such as education and health care. Other impacts of the effects of natural disasters in Dominica include the diversion of financial resources to disaster rehabilitation and relief.

Other natural hazards to which Dominica is vulnerable include earthquakes (arising from tectonic and seismic activity)[6], droughts, landslides, bush fires, and coastal swells and erosion. In 1997, the Layou River landslide resulted in significant socio-economic impacts and environmental disruption.

2.2.4. Institutional Framework for Climate Change

Principal institutional responsibilities for climate change related issues and responsibilities in Dominica rests with the Environmental Coordination Unit (ECU) of the Ministry of Agriculture and the Environment. The ECU serves as the main national implementing agency for most of the major international environmental conventions, working with partner ministries and organizations to promote the awareness and adoption of the various provisions and approaches embodied in international environmental agreements, including the UNFCCC.

Other agencies with significant responsibilities relating to climate change include the meteorological service responsible for the collection, analysis, and dissemination of information relating to weather and climate and the departments of agriculture, fisheries and forestry that are more concerned with sectoral impacts and actions of climate change. Institutional arrangements for climate change related issues remain weak and are based primarily on administrative initiative rather than on legislative mandate.

[6] In November 1988, 168 earthquake events were recorded. September 1998 – early 2000, over 2000 events in the south of the island: National Disaster Coordinator's office.

3. TECHNOLOGY NEEDS ASSESSMENT

Climate change technology needs are directly related to development priorities.

In the case of Dominica, recent weaknesses in economic performance mean that at the forefront of development planning is the need to encourage sustained macro economic growth, strengthen government's fiscal performance, and advance social (education, health, culture) programmes and infrastructural development. Consequently, climate change technology needs should be aimed at allowing for sustainable adaptation in the target sectors, including improving efficiencies and minimizing emissions of greenhouse gases from activities within these priority sectors and activities. At the same time, it is important to recognise that *it is unlikely that the Government of Dominica will be in a position to make substantial short term financial and technical input to climate change technology needs in the immediate future*.

Official development plans for Dominica envisage private sector led growth through sustainable development of the country's tourism resources. Alongside this would be a diversified agricultural sector producing high quality, environmentally friendly produce for regional and extra-regional markets, and the associated agro-processing. These sectors would be accompanied by service (e.g. offshore medical or data entry services) and manufacturing activities appropriate to the economy.

These priorities, especially for tourism and agriculture, the two drivers of the economy, are closely linked to weather patterns. Consequently, projections for global climate change such as increased variability of rainfall, more coastal erosion, and changes in the strength of tropical storms can be expected to significantly impact developments in this regard. As noted earlier, existing vulnerabilities to extreme weather events and their associated effects already constitute an important obstacle to sustainable development in Dominica. *This means that technologies for enabling adaptation to climate change should be at the forefront of climate change technology transfer efforts for Dominica*.

These sectors can also benefit from greenhouse gas mitigation technologies that improve energy efficiency and/or reduce the costs related to fossil fuel use. This would involve technologies for harnessing Dominica's considerable renewable energy potential as well as technologies for improving efficiency in the transmission, distribution and end use of energy with the aim of reducing costs and/or promoting economic growth. Such improvements in economic performance and efficiency are likely to be crucial to Dominica's efforts to successfully compete in global and regional tourism, agricultural and services markets.

3.1. Methodology

The UNFCCC recognizes the role of technology in contributing to the problem of climate change as well as its potential for providing a response to the problem. Article 4.5 of the Convention mandates developed countries to take steps to assist developing countries in the process of technology transfer. Article 4.7 provides that "*the extent to which developing country Parties will effectively implement their commitments under the Convention will depend on the effective implementation by developed country Parties of their commitments under the Convention related to financial resources and transfer of technology*".

In pursuit of action under these and other provisions relating to climate change, the UNFCCC Conference of Parties in 2001 agreed on an international framework for technology transfer that includes the preparation of technology needs assessments[7]. Technology needs assessments are intended to identify and prioritize technologies that might be implemented within the framework of national development goals to reduce vulnerability to climate change and/or reduce greenhouse gas emissions.

Various methodological approaches have been developed for the conduct of technology needs[8]. These methodologies emphasize consultative processes and the integration of climate change technology needs with wider national development objectives. In many instances, time and data availability concerns meant that it was not possible to observe all of the steps envisaged in the methodological approaches. However these methodologies have provided valuable reference points for conduct of the assessment.

The Dominica Assessment has been prepared based on discussions with officials in Dominica and a review of relevant documentation including Dominica's INC. A first draft of the report was shared with stakeholders and the comments received incorporated into the document. As far as possible, the Assessment attempts to utilize elements of the methodologies that have been developed for technology needs assessments.

3.2. Mitigation Technologies

Dominica's INC points out that the country's forestry resources result in Dominica being a net sink[9] of greenhouse gases. This means that Dominica is in fact already contributing towards measures for mitigation of the global climate. Government policy and national pride in the country's forests means that Dominica's forests can be projected to continue to make positive contributions to global greenhouse gas mitigation. However, it is uncertain how severely global climate change will itself affect the health and productivity of the country's forestry resources.

Future scenarios for mitigation of climate change at the global level are likely to be determined by political and technological factors. The adoption into force of the Kyoto Protocol to the UNFCCC should be a critical factor in determining the movement, if any, by the global community towards reductions in greenhouse gas emissions. Political factors, including instability in key oil producing areas, also remain a potent force in determining the availability, and therefore prices and consumption, of petroleum products.

[7] *Other aspects of the framework are technology information, enabling environments, capacity building, and mechanism for technology transfer.*

[8] *These include "Methods for Climate Change Technology needs assessment and implementing activities: developing and transition country approaches and experiences" and "UNDP/GEF Handbook for methodologies for technology needs assessment. Final Draft. August 2003". Additionally an effort has been made to utilize guidance developed for the Caribbean that seeks to further the need for linking technology needs with national development priorities. Appendix 1 provides a schematic of the draft framework developed for the Caribbean.*

[9] *The IPCC define a greenhouse gas sink as "any process, activity, or mechanism that removes a greenhouse gas, an aerosol, or a precursor of a greenhouse or aerosol from the atmosphere".*

The International Energy Agency (IEA) World Energy Outlook 2000, looking at trends to 2020, forecasts continued global dependence on petroleum as the primary source of fuel, with petroleum continuing to account for at least 40% of energy supply. Growth in emissions from transportation is also projected to increase as a proportion of global emissions. Natural gas is expected to continue to rise as a proportion of the global energy mix while the contribution of coal and nuclear power sources are likely to be reduced. Renewable energy is forecast to witness the greatest growth in demand and supply, particularly for wind, solar and other non-hydro sources.

Dominica possesses a range of renewable energy sources including hydro, geothermal, solar, wind, and biomass. Many of these technologies, such as hydropower and solar are already in use and contribute to national energy output, although in the case of solar and biomass these probably represent a fraction of potential. Plans are advanced within the private sector for the introduction of wind power and for assessment of the feasibility of geothermal sources for domestic and export markets. At the regional level, plans continue for a pipeline providing natural gas from Trinidad to the eastern Caribbean French territories of Guadeloupe and Martinique. This could have potential greenhouse gas mitigation possibilities for Dominica[10].

As a developing country, it is important that Dominica pursue mitigation strategies and/or activities that are consistent with its wider development goals and objectives. In the present context, this will mean ensuring compatibility with environmental standards and protection, being supportive of economic development and not worsening the government's fiscal situation.

Mitigation measures associated with these policies in the Dominica context include sustainable forest utilization and management, utilization of renewable energy resources where technically and financially viable to do so and encouraging energy conservation in transport and electricity generation, distribution and end use. Given the structure of demand for energy, *energy conservation policies and activities are likely to offer some of the most financially viable short-term measures for achieving mitigation while also contributing to socio-economic development for Dominica*. Public awareness and knowledge of conservation possibilities, and consequently the mechanisms for delivering these products, are critical to achieving this end. Technology options to support these mitigation measures are outlined below.

3.2.1. Energy Generation

A range of potential technological options exist for mitigating climate change within the energy sector. These include the development of alternative sources as well as improved efficiency of energy use. Small market size and existing fossil fuel capabilities have historically reduced the possibility for adoption of these technologies in small countries like Dominica. Rising fuel costs, falling alternative energy costs, concerns for climate protection, and concerns for energy security have however favorably increased the viability of many of these technology options. **Table 3.1** summaries these mitigation measures and their attendant technology needs.

[10] This could conceivably involve financing by way of the Clean Development Mechanism of the Kyoto Protocol.

Table 3.1 – Technology Needs for Energy Generation

Response	Mitigation Measures	Technology Needs
Renewable energy development to reduce and replace fossil fuel use.	▪ Establish policy and regulatory framework for promoting renewable energy; ▪ Establish renewable energy data-base; ▪ Human resource development; ▪ Public awareness.	▪ Information technologies; ▪ Meteorological monitoring equipment; ▪ Small-scale hydro; ▪ Wind energy technologies; ▪ Solar energy technologies; ▪ Geothermal energy technologies. ▪ Baseline data sets
Energy conservation and efficiency in generation, distribution and end-use of electricity.	▪ Devise and implement national energy efficiency and conservation programme. ▪ Establishment of standards and incentive regime. ▪ Establish natural gas as fuel for energy generation.	▪ Efficient fossil fuel generation plant; ▪ Energy efficient domestic appliances; ▪ Energy efficient air conditioning equipment; ▪ Human resource development; ▪ Information technologies.

3.2.2. Road Transportation

Growth in transportation, and associated greenhouse gas emissions, reflects many factors including increased urbanization, rising living standards, and technological developments. In Dominica economies of scale and rugged topography impose constraints on many conceptual responses to reducing emissions from the transport sector.

Table 3.2 – Technology Needs for Road Transportation Sector

Response	Mitigation Measures	Technology Needs
Public transportation to reduce growth of energy use in transportation sector.	▪ Publicly owned bus service; ▪ Public awareness; ▪ Car-pooling; ▪ Mitigation policy and regulatory regime; ▪ Human resource development.	▪ Energy efficient buses; ▪ Technical assistance.
Infrastructure	▪ Improving road surfaces and routes to reduce energy use.	▪ Road building equipment; ▪ Technical expertise; ▪ Information technologies;
Vehicle Efficiency Improvements	▪ Establishment and enforcement of standards for vehicle energy efficiency. ▪ Public awareness. ▪ Human resource development.	▪ Information technologies; ▪ Vehicle testing equipment; ▪ Efficiency improvement equipment; ▪ Emissions testing equipment; ▪ Regulations and standards establishing emission limits. ▪ Monitoring of standards and regulations

3.3. Adaptation Technologies

Given Dominica's vulnerability to many of the impacts of climate change as detailed in **Table 2.9**, it is also necessary to identify adaptation options and technology needs for those critical sectors already identified in the National Communications and other official documents.

3.3.1. Coastal Zone

With potential impacts from sea-level rise, warming seas, more intense storm activity and other non climate change threats such as pollution, the coastal zone remains one of the most dynamic and at risk areas to the adverse impacts of climate change. In Dominica, the concentration of population and economic activity in coastal areas further heightens vulnerability.

The coastal zone adaptation technologies in **Table 3.3** below are based on the IPCC methodological distinction of retreat, accommodate, and protect as the three (3) principal responses to climate change impacts in the coastal zone.

Table 3.3 – Coastal Zone Technology Needs

Response	Adaptation Measure	Technology Needs
Retreat	▪ Phased development; ▪ Withdrawal of government subsidy and services; ▪ Public awareness; ▪ Restricting development.	▪ GIS Mapping; ▪ Information technologies; ▪ Human resource development; ▪ Ecosystem monitoring; ▪ Meteorological and oceanographic monitoring.
Accommodate	▪ Protection of ecosystems; ▪ Land use codes and standards; ▪ Hazard insurance; ▪ Public awareness	▪ GIS mapping; ▪ Information technologies; ▪ Human resource development; ▪ Beach nourishment; ▪ Sea defenses; ▪ Meteorological and oceanographic monitoring.
Protect	▪ Land use and coastal area use planning; ▪ Enforcement of building standards; ▪ Hazard insurance; ▪ Public awareness; ▪ Coastal area management.	▪ Engineering technologies; ▪ Dikes, levees, and sea-walls; ▪ Groynes; ▪ Detached breakwaters; ▪ Beach nourishment; ▪ Littoral drift replenishment; ▪ Meteorological and oceanographic monitoring technologies; ▪ Human resource development

3.3.2. Disaster Response

Projections for stronger and possibly more frequent storms and hurricanes, as well as changes in temperature and rainfall patterns, mean that disaster management and response will be an increasingly significant element of the national response to climate change. Disaster management

and response activities can be envisaged at three (3) distinct but inter-related levels: community action, emergency response, and longer term hazard management/risk reduction measures – **Table 3.4**.

Table 3.4 – Disaster Management and Response Technology Needs

Response	Adaptation Measure	Technology Needs
Community level action	▪ Public awareness; ▪ Community enhancement and risk reduction projects.	▪ Information technologies (computers, internet, GIS); ▪ Environmental engineering (e.g. contour terracing, artificial reefs); ▪ Human resource development.
Emergency preparedness	▪ Communications and logistics management; ▪ Emergency shelter; ▪ Search and rescue capabilities; ▪ Public awareness.	▪ Communications equipment; ▪ Information technology; ▪ Emergency shelter; ▪ Human resource development.
Hazard management	▪ Land use planning; ▪ Zoning; ▪ Hazard resistant construction practices; ▪ Strengthened legislative and institutional framework.	▪ GIS mapping; ▪ Meteorological monitoring equipment; ▪ Information technologies; ▪ Environmental engineering – contour terracing, riverbed protection, habitat protection, sea defenses.

3.3.3. Water Resource Management

Climate change can be expected to impact the volume and distribution of rainfall in Dominica. Water resource management will be required in the context of other non-climate related stresses such as population growth. This will require that adaptive actions be taken from demand management and supply development and management. Demand management involves the use of measures for influencing water users' behavior to improve efficiency of water use. Supply development and management programmes aim at development of new or existing sources.

Other concerns for water managers include ensuring the quality of water supplies. Sea level rise and accompanying higher tides will also adversely affect estuarine freshwater conditions with implications for domestic and municipal uses, as well as affecting marine and river ecosystems.

Adaptive responses to water resource management will require actions in terms of supply development and management, demand management, and water quality. Strengthening of human resource capability and awareness must also be considered as cross-sectoral priorities if sustainability of responses is to be achieved. The relevant technology needs are summarized in **Table 3.5**.

Table 3.5 – Water Sector Technology Needs

Response	Adaptation Measure	Technology Needs
Supply development and enhancement.	▪ Improved forestry management to protect water supply; ▪ Increased storage capacity for drier conditions; ▪ Improved efficiency in distribution and supply of water.	▪ Meteorological and hydrological measurement tools; ▪ Hydrological studies; ▪ GIS tools; ▪ Construction of dams and ponds; Desalination of saline water; Water reuse.
Demand management measures and actions	▪ Economic and legal framework (e.g. pricing and allocation of property rights, restrictions/prohibitions on use of certain methods) to encourage conservation and efficient use.	▪ Water saving household technologies (low flush toilets, low water use washing machines etc); ▪ Drip irrigation; ▪ Public awareness and information tools; ▪ Technical training and exchange.
Water Quality Protection	▪ Protection of watersheds; ▪ Monitoring of water quality; ▪ Monitoring of underground fuel tanks for seepage into water system; ▪ Appropriate disposal of waste fluids and chemicals; ▪ Public awareness.	▪ Biological and chemical water treatment technologies; ▪ Testing equipment; ▪ Technical training; ▪ Construction of sluices against sea-level rise.

3.3.4. Human Settlements

Human settlements combine together many of the stresses and problems related to other sectors such as health and water. Topographical conditions have resulted in most settlements being in coastal areas at risk to coastal flooding and sea-level rise. This includes critical roads and other public infrastructure. Human settlements planning in Dominica faces severe problems in terms of personnel and technical resources. This essentially restricts development control to inspection and monitoring of buildings and related tasks. Economic and financial costs relating to extreme weather events are often greatest where human settlements and infrastructure are concentrated.

Response measures for human settlements will be required in relation to health, environmental, and financial/economic impacts of climate change. In many cases these responses overlap with those in other sectors as illustrated in **Table 3.6**.

Table 3.6 – Human Settlements Technology Needs

Response	Adaptation Measure	Technology Needs
Health Impacts	▪ Public awareness; ▪ Regulatory; ▪ Monitoring; ▪ Environmental health management; ▪ Medical interventions; ▪ Climate change related health infrastructure.	▪ Information technologies (hardware and software); ▪ Air cooling systems; ▪ Disaster resistant construction; ▪ Vector control methods.
Response	**Adaptation Measure**	**Technology Needs**
Infrastructural and Environmental Effects	▪ Public awareness; ▪ Strengthened solid waste management capability; ▪ Liquid waste; ▪ Urban and community forestry; ▪ Physical planning, building codes and development control; ▪ Strengthened physical structures.	▪ GIS tools; ▪ Human resource development; ▪ Meteorological and oceanographic monitoring equipment; ▪ Solid waste management equipment; ▪ Water and sewage systems.
Economic and Financial Consequences	▪ Insurance mechanisms; ▪ Improved development control; ▪ Public awareness; ▪ Hazard and risk assessment; ▪ Economic incentives for retrofitting and structural improvements etc; ▪ Economic diversification.	▪ Public awareness; ▪ Human resource development; ▪ GIS tools; ▪ Economic modeling and forecasting incorporating climate change.

3.3.5. Agriculture

Agriculture remains the dominant sector in the Dominica economy in terms of employment and foreign exchange receipts. The sector is already vulnerable to the effects of drought and hurricanes but benefits from productive natural assets of rich soil and plentiful rainfall. Adaptation measures should be aimed at introducing environmentally sustainable agricultural practices that will allow the agricultural sector to provide quality agricultural produce in a competitive manner for domestic and export markets.

In Dominica, the principal drivers of climate change affecting agriculture are likely to be changes in temperature, altered precipitation regimes, sea-level rise, and intensified storm and hurricane activity. This will require responses at the level of changed agricultural practices, introduction of new and modified agricultural production, and strengthened environmental protection.

Table 3.7 – Agriculture Sector Technology Needs

Response	Adaptation Measure	Technology Needs
Improved farming practices to conserve soil moisture and nutrients, reduce runoff, and control soil erosion.	▪ Increased storage of water; ▪ Improved drainage systems; ▪ Public awareness; ▪ Water conservation tools and methods; ▪ Crop rotation; ▪ Contour cropping; ▪ Agro forestry; ▪ Multi-cropping.	▪ Greenhouse technologies; ▪ Micro-dams and ponds; ▪ Water storage tanks; ▪ Information technologies; ▪ Low cost pumps; ▪ Laboratory equipment; ▪ Low cost efficiency irrigation materials; ▪ Genetic material.
Response	**Adaptation Measure**	**Technology Needs**
New and modified Crops	▪ Genetic research; ▪ Genetic engineering ▪ Use of new crops and animal types; ▪ Public awareness of genetic modification and its implications; ▪ Germplasm management; ▪ Use of traditional knowledge; ▪ Improve distribution networks	▪ Genetic material; ▪ Human resource development; ▪ Information technologies; ▪ Laboratory and storage equipment.
Environmental Management to reduce adverse environmental effects.	▪ Topographical engineering to enhance water use; ▪ River bank protection; ▪ Watershed protection; ▪ Reforestation; ▪ Establishment and maintenance of protected areas; ▪ Strengthened legislative and regulatory frameworks; ▪ Public awareness; ▪ Biodiversity monitoring and protection.	▪ Information technologies; ▪ Heavy duty equipment; ▪ River level monitoring equipment; ▪ Human resource development; ▪ GIS equipment; ▪ Meteorological monitoring equipment.

3.3.6. Health

The health sector is likely to be adversely affected by climate change via a number of pathways including increased heat related health complaints, more injuries and other problems arising from extreme weather events, and nutritional and long term chronic problems associated with alterations in weather and climatic parameters.

This will require that actions are taken to respond to adverse impacts associated with local environmental conditions and which involve adaptation at the level of environmental management. These would include vector borne and other diseases and complaints relating to environmental conditions. Action will also be needed in terms of health management and response to increased disaster events as a result of climate change.

Table 3.8. Health Sector Technology Needs

Response	Adaptation Measure	Technology Needs
Improved Environmental Management	▪ Public awareness; ▪ Improved water supply; ▪ Improved solid and liquid waste management; ▪ Environmental monitoring and surveillance; ▪ Strengthened data collection and exchange; ▪ Increased vector control; ▪ Strengthened regulatory framework; ▪ Human resource development; ▪ Flood defense systems; ▪ Development control and physical planning; ▪ Housing design; ▪ Vaccine development; ▪ Strengthened regional cooperation and information exchange.	▪ Information technologies; ▪ Technical training; ▪ Vector control equipment and supplies; ▪ Primary health care including vaccines and medicines; ▪ Epidemic forecasting tools; ▪ Laboratory equipment; ▪ GIS tools.
Disaster Response	▪ Strengthened building codes and practices; ▪ Land use planning; ▪ Community disaster management capabilities; ▪ Human resource development; ▪ Strengthened emergency response capability; ▪ Strengthened regulatory framework.	▪ Communications equipment; ▪ Water purification; ▪ Information technologies; ▪ GIS; ▪ Marine, aerial and terrestrial emergency response vehicles; ▪ Human resource development; ▪ Disaster resistant emergency shelters.
Management of Chronic Health Concerns.	▪ Strengthened data collection; ▪ Human resource development; ▪ Development of management regimes; ▪ Research programmes; ▪ Public awareness; ▪ Strengthened chronic care capabilities.	▪ Information technology. ▪ Air conditioning; ▪ Human resource development; ▪ Laboratory facilities; ▪ Appropriate chronic care equipment and facilities; ▪ Meteorological monitoring equipment.

3.4. Institutional Capabilities

Critical to achievement of virtually all of the adaptation and mitigation options will be the presence of a strengthened capability for coordinating and advancing measures relating to climate change.

Of particular importance at this stage is the issue of information dissemination. This arises from the need to sensitize decision makers to climate change concerns at various levels utilizing

different types of media. The intention is to get persons in key sectors to incorporate concerns for climate change into the planning and implementation of activities. Similarly, but at a different level, it is necessary to strengthen technological capability to enhance greater public awareness of climate change.

Important initiatives have already begun in this regard by the ECU utilizing resources under the UNDP/GEF Enabling Activities project. Workshops and seminars have exposed an increasing amount of key sectoral and technical agencies to issues relating to climate change. Efforts have also been made to sensitize sections of the general public about climate change issues and concerns. The focus of efforts in the future should be to extend the capability to provide and facilitate various types of information relating to climate change.

4. SYSTEMATIC OBSERVATION NETWORKS

4.1. Methodology

The methodological framework used for this assessment was based on Decision 5/CP5 of the UNFCCC Conference of Parties (COP).

That decision *inter alia:*

- ✓ Urged parties to address deficiencies in climate observing networks and to put forward specific proposals to this end; and

- ✓ Adopted reporting guidelines on global climate observing systems.

The full text of the COP decision is attached as **Appendix 2** and the Reporting Guidelines as **Appendix 3**.

The requirements in the Reporting Guidelines are based on the needs for meteorological, atmospheric, oceanographic and terrestrial observations of the climate system as identified by the Global Climate Observing System (GCOS).

GCOS has identified a minimum set of Essential Climate Variables that is deemed essential and has elaborated a set of climate monitoring principles that countries should adhere to in developing observational networks. The Essential Climate Variables are contained in the Second Report on the Adequacy of the Global Observing Systems for Climate in support of the UNFCCC submitted by GCOS and are reproduced in **Table 4.1**, while the climate monitoring principles are included in **Appendix 3**.

Table 4.1 – Essential Climate Variables

Domain	Essential Climate Variables
Atmospheric (over land, sea and ice)	**Surface**: Air temperature, Precipitation, Air pressure, Surface radiation budget, Wind speed and direction, Water vapour. **Upper-air**: Earth radiation budget (including solar irradiance), Upper-air temperature (including MSU radiances), Wind speed and direction, Water vapour, Cloud properties **Composition**: Carbon dioxide, Methane, Ozone, Other long-lived GHGs, Aerosol properties
Oceanic	**Surface**: Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Current, Ocean colour (for biological activity), Carbon dioxide partial pressure **Sub-surface**: Temperature, Salinity, Current, Nutrients, Carbon, Ocean tracers, Phytoplankton
Terrestrial	River discharge, Water use, Ground water, Lake levels, Snow cover, Glaciers and ice caps, permafrost and seasonally-frozen ground, Albedo, Land cover (including vegetation type) Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf area index (LAI), Biomass, Fire disturbance

The methodological approach therefore consisted of an assessment of the extent to which Dominica has operationalised systems necessary to generate the Essential Climate Variables (where relevant) and the capacity needs for addressing any deficiencies that were identified.

4.2. Current Data Collection

4.2.1. Atmospheric Variables

It should be noted at the outset that systematic observation activities in Dominica have been undertaken independent of any programming for climate change. They are more closely linked to the general commitments of the country in the field of aviation-related meteorology.

(a) Surface Variables

The meteorological offices at the Canefield and Melville Hall Airports are monitoring all of the Surface climate variables with synoptic meteorological stations, which include the following equipment, viz:

- 10 meter tower
- NEMA 4-Enclosure
- Data logger with telemetry
- Rainfall sensor
- Wind speed & direction sensor
- Barometer pressure sensor

The World Bank has supplied automatic weather stations, two of which were installed at each airport in January 2003. These stations measure the following physical parameters, viz:

- Rainfall
- Pressure
- Air temperature
- Humidity
- Dew point
- Vapour
- The intensity of the rain over a given period

The stations record this information every five (5) minutes and the data is stored on tape. Backup to zip disks are done at the end of the year. Both of these stations are automated, so that the information will be collected 365 days a year, irrespective of office hours/holidays.

Photo 4.1 - Automated Weather Station at Canefield Airport

Data on visibility is recorded manually, and no data is collected on radiation intensity, sunshine intensity and the ultra-violet (UV) index.

The data collected by the new automatic stations is sent simultaneously to the airports and the Office of Disaster Management (ODM). Neither airport operates 24 hours a day, and the ODM have a back up generator. This means that the receipt of the data is not always being monitored

and there is potential for breaks in the data transmission should a technical problem occur while the airport is closed, or when there is a power failure affecting the ODM.

Dominica has an additional ten (10) new wireless-automatic weather stations, similar to the ones described above, which will be installed around the country in locations selected by the ODM. The data will be sent directly to the National Hurricane Centre in Miami. The data from the airports go directly to Washington, D.C.

Photo 4.2 – Temperature Observation at Canefield Airport

Rainfall data are also collected by other agencies at points other than the airports. These agencies are:

- Dominica Electric Company Ltd. (DOMLEC) - collects rainfall data using three (3) manual rain gauges. They collect the data daily in some cases and thrice weekly in others in the following locations - Fresh Water Lake, Laudat Power Station and Trafalgar Power Station.

- The Forestry, Wildlife and Parks Division collects rainfall data manually each day at six (6) stations and records the data on a weekly sheet, which is sent to their office. The data is compiled on a monthly and yearly basis in six (6) locations. The data is recorded manually and sent to the Division of Agriculture on a monthly basis.

- The Division of Agriculture collects rainfall data at fourteen (14) locations throughout Dominica. This is done manually at this time, but the Division has recently taken possession of six (6) new portable Davis Vantage Pro 6160 wireless weather stations which should be in operation by December 2004. These stations measure the following, viz:
    - Rain fall data
    - Temperature
    - Amount of light
    - UV
    - Wind Speed & Direction

  These stations are portable and the Department of Agriculture plans to use them to help the farmers determine the best time to plant crops/best type of crop to plant and best location for a given crop.

(b) Upper-Air Variables

None of these variables are being monitored in Dominica.

(c) Composition

None of these variables are being monitored in Dominica.

4.2.2. Oceanic Variables

These essential climate variables are not currently being monitored in Dominica. A sea level monitoring station was installed at the Coast Guard Base as part of the CPACC project. It was destroyed during Hurricane Lenny in 1999 and has not been replaced. The location of the data collected in unknown.

A tidal station at the Fisheries Development Division was also destroyed by Hurricane Lenny and has not been replaced. All the data accumulated during it operational period has been lost.

The Fisheries Development Division is involved in ongoing measurements of the shallow submarine hydrothermal vents in the Soufriere/Scotts Head Marine Reserve (SSMR). This data is being collected as a part of a PhD thesis for a group of students from IECB University of Vienna who are having the data forwarded to an overseas company for retrieval and downloading of information. The Division would like to be a major stakeholder and integral player in climate change issues, in particular sea level rise issues, and has just appointed an officer who will be responsible for climate change matters as related to fisheries. It is in the process of assessing its needs in this respect and has identified an automatic tidal station as high on its list of priorities.

4.2.3. Terrestrial Variables

(a) River Discharge-Water Use and Ground Water Level

The freshwater resources in Dominica come from ten (10) major watersheds and their accompanying river basins and there is a need for the river discharge-water level, flow rate, water quality, and the like to be measured in each of the major watersheds.

River discharge is measured in Dominica by DOWASCO in one (1) river. Other than that, no other measurements are being taken or recorded.

DOWASCO tests the water quality on a daily basis at its in-house laboratory for Bacteriological analysis, CL2 residual, Total Coliform, Faecal coliform and E-Coli. The physical parameters are:

- Temperature
- pH
- Conductivity
- Turbidity

The chemical parameters are:

- Aluminium
- Copper
- Ammonia

- Manganese
- Iron
- Chloride
- Sulphate
- Sulphide
- Nitrite
- Nitrate
- Orthophosphate
- Total hardness
- Total solids
- Total dissolved solids

They occasionally measure the river flow using a flow velocity meter, but do not measure the level of the lakes, or test the water quality of the lakes.

DOMLEC measures the level of the freshwater lake on a periodic basis (March-June-dry season) and the water heights in the areas around the hydroelectric headworks.

(b) Land Cover

Land Cover is monitored by the field staff of the Lands and Surveys Division and the Forestry, Wild Life and Parks Division. There is limited monitoring of land cover via aerial photographs. The last one was done in 1992.

The Physical Planning Department has a Geographic Information System (GIS) mapping system that was donated by the Canadian Government in 1994. However due to the lack of funds from government, the GIS programme has been inactive. The European Union will be providing funding for Land Use Planning and Environmental Management to strengthening the Physical Planning Department, the formulation of a land use policy, administration and development control activities, and putting in place appropriate legislation. However the funds do not cover long-term training for human resources, in the context where the department has identified an urgent need for one person to be trained in GIS.

(c) Fire Disturbances

The Dominica and Fire Ambulance Services is responsible for monitoring and responding to wild land fires. The brush fire season in Dominica usua1ly coincides with the "dry" season, with the greatest amount of activity occurring in the months of March through May. The majority of the wild land fires occurring in Dominica can be classed as 'brush" fires, with few true forest fires per se.

The available data shows that there has been an increase in the number of fires responded to in recent years – **Table 4.2**.

Table 4.2 - Wild Land Fires

YEAR	1981/85	1986/1990	1991/1995	1996/2000	2001/2003
Av. # Fires	103	106	141	140	159

Source: Dominica and Fire Ambulance Services

An analysis of the years when the most fires and least fires were responded to, highlighted two factors as the common denominators – the amount and distribution of rainfall, coupled with vegetation type, are a1ways intimately connected to the risk and eventual occurrence of brush / forest fires.

Ninety-eight per cent (98%) of all brush fires responded to by the Dominica Fire Department are those involving plant species prone to fires during the dry months. Additionally, the years when less rainfall was recorded are those when the most fires *are* responded to.

In 1999, the Forestry, Wild Life and Parks Division performed a reconnaissance survey in the southern part of Dominica (from Loubriere in the south to Salisbury in the North) to assess the effects of the bush fires on lowland vegetation at an elevation ranging from sea level to about 800 ft above sea level. The public threat from the bush fires was so low due to the remote location of the fires that no other action was taken.

4.2.4. Summary

The data being collected in Dominica is inadequate to support monitoring of climate change trends in Dominica. There is no data collection and monitoring of critical variables like sea levels and emissions of greenhouse gases, including carbon dioxide and methane. Most of the data collected relate to atmospheric surface variables and the collection is not comprehensive. Most of the data collection is limited to the airports, with precipitation being the only variable that is collected in other parts of the island. However, the distribution of the collection points have not been rationalized, with the result that even this data does not provide a comprehensive picture of precipitation in Dominica.

4.3. Systematic Observation Capabilities

4.3.1. Equipment

Dominica has a mixed bag of equipment. Each department has purchased or has been given different types equipment, none of which is compatible with the others' systems.

The Office of Disaster Management and the meteorological office have a total of thirteen (13) new automatic weather stations, which can collect and store the data digitally and operate twenty four (24) hours a day, seven (7) days a week. However, only four (4) automatic stations are currently in operation (two (2) at each airport). The remaining nine (9) units will be installed when the human and financial resources are available for additional cable and personnel. *These additional stations represent an opportunity to rationalize data collection across the island to provide a comprehensive picture for the variables being monitored.*

4.3.2. Data Storage

Data storage by the various stakeholders in done both manually and digitally viz:

- The Forestry Department stores the rainfall, wind speed and direction data manually and is in the process of converting the monthly records to a digital format.

- The Meteorology Office stores the wind speed and direction, air temperature, due point, pressure, and vapour and rainfall data digitally.
- DOMLEC stores the rainfall data both digitally and manually.
- DOWASCO stores the rainfall data both digitally and manually.
- The Department of Agriculture stores the rainfall, wind speed and direction data manually.
- The Fisheries Division stored the data tide range both digitally and manually.
- The Office of Disaster Management stores the rainfall, wind speed & direction, air temperature, due point, pressure, vapour, and UV data digitally.

4.3.3. Human Resources Capabilities

The Meteorological Offices and the Office of Disaster Management lack the full complement of personnel necessary to collect data 365 day per year.

4.3.4. Institutional Capacity

Dominica lacks a significant institutional capacity to carry out its responsibilities and obligations. At present, each of the stakeholders is "doing their own thing". There is no central clearinghouse for the data and no central purchasing office for equipment. Several government departments are monitoring for rainfall-wind speed and direction in basically the same area, whilst a large section of Dominica has no records or history of rainfall data.

If there was better sharing of information and coordination there would not be any duplication of effort and the existing human resources could possibility cover the entire country. Both time and money would be saved and the coverage could be extended to weekends and holidays.

Currently all the stakeholders in Dominica are facing the same problems, viz:

- Lack of funds;
- Lack of trained personnel; and
- Broken equipment/no equipment.

The most pressing need in Dominica is for all the stakeholders to sit down and discuss their equipment and manpower needs, and decide on an institutional protocol for collection, storage, dissemination and submission of climate-related data to the appropriate users.

Consideration has to be given to the role of the Environmental Coordinating Unit in this process, as the principal institutional responsibilities for climate change related issues in Dominica rests with that Unit. It serves as the main national implementing agency for most of the major international environmental conventions working with partner ministries and organizations to promote the awareness and adoption of the various provisions and approaches embodied in international environmental agreements, including the UNFCCC. *The problem is that the ECU does NOT have the legal authority (legislative mandate) giving it jurisdiction for developing, maintaining and disseminating climate change data in the Commonwealth of Dominica*.

Consideration also has to be given to the role and function of the meteorological services. There is an ongoing demand for meteorological information for a variety of uses – aviation, disaster management, agriculture, water supply, hydroelectric power, and climate change monitoring – that cannot be supplied by the current aviation-focused service.

There is also a need to develop and/or strengthen the working relationship with the private sector - especially DOMLEC and DOWASCO - in the gathering and sharing of climate change related information.

5. IMPROVEMENTS IN EMISSION FACTORS

5.1. Methodology

This component was a direct follow-up to the Greenhouse Gas Inventory done as part of the preparation of the Initial National Communication. That process had identified a number of sources of uncertainty in the GHG as a result of inappropriate emission factors and/or unavailable or inaccurate data. This component was therefore aimed at laying the foundation for more accurate GHG inventories in the future and focused on:

- the development of more relevant emission factors as well as modalities for sourcing data to compute recommended emission factors which are deemed appropriate; and
- the identification of data gaps and new data for further development.

The methodology specified that the "… procedure for selecting data will take the following into consideration:

- The magnitude and contribution of the GHG emission and removal used to prioritise relevant sectors;
- Sensitivity of the calculation estimates;
- Extent of improvement of estimate uncertainty;
- Relevance of the source/sink inventory to meet national priorities;
- Feasibility of the implementation of the abatement measures; and
- Availability of low cost data collection measures."

5.2. Data Gaps

The Report on Phase 1 of the Initial National Communication identified several areas for which emission factors or relevant data for computing GHG emissions were either unavailable or incomplete. This report also identified a number of uncertainties with respect to GHG emissions in Dominica.

In light of these data issues and the uncertainties identified, default values of emission factors proposed by the IPCC were used to compute GHG emissions. These do not capture the local realities, are not country specific and should be treated as estimates and approximations. It is also important to note that where data was not available, data from St. Lucia and Antigua were used as proxies since it was felt that these countries were similar in conditions and circumstances to Dominica. This approach should be reconsidered since in terms of size, forest cover and population, these countries are significantly different from Dominica.

The following identifies the key data gaps by key areas for which additional information will be required.

5.2.1. Transport

Information on the following is required to compute emission factors since those used were proxies:

- Class of vehicle and type of pollution control equipment fitted;
- Type of fuel consumed and average rate of consumption;
- Condition of the vehicles which is influenced by the age and level of maintenance; and
- Operating factors such as driver behaviour, weather conditions, road type and traffic type.

In addition, given the expansion in transportation that has taken place in Dominica since 1994, current *levels of emissions have to be higher* even with the indefinite moratorium on leaded gasoline. Moreover, *the use of diesel engines on most mass transit buses* may be a big contributor to GHG emission specifically CO_2

5.2.2. Energy Industries

Energy industries contributed roughly 22Gg of CO_2 in 1994. That contribution comes from power plants using gas/diesel oil mainly for the production of thermal electricity. Bitumen is also imported but using mainly in road pavement. This bitumen is partially combusted as a preparation for use in road pavement and that should contribute to CO_2 emission. Data on tonnage of imported bitumen, or area of paved roads, are required to give a more accurate estimate of emissions of CO_2 and NMVOC.

The report does not cover the emission of nitrous oxides from substances used in dry cleaning. Several such businesses have emerged recently and data from these sources should be collected and emissions calculated.

5.2.3. Agriculture

Current livestock data by population and type is required to give a more accurate calculation of both enteric fermentation and manure management. The most recent data available is from the 1995 Dominica Agricultural Census.

5.2.4. Solid Waste

Emission factors for solid waste have to be developed and accurate volume of waste must be determined. Wastes are not separated before being emptied into the landfill. Different waste kinds will have differing levels and rates of Methane (CH_4) emission.

5.2.5. Land Use, Land Use Change and Forestry Sector (LULUCF)

Dominica, according to the National Inventory on Greenhouse Gases, is a net remover of GHGs. However, the data used to determine the level of removals were estimates, as data on non-forest trees were based on expert opinion. Accurate data on non-forest trees are required.

While Dominica has no savannas, bush fires are a common practice every year during the dry season. Large acreages are burnt. It is important to calculate the emissions from that since the persistent burning has turned the large patches of forest into permanent grassland.

5.3. Priority Areas for which Accurate Data is Required

Given Dominica's unique circumstances, the following prioritization has been assigned to the identified sectors:

1. Acreages of non-forest trees and acreages affected by the indiscriminate burning of forests and grasslands during the dry season. This contributes to the seasonal emission of GHGs and resulting destruction of forest destroys sink areas. These acreages must be calculated to determine GHG emissions.

2. The Energy sector with specific focus on the transport and electricity generation, since these are the major contributors of GHG emissions in Dominica. Appropriate emission factors are to be developed and fuel types disaggregated.

3. The amount of Bitumen imported or the area of paved roads covered with bitumen should be calculated and the type of fuel determined.

4. The volume of waste dumped into the landfill and the identification of open-waste sites particularly in the North of the island.

5. The final priority area is the headcount of livestock population by type to measure emission by enteric fermentation and manure management.

Land Use, Land Use Change and Forestry
The LULUCF data is accorded the highest priority as Dominica's status as a net sink of GHG needs to be preserved and therefore needs to be closely monitored.

The country's commitment to preserving the natural environment dates back to the 1970s with establishment of the Central Forest Reserve and the Morne Trois Piton National Park which UNESCO declared a World Heritage Site in 1998. In addition, the Cabritts National Park was established. The 1975 National Parks and Protected Areas Act protects the parks from destruction or the removal of flora and fauna. Forest rangers are appointed under permanent establishment in order to monitor activities with the park. The existence of the over 100 year old pristine Botanic Gardens in Roseau bears testimony to the island's commitment. Further the promotion of the island as an eco-tourism destination strengthens the resolve to continue to preserve the natural environment. This makes the case for the need to continue to provide support for the preservation of the forest resources as they are a major aspect of the economy of Dominica and since they contribute significantly to the removal of Greenhouses Gases from the atmosphere.

Non-forest trees include plants grown for their aesthetic and economic value; they include plant crops and plants grown as horticulture. Many are fruit trees and are found in or near residential areas. It is not unusual, using rapid assessment strategies during windstorms and hurricanes, to estimate the number of trees of that nature destroyed. While they are of some economic value,

they also remove Greenhouse Gases from the atmosphere. It is essential therefore that some estimation of the number of these trees be determined to ascertain their contribution to the removal of these GHGs.

While Dominica has been more a sink for removal of GHGs, destruction of forest cover particularly on the West or leeward coast of Dominica may be slowly removing the advantage that the country now enjoys. Large tracts of once forested areas are being turned into permanent grassland as a result of annual burning during the dry season. This appears to be more prevalent on the West Coast which is the rain shadow area of Dominica. The burning has three impacts, viz:

- The burning itself emits CO_2 into the atmosphere and increases its concentration;
- It destroys the plant cover and the ability to remove the CO_2 concentration in the air particularly in the short run; and
- In the long run by turning forested areas into permanent grasslands, the efficiency with which CO_2 is removed in compromised as grass may be less efficient and effective removers of GHGs, as compared to woody plants and trees.

Photo 5.1- Destruction of Forest Cover at Morne Rachette

It is important to monitor this so as to assist in halting the spread of this grassland and retain the integrity of Dominica as a net remover of GHGs. Moreover, the impact of the dry season on the reduction of plant canopy on the West Coast which appears to be in the rain shadow of the country may result in seasonal variations in the efficiency of the removal of GHGs.

Transport

The transport sector is next in line given its contribution to GHGs in the 1994 Inventory and the significant growth in the number of vehicles on the road since 1994. Estimates (May 2004) place the number at about 15,068: that is 1 vehicle per 5 persons. Data from the Inland Revenue Division, Ministry of Finance and Planning, indicates that on average, the number of vehicles in Dominica increase by 250 per year. *This has increased the fuel use and greenhouse gas emissions in Dominica.*

Several initiatives have been implemented to mitigate the impact. These include:

- The imposition of a levy on imported vehicles manufactured before 1996; and
- A ban on the importation of leaded petroleum.

However the continued importation of the cheaper diesel fuel and its higher carbon content make it a prime emitter of GHGs. There are other potential issues associated with this level of importation of vehicles, including traffic congestion. This sector therefore has to be monitored to measure the impact.

Electricity

The Dominica Electricity Company (DOMLEC) is the sole generator of electricity in Dominica. DOMLEC operates as a private entity and the viability of operations has to be considered as a major incentive for staying in business. Approximately 40% of the electricity consumed comes from three hydroelectric power plants located in Laudat and Trafalgar. The remainder is generated from 2 diesel-powered generators located in Fond Cole and Portsmouth. Because most of the electricity is generated by diesel and the potential for increase appears to be most feasible in that area rather than in hydro-electric power, according to an official at DOMLEC, it is necessary to treat these areas as a major source of emissions.

The current position of DOMLEC is that it does not believe that there is much viability in expanding the HEP generation given the high initial cost involved and the low potential for satisfactory returns on investment as a result of the small and restricted market and subsequent demand. However they would be prepared to buy from developers of alternative energy sources, if required, who would obviously have covered the initial cost.

Photo 5.2 – DOMLEC Power Plant at Fond Cole

Dominica's population and therefore demand for electricity is not expected to increase significantly. With 60% of the electricity being generated by diesel fuel and this being the area most likely to experience an increase, should the demand increase, then it is essential that DOMLEC's electricity generation be monitored to gauge and report on emissions.

The information will also be important for effective change towards more environmentally friendly and sustainable energy sources, given that the Government is interested in further exploring the possibility for hydro-electricity and other forms of renewable energy, given the availability of natural sources in Dominica – water, wind and geothermal.

Bitumen

Currently the amount of bitumen imported into the country is at 150,000 metric gallons according to the data from the Public Works Garage, the main importer of bitumen. Recently, a private company, ACE Engineering, has begun importation of Bitumen in Dominica. The increase in the number of motor vehicles has increased the demand for roads and for bitumen to be used in resurfacing. The burning of the bitumen in preparation for use emits CO_2 into the atmosphere. Further once applied it becomes a source of NMVOC. This is a priority area

therefore for both activity data and the emission levels. It is necessary to determine both the combustion in preparation for application of the bitumen and the amount of bitumen eventually used. The area of roads can also be used as a default factor for determining levels of emission.

Solid Waste

Dominica has two major landfills, which appear to have reached full capacity. Another site has been identified and is earmarked for the location of the new landfill. This will mean that by the end of 2005 there will be one landfill. Landfills are noted for emitting methane. The existing landfills will be closed and vegetated. The new site is expected to last at the current rate no more than fifteen (15) years. The separation of waste and the promotion of composting are among two of the strategies that will be employed by the Solid Waste Management to increase the useful life of the landfill.

Photo 5.3 – Sanitary Landfill at Fond Cole

There are a few open dumpsites that still exist from which methane may be emitting. The new landfill will have a Weigh Bridge which means that data on the volume of waste entering the landfill could be accurately measured. Because the waste is not separated, developing accurate emission levels may be problematic. However, expert opinions on the volume of garbage entering the fill may be used in the short to medium term but accuracy has to be addressed in the long term if accurate GHG emissions for this activity and for the country are to be calculated. Different waste types have differing properties and rates of decomposition. By separating the waste by compositional properties, accurate emissions for each type can be calculated.

The potential for the expansion in the generation of waste necessitates its monitoring, as the increase will have implications for higher levels of GHG emissions.

5.4. Reasons for Data Gaps

Overall Organizational behaviour in Dominica does not include a culture of data collection and analysis. Even where data are collected, gaps exist in terms of coverage and/or method. Time gaps exist as well. Many decisions therefore are not based on information, but hunches and the result is that often the wrong problems are solved.

The problems in data collection and analysis are wide ranging and include:

- The absence of clear and explicit policies on data collection, analysis, reporting and use within the public sector in particular and the country in general.

- The misunderstanding of the role that data play in establishing an informed position for decision-making and forming opinions.

- The lack of, or absence of, experts and expertise in the areas of data collection and management particularly in the development of databases relevant to GHG emission.

- The lack of, or absence of, financial and related resources for procuring these experts and their expertise and sustaining gains made under projects designed for institutional strengthening in this regard.

- The absence of explicit protocols for the operations of any available databases and data management practices to sustain existing databases.

- Lack of expertise and manpower to collect and analyse data and present them in a form that is meaningful for reporting.

- Data are not disaggregated and as such it remains a challenge to develop indicators that target the specific areas of concerns.

- In many cases, the methods of storage and retrieval are part of the problem. The prevalence of ICT as data management tools is only now beginning to emerge as part of the modus operandi of institutions and organisations in Dominica.

With respect to the data gaps identified in the sectors that contributed to the 1994 GHG Inventory, the reasons varied among the sectors as follows:

5.4.1. Transport

Generally, insurance companies, Statistical Division, Traffic and Customs collect detailed data on vehicles although this is restricted to the details on the chassis of the vehicle and its age. Fuel performance and efficiency data on vehicles are never collected. While data on the sale of fuel by type is available at the bulk filling stations, how this performs once it is used by any vehicle becomes problematic without the information on age of the vehicle, its fuel efficiency capabilities, the attitude of the driver and so on.

Photo 5.4 - Increasing Vehicle Emissions

The content properties of the gasoline are required but such information is not important to the operations of the company and therefore is not part of the brief data set sent to local companies from their parent companies in Antigua.

5.4.2. Electricity generation

This information is easier to collect since there is only one company generating electricity. A review of the database provides information on fuel performance (17.7kw per imperial gallon). Further the electricity use appears to be disaggregated by the sector. Where the gap exists is in information on the content of the petroleum, especially the carbon content and the rate at which it burns. This information is not collected because the company has never been required to do so and since the information bears no consequence for its operation, unless it is mandated it will not be collected. More information is required on the fuel efficiency devices installed and their performances at the power generation station.

5.4.3. Bitumen

Data on the importation, storage and supply of Bitumen is collected. Information on its content is required, as this is not collected. This information is not important to the purposes for which the bitumen is required and would have to be requested. The absence of expertise to do so may be part of the problem.

5.4.4. Solid Waste

The Dominica Solid Waste Management Corporation is responsible for the handling and disposal of solid waste in the Commonwealth of Dominica. This is a relatively new and independent company whose functions were previously carried out by the Ministry of Health and Social Security. Data, therefore, on the volume of solid waste generated and disaggregated by type is not available. Further, data on emissions are also not available. It may be difficult to disaggregate data by type since garbage is not sorted by type at the level of the household. Also, it may be more feasible at present to collect data on the total volume of garbage disposed at the landfill. However, in the long run more accurate data would require disaggregation.

5.4.5. Burning of Biomass

Data on the burning of grasslands has never been collected and as such do not exist. Estimates of acreages of bush fires are made by the Fire and Ambulance Services in cases where they have been called out, but this only happens in cases where these fires threaten homes. The bulk of these bush fires go unreported. Large tracts of land have been turned into permanent grassland and because their annual burning does not raise any concerns, they go unreported and undocumented. As shown earlier, the reduction in the biomass increases the emissions of CO_2 and reduces the vegetation cover that is important for the removal of that very carbon dioxide.

5.4.6. Emission Factors

In many cases specific emission factors for Dominica have not been developed and could not be used in the calculation of GHG emission. Default factors as recommended under IPCC guidelines were used and those of countries, notably Antigua and St. Lucia considered to be

within a similar geographical area as Dominica. Further, IPCC conversion factors were used in order to calculate apparent consumption on activities such as fuel. These do not capture the milieu of local conditions and behaviour that are critical for developing those emission factors and compromises the accuracy of the data produced.

Additional issues related to the collection of GHG data include:

- The Absence of legal obligations for the collection of GHG related data.
- The absence of up-to date methods and technologies for the storage, analysis and retrieval of GHG data.
- The absence of networks designed to collect data already gathered and existing in other institutions like insurance companies, within the country.
- Organisations in Dominica are currently under no obligation to report on GHG activities in a timely and prescribed manner.
- Most of the available data appears to be that which are pertinent to the operations of the organisations involved. A possible reason for this may be the traditional method of storing information on paper.
- There is still a lack of sensitisation on GHG emissions, its sources and impacts and therefore a lack of awareness among those who are engaged in GHG emission related activities and enterprises.

5.5. Specific Actions Required by Sector

5.5.1. Forestry

The Forestry, Wildlife and Parks Division is responsible for the management of all forest on state lands. The Division has divided Dominica into four (4) ranges or management areas. Each area is manned by forest rangers. Additional appointed staff below the level of Assistant Forest Officer include ten (10) Forester IIs (Forest Guards) and one (1) Forester I (Forest Ranger).

These Officers submit reports on a regular basis and the reports are collated by an officer using a generic spreadsheet. The data collected include:

- Selective logging
- Deforestation
- Squatting (which involves forest removal)
- Biomass burning
- Plant characteristics

The information is categorised by programme areas and is received on a small computer network located in the offices of the Division.

There are several key issues of concern:

- Verification of the data
- Reliability

Strengths

- There is a system of data collection and apparently this is working satisfactorily.
- The Division has a computer network.
- There is a data management person who enters the data.

Data Gaps

- The Division does not collect data on non-forest trees given the costliness of the undertaking.
- It does not collect data on forest on private lands except in the Laoma region of the Carib Territory as part of its research and reforestation programme.

Action Required

- One of the officers in each of the ranges should be given responsibility to verify information to ensure reliability. This is critical since Dominica is a net source region.
- The existing computer network must be expanded to include the clerical staff that can assist in data input and management. The current officer can then be free to focus on data analysis.
- The data storage should move from a spreadsheet to a database. This is to facilitate the ease with which queries can be made and reports prepared.
- The forest rangers need to be trained in data collection, verification and management.
- All officers need to be trained in data analysis, report writing and information sharing for decision-making. The Statistical Division can be approached for assistance.
- Modalities have to be developed for collecting data related to the forests on private lands to ensure comprehensive national coverage.

5.5.2. Division of Agriculture

The Division of Agriculture is responsible for agricultural development and planning in Dominica, including animal husbandry and plant cultivation. There is a special department responsible for livestock. This Division has been hardest hit with respect to the current austerity measures being undertaken by the government. It is expected that most of the workers in the propagation unit will be released at the end of the 2004 financial year.

Several attempts have been made to develop information system within the Ministry of Agriculture. DAISY and AIMS have been two such systems. An Agricultural Information Unit was established but has been heavily understaffed. While STABEX funding has been available to develop the system not much has been done.

There have been changes in the organisational arrangement as a result of the worker redundancy. There were five agricultural districts and district officers were responsible for data collection and information gathering. The current team approach has seriously affected the progress made.

The Division is responsible for data on the following

- Burning of agricultural waste.
- Livestock manure.

- Head count of livestock.

Strengths

- Data exists and there is a recognised need for data and information for decision-making.
- Funding exist under STABEX to develop an information system.
- An information champion has already been identified in the Division.

Data Gaps

- Data is disorganised.
- The absence of a systematic collection system as a result of organisational changes.

Action Required

- Establish a platform for information management.
- Develop a network for information sharing.
- Need to establish a central location for data collation and management.
- Existing data has to be organised.
- Develop/select a database software to input data.
- Clerks should be fitted with computers and trained in data management.
- Use extension and other field officers in collection of data on agricultural waste.
- Train two officers in data collection and analysis.

5.5.3. Transport Sector

There has been a huge influx of vehicles in Dominica since 1995. The ratio of vehicles to people is about 1:7. Many of these vehicles are reconditioned or used vehicles and while an environmental levy has been imposed proportionate to the age of the vehicle, this has not abated the flow into Dominica. In addition, the sale of leaded fuel has been discontinued but diesel is still being sold. Buses and dump trucks are mostly diesel engines. There is therefore an increased demand for fuel in Dominica and the possible increase in emissions from this source over the past ten (10) years.
Several institutions are responsible for transport data that impact on GHG emissions. These are

- Filling stations for fuel imports and sales.
- Auto dealers and mechanics for information of age of vehicles, fuel efficiency devices installed.
- Ministry of Communication and Works and Finance for policy formulation regarding the transport sector and GHG emissions.

Strengths

- An environmental levy has been imposed on used vehicles imported into Dominica.
- The use of leaded fuel has been discontinued.
- Receive certificate of quality with respect to imported fuel that contains some information on content.
- Data on fuel sales is collected by attendants at filing stations,
- Automatic tallying machines.

Data Gaps

- Absence of data on chemical content of fuel.

- Absence of data on fuel efficiency devices.
- Absence of a systematic data collection on the age of vehicles.

Action Required

- Bulk or Filing stations need to establish databases for information on analysis of information.
- Bulk or Filing station need to store data on chemical content of fuel imported into Dominica.
- Auto dealers and mechanics should collect data on age of vehicle, engine particulars, fuel efficiency devices mounted if any.
- Auto dealers and mechanics should develop platforms for data management and analysis.
- Attendants, dealers and mechanics should be trained in data collection and management.
- Ministry of Communication and Works, Agriculture and the Environment, Finance and Planning, need to establish policy for the proper collection, management and reporting of data on GHG Emission.

5.5.4. Energy (Electricity Generation)

DOMLEC is the lone electricity company in Dominica. The company operates three fuel-generated power stations. These are responsible for the generation of 21 mw of electricity. Diesel is the fuel used in this generation. DOMLEC needs to monitor its fuel use to determine the contribution of this sub-sector to GHG emissions.

DOMLEC is responsible for:

- Fuel purchased and used at each plant.
- Monitoring the use of fuel at each plant

Strengths

- DOMLEC has a small database in Microsoft excel.
- DOMLEC currently monitors fuel use in electricity generation.

Action Required

- An alphanumeric database is required for queries and reports.
- Develop separate databases for each generation station.
- Train plant attendant in electricity generation and GHG emissions.
- Install fuel efficiency devices or maintain fuel efficiency practices in the generation of electricity.
- Maintain record on efficiency practices.

5.5.5. Bitumen Production

The Public Works Garage is responsible for the import and use of the Bitumen used in the construction of roads. A technician is responsible for the plant and oversees the preparation of the product. This plant is at a nearby but remote location from the main garage offices. Data on bitumen is collected at the site manually and transferred to the main office of the garage where they are kept in manual files. While it may be easy to retrieve that information on demand, no officer is responsible for data management with respect to bitumen. One officer with two

portfolios has to take on this additional work. At present there are no electronic platforms for the bitumen section.

The garage uses ACCPAC, which is accounting software and the current computer system at the main office is networked.

Strengths

- The bitumen plant has a technician who has tremendous experience in production.
- There are data collection methods although no verification or reliability system exists.
- Receives on request a certificate of quality that provides information on content of bitumen.
- The Garage recognises the need to move from the paper records to an electronic database.
- The Garage now has to report on quality certification to multinational companies with whom they do business.

Data Gaps

- Some of the equipment is obsolete.
- Data on imports and production of bitumen are kept but that on chemical content are not kept.

Action Required

- The plant should be included as part of the larger garage electronic network system/develop a separate platform with appropriate software.
- An appropriate electronic database should be developed for the management of data in respect of bitumen.
- Train the technicians in the basic use of computers and data management.
- Mount an awareness programme for employees in the bitumen plant in GHG emissions and Bitumen.
- Establish protocol(s) for information sharing within and between the garage and ECU.
- Develop and maintain a website of the garage with bitumen information posted.

5.5.6. Solid Waste

The Solid Waste Management Corporation is responsible for the management of solid waste in the Commonwealth of Dominica. It is a quasi-government corporation established in an attempt to privatise waste management in Dominica. The Corporation depends on government for most of its revenue. The current fiscal difficulties experienced by the government have affected the operations of the Corporation. Recently a garbage levy was imposed on selected areas of Roseau.

Strengths

- The company has a data base which requires updating.
- A characterisation of waste study was done in 2002 which estimates volumes and projection of wastes.
- The Company has a cadre of staff who can be trained and given additional responsibility for monitoring waste.
- The company has begun the implementation of a levy on waste for selected areas in Roseau. That will be expanded to other areas.

Gaps

- The need for developing and maintaining appropriate database system
- Appropriate training in data collection, and analysis
- Methane production experiments to be conducted on sample projects
- Existence of a website or portal for posting information
- Absence of a clear public education programme designed to reduce waste

Action Required

- Train officers in data management and analysis
- Conduct workshop for officers in solid waste and GHG emissions
- Review and expand database for effective management of solid waste
- Develop website for disseminating data and information
- Develop and implement a public awareness programme designed to reduce waste
- Design policies and guidelines for the separation of waste
- Design and conduct test and studies in methane production in solid waste
- Monitor the production of methane on site and devise ways to use as small scale alternative energy

5.5.7. Emissions Factors

In many cases specific emission factors for Dominica have not been developed and could not be used in the calculation of GHG emission. Default factors as recommended under IPCC guidelines were used and those of countries, notably Antigua and St. Lucia considered to be with thin similar geographical area as Dominica. Further, IPCC conversion factors were used in order to calculate apparent consumption on activities such as fuel. These do not capture the milieu of local conditions and behaviour that are critical for developing those emission factors and compromises the accuracy of the data produced.

Action Required

- Emission factors specific to Dominica should be developed and used in the calculation of GHG emissions. This is critical since Dominica is a net remover of GHG and needs to preserve that advantage.
- The local expertise required to calculate these factors should be developed, as none exists at present. Such expertise should reside with the ECU and should constitute an aspect of its institutional strengthening capacity.
- Regional capacity for the calculation of GHG emission factors should be developed for those activities that are similar across countries of the region e.g. fuel consumption, energy generation.

5.5.8. Environmental Coordinating Unit (ECU)

The ECU is responsible for coordination of the environmental programme and activities in Dominica. Set up under the Ministry of Agriculture and the Environment, it is staffed with a manager and five (5) support staff.

While the unit has been mandated with the task of monitoring *inter alia* GHG emissions in Dominica, it too does not have the capacity to meet its own mandates. The inadequate staffing,

expertise and equipment are among the key factors responsible. However data already exist in several sources as identified and including the Bureau of Standards which can assist in quality assurance/standards for household and other goods – stoves, refrigerators, computers and the like.

Strengths

- The very existence of a coordinating unit creates a platform for the monitoring of GHG emissions.
- There are five officers within the unit including a clerk who can assist in the monitoring process.
- There is a strong awareness and commitment to environmental conservation.

Data Gaps

- The unit has neither platforms nor databases for the monitoring of GHG emissions.
- There are no clear policies and procedures for reporting data or collecting information on GHG.
- There is no expertise within the unit in monitoring GHG emission or calculation of emission factors.
- Absence of a legislative mandate for GHG monitoring and other environmental issues

Action Required

- Increase staffing capacity for monitoring GHG emissions.
- Train staff in graduate level data management and reporting.
- Develop and maintain a data management system.
- Train one or two officers at the graduate level in calculation of emission factors.
- Formulate /sponsor policies, standards and procedures for GHG emission data collection, management, analysis and reporting in collaboration with Bureau of Standards.
- Prepare pamphlets and flyers.
- Conduct radio programmes as part of a public awareness campaign on GHG emissions.
- Manage the national database for GHG emissions and monitor these emissions.
- Prepare an annual report on GHG emissions in Dominica.
- Disseminate information to stakeholders, flag critical sectors.
- Develop a platform (website) for easy posting and dissemination of information.
- Transmit Environmental levy to the ECU as a measure of sustainability once donor funding has been depleted
- Provide legislative mandate/framework for ECU to formalise its operations and its ability to access donor funding

6. SUMMARY OF CAPACITY NEEDS

The foregoing analysis has shown that Dominica has significant capacity deficiencies in each of the thematic areas reviewed – Technology Needs, Systematic Observation Networks and Improvement in GHG Emission factors. It has also shown that the current economic constraints will limit the extent to which the Government can aggressively respond to these capacity deficiencies. What is therefore needed is for Dominica to begin to address those issues that are feasible within its present constraints, while seeking the assistance of the international community in addressing the other more complex issues.

It must be noted however that, notwithstanding the provisions of the UNFCCC, financing for the implementation of technology needs and systematic observation projects remain virtually non-existent. This suggest the need for enabling type activities that can catalyze private sector, community and other resources towards collaborative implementation with public and private sector stakeholders in implementing climate change adaptation and mitigation related policies and measures.

In this context, it is significant to note that there are two (2) cross-cutting issues that have emerged from the thematic analyses, and which are deemed fundamental to the success of any climate change programming in Dominica. These are:

- The need for an Institutional Framework, wherein the responsibilities are clearly identified and within which the lead institution(s) have the mandate to perform.

- Public and stakeholder education and awareness, to extend beyond general awareness raising activities, into the realm of targeted sectoral activities, aimed at sensitizing specific sectors of the threats from climate change to their operations and soliciting their participation in responding to the problem of climate change.

These issues should receive priority attention in any program of capacity development as their implementation can provide a "jump-start" to other activities.

At the thematic level, priority actions include the following:

- *Technology Needs* – Increase in use of renewable energy to retain Dominica's status as a net GHG sink.

- *Systematic Observation* – Rationalisation of meteorology services to satisfy needs for meteorological information and upgrading of basic data collection.

- *Greenhouse Gas Emissions* – Improving capabilities to accurately monitor GHG emissions.

Project profiles to address these five (5) priorities are presented in the next section.

7. RECOMMENDED PROJECT PROFILES

PROJECT 1:

TITLE: Strengthening Institutional Framework for responding to Climate Change

PROBLEM: Environmental Coordinating Unit is charged with responsibility for providing leadership in national climate change-related programming. The department does not have a legal mandate for carrying out some of the responsibilities e.g. collection of GHG data, and does not have the personnel and skills necessary to provide the required leadership.

DEVELOPMENT OBJECTIVE: To provide a framework for mainstreaming climate change issues into the national dialogue.

PROJECT OBJECTIVE: To restructure the ECU to enable it to more effectively carry out its responsibilities under the UNFCCC and other MEAs.

OUTPUTS:

- ECU legally mandated to provide leadership in climate change related activities.
- ECU adequately staffed with requisite number of personnel and skills.
- ECU implementing a structured program aimed at mainstreaming climate change in national development.

BARRIERS:

- Availability of financial resources
- Availability of persons with requisite skills

STATUS:

The ECU currently coordinates all activities and is thus already recognized as working on these issues. However, its impact has been limited as it does not have the mandate or capacity to effectively carry out its responsibilities.

ACTIVITIES:

- ECU management prepare a brief, outlining responsibilities that arise from their role as focal point for UNFCCC and other MEAs.
- ECU management dialogue with Legal Department with respect to scope of authority and legal mandates required for implementing responsibilities.

- ECU management assess number and type of personnel required to implement responsibilities.

- ECU management, in collaboration with Minister, prepare a Cabinet brief on the basis of discussions with Legal Department, seeking authorization for changes that need to be made, and outlining cost and other implications.

- ECU implement recommendations once Cabinet provides necessary authorization. This may require an initial period of training to develop requisite skills.

ASSUMPTIONS

- Climate Change and other environmental issues are considered a sufficiently high priority by the Government.

- Political will to provide the ECU with the necessary authority.

INDICATIVE COSTS

The costs of this process will be internalized by the ECU. However, there will be additional costs for implementation of the new structures which will be assessed during this process.

PROJECT 2:

TITLE: Information Dissemination For Climate Change Adaptation And Mitigation

PROBLEM: Vulnerability to climate change is increasing, and opportunities for sustainable energy not realized, because stakeholders are unable to undertake needed adaptation and mitigation to climate change due to inadequate understanding and information of climate change issues and concerns.

DEVELOPMENT OBJECTIVE: Vulnerability to climate change is reduced and opportunities for sustainable development enhanced as stakeholders receive adequate information to sensitize them to policies, technologies and measures for climate change adaptation and mitigation.

PROJECT OBJECTIVE: Provision of necessary support to the Environmental Coordinating Unit (ECU) to enable it to strengthen its ability to sensitize national stakeholders on matters relating to climate change adaptation and mitigation.

OUTPUTS:

- Increased awareness of climate change among senior technical and managerial level policy makers in public and private sectors.
- Increased awareness of select target groups (e.g. schoolchildren, media, disaster response personnel, building contractors) of climate change issues.
- Increased availability of information on climate change relevant technology for Dominica through establishment of virtual and on-the-ground climate change information centers.
- Public education on climate change.

BARRIERS:

- Availability of financial resources.
- Limited technical capacities.
- Inadequate information technologies.

STATUS:

- ECU presently implements some public awareness and capacity building activities.
- Proposed and ongoing regional initiatives[11].

[11] Particularly the activities of the regional Caribbean Renewable Energy Development Project (CREDP).

ACTIVITIES

- Establishment of technology clearing house.
- Technical workshops and seminars.
- Establishment of national climate change web site.
- Preparation and distribution of multi-media material.
- Use of theatre, drama and other popular media to sensitise the general public on climate change and its implications.

ASSUMPTIONS

- Availability of financial resources.
- Administrative commitment.
- Availability of technical expertise.

INDICATIVE COSTS[12]

ACTIVITIES	COST (US$)
Establishment of Technology Clearing House (equipment, software, short-term training)	12,000
Technical workshops and seminars (coffee breaks, logistics, equipment rental etc) [13]	6,000
Establishment of web-site (preparation of material, web-hosting, short term expertise, technical support)	8,000
Preparation and distribution of multi-media material (CD:Rom, printed material, posters)	6,000
Preparation and dissemination of public education materials using theatre, drama and other popular media	30,000
Total Cost (US$)	**62,000**

[12] Personnel costs for running the system are not included. These would likely require at minimum one person for the maintenance and administration of the site.

[13] Based on ten workshops aimed at specific target groups (e.g. agriculture, tourism, forestry, government technocrats and schoolchildren).

PROJECT 3:

TITLE: Reducing Greenhouse Gas Emissions through Development Of Renewable Energy Resources

PROBLEM: Greenhouse gas emissions continue while potential for sustainable use of Dominica's renewable energy resources remains unfulfilled.

DEVELOPMENT OBJECTIVE: Enhanced economic development through sustainable use of renewable energy resources, resulting in reduced emissions of greenhouse gases.

PROJECT OBJECTIVE: Preparation of a feasibility study to determine economic, environmental and other parameters for assessing exploitation of various forms of commercially viable renewable energy in Dominica, and related financing plan for implementation.

OUTPUTS:

- Feasibility study for reduction of greenhouse gas emissions through enhanced efficiency in thermal energy generation.
- Development of potential renewable energy options for Dominica including wind, solar and geothermal energy.
- Financing plan for greenhouse gas mitigation integrated thermal energy replacement and renewable energy development programme.

BARRIERS

- Weaknesses in meteorological database.
- Availability of financing.
- Reduction in energy demand.

STATUS

- Ongoing development of wind energy demonstration facility.
- Possibilities for geothermal.
- Possibility of intra-Caribbean natural gas pipeline.

ACTIVITIES

- Preparation of terms of reference for feasibility study.
- Identification of funding.

- Implementation of the study.

ASSUMPTIONS

- Official commitment exists for realization of the objectives.
- Institutional capabilities exist for implementation
- Financing is available.

INDICATIVE COSTS

Activities	Cost (US$)
Preparation of detailed Terms of Reference (consultancy costs)	5,000
Identification of Funding (documentation, communication)	3,000
Implementation of Study (mobilization, resource assessments, travel, logistics, consultative processes, communications, report preparation)	140,000
Total Cost (US$)	**148,000**

PROJECT 4:

TITLE: Rationalisation of Meteorology Services

PROBLEM: There is an ongoing demand for meteorological information for a variety of uses – aviation, disaster management, agriculture, water supply, hydroelectric power, climate change monitoring – that cannot be supplied by the current aviation-focused service provided by the meteorological offices. At the same time, the other institutions are investing in systems that are not comprehensive, sometimes duplicate existing systems and are sometimes incompatible with each other. This represents a wastage of scarce resources.

DEVELOPMENT OBJECTIVE: To provide users of meteorological information with access to comprehensive information that would enhance their programming and their sectoral contributions to national development.

PROJECT OBJECTIVE: To maximize the use of resources available for the collection, analysis and use of meteorological information in Dominica.

OUTPUTS:

An agreed upon protocol for the recording, storage, analysis and dissemination of meteorological data in Dominica. This protocol should aim to maximize the use of the available resources by distributing responsibilities for data collection among the various players, assigning one entity to be the central repository of all meteorological data, and establishing modalities for access, dissemination and security of the data.

BARRIERS

- Institutional reluctance to collaborate.
- Institutional reluctance to share data with other organizations.

STATUS

The data that is collected by the individual organizations are being made available to potential users who are interested in accessing it. However, the quality of the data suffers from deficiencies including lack of temporal and spatial comprehensiveness and incompatibility of storage formats.

ACTIVITIES

- ECU take the lead in convening a meeting(s) of all players. The meeting(s) will review the current status of meteorological data, assess the requirements for rationalization and develop a draft protocol to be ratified by all parties
- Individual players ratify protocol and set plans in motion to perform their established role.

ASSUMPTIONS

- Key players recognize the benefits of co-operating in this field.

INDICATIVE COSTS

The costs of this process will be internalized by the participating entities.

PROJECT 5:

TITLE: Improving the accuracy of GHG Inventories

PROBLEM: Some aspects of Dominica's 1994 GHG was based on estimates and assumptions in the absence of reliable data on some of the sectors.

DEVELOPMENT OBJECTIVE: To enable Dominica to produce accurate GHG inventories, which will provide a basis for the development of appropriate mitigation policies.

PROJECT OBJECTIVE: To strengthen the accuracy of the data that is available for the compilation of GHG inventories in Dominica.

OUTPUTS:

- More accurate data available for the compilation of GHG inventories in the targeted sectors – Land Use, Land Use Change and Forestry, Road Transport, Electricity Generation, Bitumen Use and Solid Waste.

BARRIERS

- Institutional culture where collection and use of data is not valued.
- Unavailability of finances.

STATUS

There are no related activities being conducted at this time.

ACTIVITIES

- Training in data collection and analysis for personnel in targeted sectors.
- Purchase of appropriate hardware and software.
- Database development and maintenance

ASSUMPTIONS

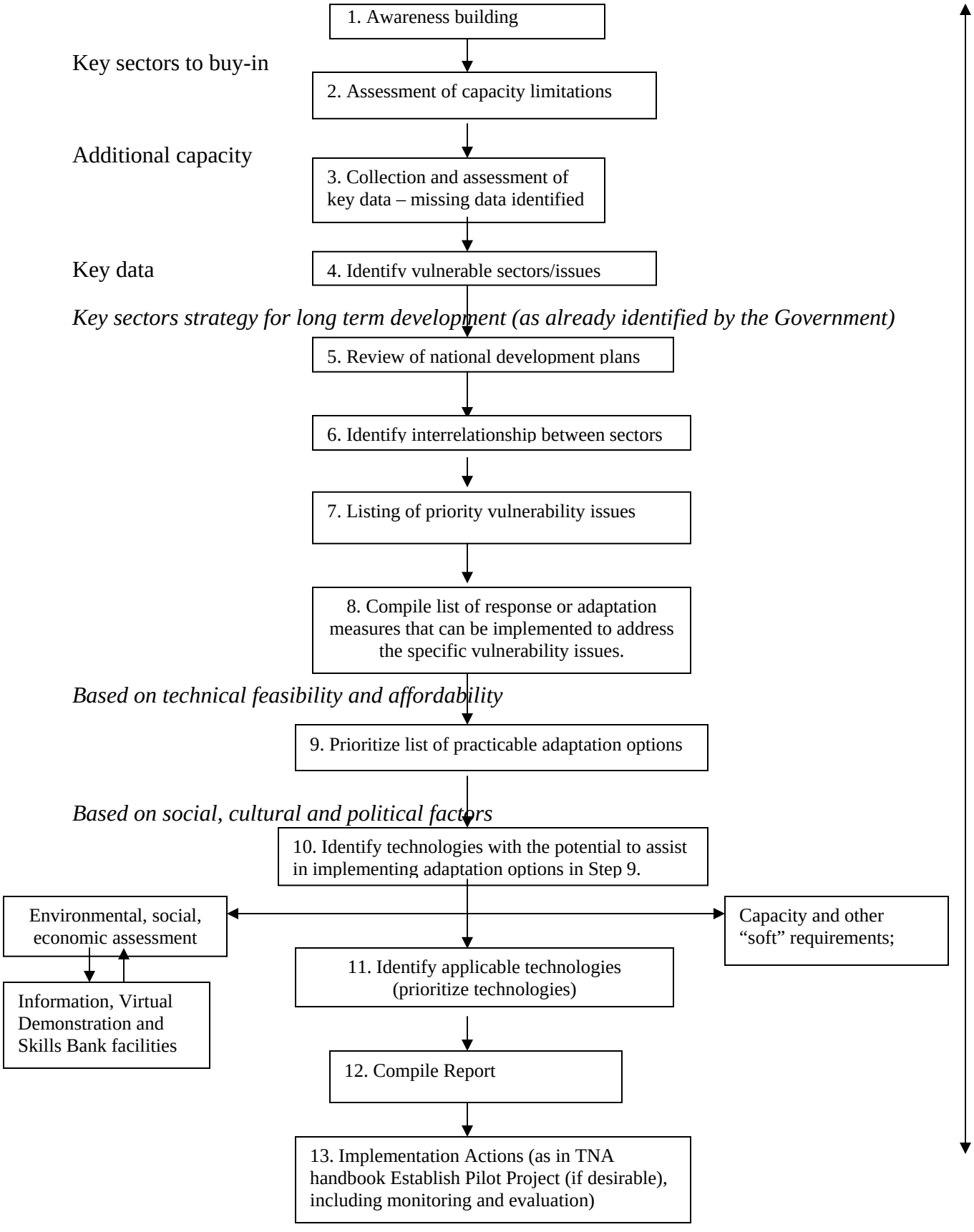
- Operational processes will allow data to be collected without significant disruption in work flows and without significant additional costs.

INDICATIVE COSTS (US$)

Sectors	People	Platform	Process
Forests **($27,000)**	Data management Training 20 x 10days@US$50=$10,000 Professional fees 10 days @US$150 = $1,500 **Total = $11,500.00**	Procure 3 computers @ US$1,500 =$4,500 Database Development $5,000 Software and licensing $6,000 **Total = $15,500.00**	
Agriculture **($33,500)**	Data collection and analysis Training 10 x 10 days @$50 = $5,000 Professional fees = $1,500 Data collection and analysis training 2 x 10 days @$50 = $1,000 Professional fees = $1,500 Networking and maintenance training 1 x 10 days @ $50 =$500 Professional fees = $1,500 **Total =$11,000.00**	Procure 3 computers @ $1,500 =$4,500 Materials for networking = $2,000 Server = $4,000 Software = $6,000 Internet = $1,000 Professional fees = $5,000 **Total = $22,500.00**	
Transport **($33,500)**	Training in data collection and management 20 x 10 days@ $50 =$10,000 Professional fees = $1,500 Train attendants 10 x 10 @$50.00 = $5,000 Professional fees = $1,500 Train bulk station managers 3 x 10 @$50 = $1,500 Professional fees = $1,500 **Total = $21,000.00**	Software for database = $6,000 Licensing = $1,500.00 Professional fees = $5,000 **Total = $12,500.00**	

Energy **($6,250)**	Maintenance of database 3 x 5 days @50 = 750.00 Professional fees = $1,500.00 Fuel efficiency practices 5 x 10 days @$50 = $2,500 Professional fees = $1,500. **Total = $6,250.00**		
Bitumen **($42,500)**	Workshop on bitumen and GHGs 10 x 5 days @ $50 =$2,500 Professional = $1,500 Training in data management 4 x 10 days x $50 = $2,000 Professional fees = 1,500 **Total= $7,500.00**	Procure 2 computers 2 @1500.00 = $3,000 Develop data base and website = $10,000 Software and licensing = $7,000 Efficiency devices = $10,000 **Total = $30,000.00**	Establish standards for data verification = $2,500.00 Testing for NVMOC = $2,500.00 **Total = $5,000.00**
TOTALS ($142,750)	**$57,250**	**$80,500**	**$5,000**

APPENDIX 1
Draft Framework of Modified TNA Activities as applied to Adaptation



APPENDIX 2
COP Decision 5/CP.5
Research and systematic observation

The Conference of the Parties,

Recalling Articles 4.1(g), 4.1(h) and 5 of the United Nations Framework Convention on Climate Change,

Recalling also its decisions 8/CP.3, 2/CP.4, and 14/CP.4,

1. *Recognizes* the need to identify the priority capacity-building needs related to participation in systematic observation;

2. *Invites* the secretariat of the Global Climate Observing System, in consultation with relevant regional and international bodies, including the Global Environment Facility, to organize regional workshops on this issue;

3. *Urges* Parties to actively support and participate in these regional workshops;

4. *Invites* the secretariat of the Global Climate Observing System to continue to assist and facilitate the establishment of an appropriate intergovernmental process to identify the priorities for action to improve global observing systems for climate and options for their financial support;

5. *Requests* the secretariat of the Global Climate Observing System to report on this matter to the Subsidiary Body for Scientific and Technological Advice at its twelfth session;

6. *Urges* Parties to address deficiencies in the climate observing networks and invites them, in consultation with the secretariat of the Global Climate Observing System, to bring forward specific proposals for that purpose and to identify the capacity-building needs and funding required in developing countries to enable them to collect, exchange and utilize data on a continuing basis in pursuance of the Convention;

7. *Adopts* the UNFCCC reporting guidelines on global climate observing systems;1
FCCC/CP/1999/6/Add.1

8. *Invites* all Parties to provide detailed reports on systematic observation in accordance with these guidelines, for Parties included in Annex I to the Convention in conjunction with their national communications, pursuant to decision 4/CP.5, and on a voluntary basis for Parties not included in Annex I;

9. *Invites* the Convention secretariat, in conjunction with the secretariat of the Global Climate Observing System, to develop a process for synthesizing and analysing the information submitted in accordance with the UNFCCC reporting guidelines on global climate observing systems.

APPENDIX 3

III. UNFCCC REPORTING GUIDELINES ON GLOBAL CLIMATE CHANGE OBSERVING SYSTEMS

I. INTRODUCTION

A. Objective

1. The purpose of these guidelines for reporting on global climate observing systems for Annex I and, as appropriate, non-Annex I Parties to the Convention, is to assist Parties in reporting their actions with regard to global climate observing systems, development of observational networks and, as appropriate, support for non-Annex I Parties to the Convention, as defined in Articles 4.1(g) and (h), 5 and 12.1(b) of the Convention.

B. Structure

2. The information identified in these guidelines shall be communicated by the Party in a single document and submitted to the Conference of the Parties through the secretariat, and shall be in one of the official languages of the United Nations. Parties may include a reference to a national focal point and/or web site where additional copies may be obtained. The length of the report may be decided by the submitting Party but every effort shall be made to avoid over-lengthy reports. Parties also should provide an electronic version of their reports to the secretariat.

II. REPORTING

A. General approach to systematic observation

3. Parties shall describe the status of their national programme for systematic observation to meet the needs for meteorological, atmospheric, oceanographic and terrestrial observations of the climate system as identified by the Global Climate Observing System (GCOS)[1] and its partner programmes in line with Article 5 of the Convention. A list of the technical acronyms used in these guidelines is given in appendix 1.

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[1] As agreed by the responsible agencies (World Meteorological Organization (WMO), Intergovernmental Oceanographic Commission (IOC) of UNESCO, United Nations Environment Programme (UNEP) and International Council for Science (ICSU)), the GCOS is made up of the climate observing components of the World Weather Watch (WWW), Global Atmosphere Watch (GAW), World Hydrological Cycle Observing System (WHYCOS), Global Ocean Observing System (GOOS), Global Terrestrial Observing System (GTOS), and relevant observation systems established under the World Climate Research Programme (WCRP) and the International Geosphere-Biosphere Programme (IGBP).

4. In describing their national programme, Parties should, where relevant, report on the following:

(a) Existing national plans and their availability, the time frame for their implementation and specific commitments to address GCOS requirements;[2] Parties should also list and describe the responsibilities of the ministries and agencies, including space agencies, responsible for implementing the plans;

(b) Parties may, if they so wish, provide additional information to that sought in the guidelines, including maps of networks and participation in other relevant programmes, such as the Integrated Global Observing Strategy (IGOS).

5. Parties should describe the extent to which national data on systematic observations are exchanged with other Parties and provided to international data centres. Parties should describe any barriers to the exchange of data or provision of data to international data centres. Parties should, as necessary, describe any national policy or guidance relevant to the exchange of data relevant to meeting the needs of the UNFCCC.

6. Parties should describe actual and/or planned activities for capacity-building in developing countries related to collection, exchange and/or utilization of data to meet local, regional and international needs.

7. Parties should describe actual and/or planned actions since the publication of the previous national communication to strengthen international and intergovernmental programmes related to global climate observing systems.

8. Where information required in these guidelines cannot be provided, Parties should report on any difficulties encountered, needs that should be met to facilitate improved reporting, and steps taken to improve availability of information.

B. Meteorological and atmospheric observation

9. Parties shall, to the extent possible, describe their participation in GCOS, through their provision of meteorological and atmospheric observations including: the GCOS Surface Network

[2] Plan for the Global Climate Observing System (GCOS), Version 1.0, May 1995 GCOS-14 (WMO/TD-No. 681).

(GSN),[3] GCOS Upper Air Network (GUAN)[4] and Global Atmosphere Watch (GAW).[5] Parties should describe to what extent the observations correspond to the GCOS/GOOS/GTOS climate monitoring principles (appendix 2) and relevant best practices.[6]

10. In describing their national programmes, Parties should, where relevant, report on the following: international data exchange; the provision of metadata to the World Data Centres; and participation in, and support for, international quality control and archiving programmes.

11. Parties should, in order to facilitate integration of national reports, complete table 1.

Table 1. Participation in the global atmospheric observing systems

	GSN	GUAN	GAW	Other*
How many stations are the responsibility of the Party?				
How many of those are operating now?				
How many of those are operating to GCOS standards now?				
How many are expected to be operating in 2005?				
How many are providing data to international data centres now?				

* Provide brief details

[3] Initial selection of a GCOS Surface Network, February 1997. GCOS-34 (WMO/TD No. 799). See also http://www.wmo.ch/web/gcos/gcoshome.html for details of GSN and GUAN requirements.

[4] Report of the GCOS Atmospheric Observation Panel, second session. Tokyo, 1995. GCOS-17 (WMO/TD No. 696) See also http://www.wmo.ch/web/gcos/gcoshome.html for details of GSN and GUAN documents.

[5] GAW requirements are specified by the WMO Executive Council Panel of Experts on Environmental Pollution and Atmospheric Chemistry and its best practices are guided by GAW Quality Assurance/Science Activity Centres and calibration centres. See also http://www.wmo.ch/web/arep/gaw_home.html.

[6] GSN and GUAN best practices are given in the WMO Manual on the Global Observing System, sections 2.10.3.17 and 2.10.4.9 respectively.

C. Oceanographic observations

12. Parties shall, where relevant and to the extent possible, describe their participation in GCOS and GOOS through their provision of oceanographic observations[7] including, for example, sea surface temperature, sea level, temperature and salinity profiles, energy and carbon flux data. Parties should describe to what extent the observations correspond to the GCOS/GOOS/GTOS climate monitoring principles (appendix 2) and other relevant best practices.

13. In describing their national programmes, Parties should, where relevant, report on the following: international data exchange; and their participation in, and support for, international quality control and archiving programmes.

14. Parties should, in order to facilitate integration of national reports, complete table 2.

Table 2. Participation in the global oceanographic observing systems

	VOS	SOOP	TIDE GAUGES	SFC DRIFTERS	SUB-SFC FLOATS	MOORED BUOYS	ASAP
For how many platforms is the Party responsible?							
How many are providing data to international data centres?							
How many are expected to be operating in 2005?							

Note: See appendix 1 for explanation of acronyms

[7] The GOOS 1998. *IOC1998,IOC, Paris.* See also http://ioc.unesco.org/goos/act_pl.htm for details of ocean observation requirements and for guidance on best practices.

D. Terrestrial observations

15. Parties should describe their participation in GCOS and GTOS programmes for terrestrial observations[8] including the Global Terrestrial Network - Glaciers (GTN-G),[9] Global Terrestrial Network - Permafrost (GTN-P),[10] and the Global Terrestrial Network - Carbon (FLUXNET),[11] and other networks monitoring land-use, land cover, land-use change and forestry, fire distribution, CO_2 flux, and snow and ice extent. Additionally, a general description of programmes for hydrological systems should be given. Parties should describe to what extent the observations correspond to the GCOS/GOOS/GTOS climate monitoring principles (appendix 2) and relevant best practices.

16. In describing their national programmes, Parties should, where relevant, report on the following: international data exchange; the provision of metadata for these networks; and participation in international quality control and archiving programmes, including hosting international archiving and/or quality assurance and quality control centres.

17. Parties should, in order to facilitate integration of national reports, complete table 3.

Table 3. Participation in the global terrestrial observing systems

	GTN-P	GTN-G	FLUXNET	Other
How many sites are the responsibility of the Party?				
How many of those are operating now?				
How many are providing data to international data centres now?				
How many are expected to be operating in 2005?				

[8] GCOS/GTOS Plan for Terrestrial Climate-related Observations, version 2.0, June 1997. GWS-32 (WMO/TD. No 796). See also http://www.wmo.ch/web/gcos/pub/topv2_1.html# contents for a general outline of terrestrial observations requirements.

[9] Report of GCOS/GTOS Terrestrial Observation Panel for Climate (TOPC). Birmingham, July 1999. See http://www.geo.unizh.ch/wgms/ for guidance on GTN-G requirements and best practices.

[10] See http://www.geography.uc.edu/~kenhinke/CALM/ for guidance on GTN-P requirements and best practices.

[11] Report of GCOS/GTOS Terrestrial Observation Panel for Climate (TOPC). Birmingham, July 1999. See http://www-eosdis.ornl.gov/FLUXNET/fluxnet.html for guidance on FLUXNET requirements and best practices.

E. Space-based observing programmes[12]

18. Parties should, where relevant, provide information on their participation in national and international space-based observing programmes or programmes using satellite data to derive climate-related information.

19. Parties should include the following information: summary description of space series, missions, and/or instruments; mechanisms for access to data and products by international programmes in relation to climate change; mechanisms for archiving, quality assurance and quality control; major domains of applications (atmosphere, ocean, terrestrial); and prospects for long-term continuity, including expected overall lifetime of observational programme. Parties should describe to what extent the observations correspond to the GCOS/GOOS/GTOS climate monitoring principles (appendix 2) and relevant best practices.

20. Where space activities are undertaken jointly with other Parties or multinational bodies, Parties should either list participating Parties or should refer to the report of another Party in which the information can be found.

21. Parties should include in their reports information on climate-related space activities in which the private sector is partly or wholly involved.

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[12] Refer to GCOS-15 (WMO/*TD No 685).* The GCOS Plan for Space-based Observations, Version 1.0, June 1995 (GCOS-15) is available at http://www.wmo.ch/web/gcos/publist2.html#plan while GCOS space-based observations requirements can be found by specifying GCOS as the user in http://sat.wmo.ch/stations/_asp_htx_idc/Requirementsearch.asp.

Appendix I

DEFINITION OF ACRONYMS USED IN THE GUIDELINES

ASAP	Automated Shipboard Aerological Programme
FLUXNET	Global Terrestrial Network - Carbon
GAW	Global Atmosphere Watch of WMO
GCOS	Global Climate Observing System
GOOS	Global Ocean Observing System
GSN	GCOS Surface Network
GTN-G	Global Terrestrial Network - Glaciers
GTN-P	Global Terrestrial Network - Permafrost
GTOS	Global Terrestrial Observation System
GUAN	GCOS Upper Air Network
ICSU	International Council for Science
IGBP	International Geosphere-Biosphere Programme
IGOS	Integrated Global Observing Strategy
IOC	Intergovernmental Oceanographic Commission of UNESCO
SFC Drifters	Surface Drifters
SOOP	Ship of Opportunity Programme
Sub-SFC	Sub-surface
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
VOS	Volunteer Observing Ship
WCRP	World Climate Research Programme
WHYCOS	World Hydrological Cycle Observing System
WMO	World Meteorological Organization
WWW	World Weather Watch of WMO

Appendix 2

GCOS/GOOS/GTOS CLIMATE MONITORING PRINCIPLES[1]

Effective monitoring systems for climate should adhere to the following principles:

1. The impact of new systems or changes to existing systems should be assessed prior to implementation.

2. A suitable period of overlap for new and old observing systems should be required.

3. The results of calibration, validation, data homogeneity assessments and assessment of algorithm changes should be treated with the same data.

4. A capability to routinely assess the quality and homogeneity, including high-resolution data and related descriptive information of data on extreme events should be ensured.

5. Consideration of environmental climate-monitoring products and assessments, such as IPCC assessments, should be integrated into national, regional and global observing priorities.

6. Uninterrupted station operations and observing systems should be maintained.

7. A high priority should be given to additional observations in data-poor regions and regions sensitive to change.

8. Long-term requirements should be specified to network designers, operators and instrument engineers at the outset of new system design and implementation.

9. The carefully planned conversion of research observing systems to long-term operations should be promoted.

10. Data management systems that facilitate access, use and interpretation should be included as essential elements of climate monitoring systems.

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[1] GCOS-39 (WMO/TD-No.87) (UNEP/DEIA/MR.97-8) (GOOS-11) (GTOS-11) Report of the GCOS/GOOS/GTOS Panel, Third session (Tokyo, Japan, 15-18 July, 1997).