



Addressing Climate Change by Promoting
Low Carbon Climate Resilient Development
in the UK Overseas Territories

Needs Assessment:
Montserrat

Department for International Development

July 2012

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Background and Purpose

Introduction

This report forms one of a suite of 16 individual needs assessments of the UK Overseas Territories (UKOTs) produced as part of the process of developing a DFID/FCO led cross HMG programme design to address climate change by promoting low carbon climate resilient development in the UKOTs. The purpose of this assignment was to identify the scope and best way to deliver an appropriate climate change programme for all UK OTs and develop a business case for it (contract duration Feb – June 2012).

The purpose of the reports was to provide a rapid synthesis of information contained within available documentation and frame this in a way which: helped to establish a clear rationale for a generic framework forming one business case for the UK OTs but not allowing this to exclude targeted and selective action to meet specific needs. They were also designed to provide an evidence base for the later comparative analysis across OTs and subsequent prioritisation of different approaches for the business case, which was going to be designed later in the consultancy

It was agreed in May 2012 by the client and the consulting team that the contract was not fully deliverable as expressed in the original Terms of Reference. Details of the full programme of work and consultation is available in the project Inception Report (29th March 2012) and End of Contract Report (11th June 2012).

These reports now form a standalone output of the abbreviated consultancy.

The Reports

The original purpose of the reports still holds and the reader should recognise that the design and level of analysis in this report was set to be achievable within the time available (2 days of evidence gathering, research and writing against over 150 specific data points) and for the original purposes specified and no other. This report provides a general overview to facilitate future potential decision making and does not constitute a comprehensive nor in-depth analytical climate change report.

In a process facilitated by the UK Overseas Territories Association, data content in this report has been reviewed by in-country stakeholders via a nominated point of contact, with feedback incorporated if appropriate.

The report is tailored to the data points required to complete a climate change vulnerability matrix (VAM) tool. The VAM is structured around an understanding of four main issues: the exposure of an OT to climate change (threat analysis); adaptation and resilience; low carbon development and UK exposure. Each issue contains a number of subsets and indicators.

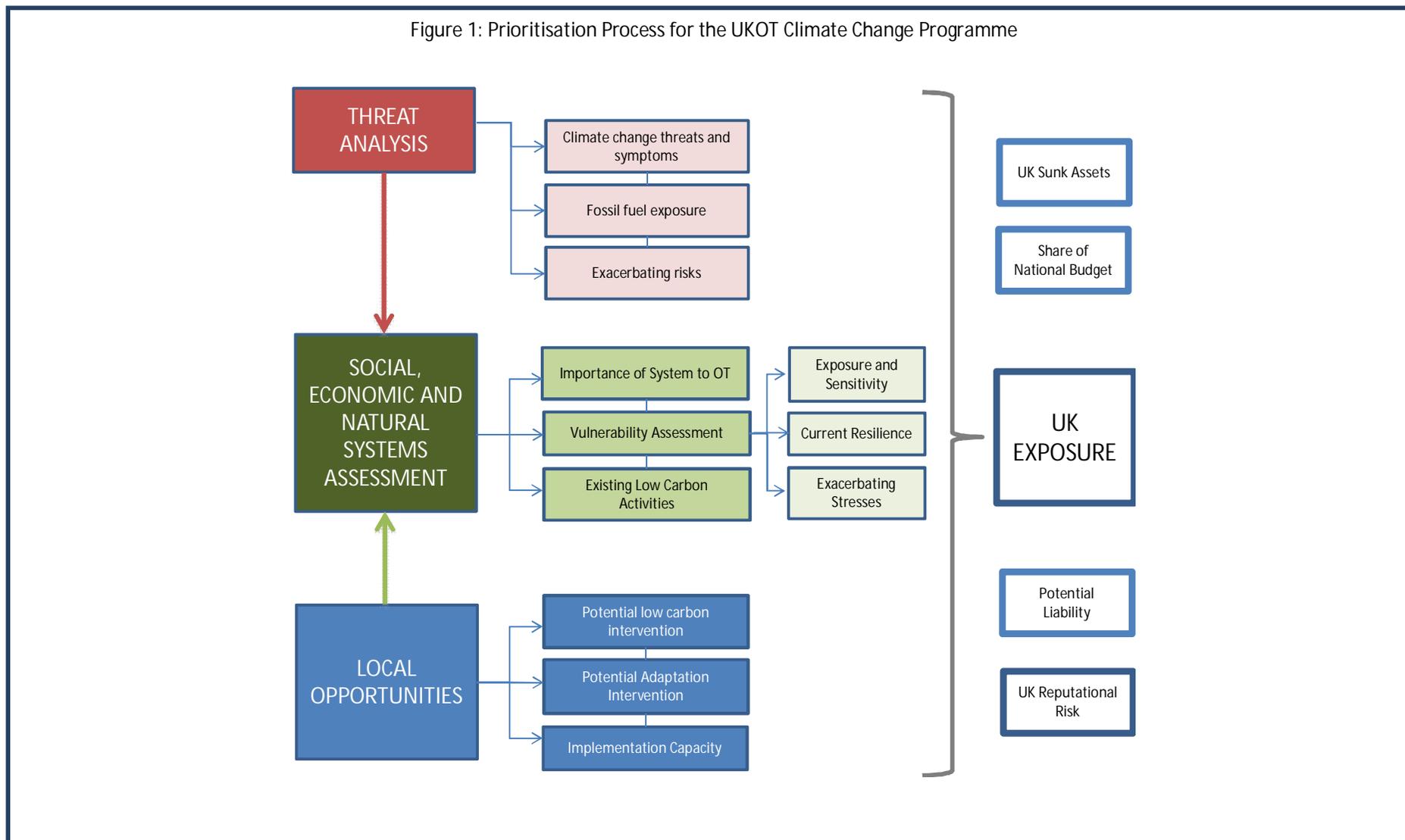
The completed VAM in this report uses a RAG colour coding system to provide a comparative analysis across all of the OTs to feed into the overall programme design. In most cases, data has been included specifically for the later appraisal and business case design process which would have followed.

Attached as annexes to this report are: an associated glossary of terms; a climate change VAM system definitions list; the VAM scoring system (which feeds into the coloured squares in the report text); the scored OT VAM; an initial programme approach table with preliminary sectoral and geographical analysis; and, if relevant, a greenhouse gas emission table.

Figure 1 overleaf illustrates how the data points in the VAM and in this report would have fed into the prioritisation process for a potential UKOT Climate Change Programme and DFID Business Case.

For a full understanding of how the data in this report and the VAM framework has been used, the reader is directed to the programme approaches which are elaborated in the programme Inception Report.

Figure 1: Prioritisation Process for the UKOT Climate Change Programme



Needs Assessment: Montserrat



KEY INDICATORS

Population:	4,922 2011
GDP:	US\$36.8 million (2007)
Per Capita GDP:	US\$7,696 million (2007)
ODA Entitled:	Yes
UK Annual Budget Support:	60% (2010)
Value of UK Sunk Assets:	N.A.
Key Economic Sectors:	Mining/quarrying, construction, financial/professional services, tourism.

Threat Exposure Analysis

Climate Change Exposure

Montserrat's Climate is marine subtropical, with a prevailing North-easterly trade wind, an average annual temperature of 28°C with seasonal lows in January and highs in September. Rainfall varies from an annual median of 107cm in drier coastal areas on the eastern side to 250cm in the Centre Hill peaks, with some distinct seasonal variations and a remarkable spatial distribution – there are huge variations in rainfall within very narrow bands¹. In broad terms the dry season runs from February to June and the wet season from July to January. The wet season generally coincides with the Atlantic hurricane season, which sends hurricanes north-westwards towards the eastern Caribbean and Montserrat, bringing high winds and torrential rain.²

The most recent hurricane to significantly affect Montserrat was Hurricane Earl which passed through in late August 2010. Although the eye of the storm passed well to the north of Montserrat, the island was caught in the outer bands of the system which carry rain causing widespread damage to infrastructure. The torrential rain brought extreme surface water flows, with widespread flooding of ghauts and the transportation and deposition of large quantities of rock and vegetation.³

In recent decades the number of “very hot days” (temperatures at or above the 90th percentile) have increased, while the number of “really cool” days and nights (temperatures at or below the 10th percentile) have fallen. A drying trend for the Caribbean summer (June to August) has also been observed.⁴

Sea surface temperatures (SST) (for the region) are also rising and generally exceed those being observed over the global tropical oceans over the past 20 years; warming is occurring at 0.2°C to 0.5°C per decade.⁵

¹ Montserrat Utilities Limited (MUL) (2011): Data tables and information provided by Bill Tonge of MUL

² Gray, G. A. L. (2010). Montserrat National Climate Change Issue Paper, Montserrat: Ministry of Agriculture, Land, Housing and the Environment

³ Government of Montserrat (2012): “Physical Development Plan for North Montserrat 2012-2022” Physical Planning Unit, Ministry of Agriculture, Land, Housing and the Environment, Montserrat, April 2012.

⁴ Neelin, J. D., Munnich, M., Su, H., Meyerson, J. E., and Holloway, C. (2006), “Tropical Drying Trends in Global Warming Models and Observations” PNAS April 18, 2006 vol. 103 no. 16 6110-6115 available at <http://www.pnas.org/content/103/16/6110.full.pdf+html>

⁵ Simpson, M.C., Scott, D., Harrison, M., Silver, N., O’Keefe, E, Harrison, S., Taylor, M., Sim, R., Lizcano, G., Wilson, M., Rutty, M., Stager, H., Oldham, J., New, M., Clarke, J., Day, O.J., Fields, N., Georges, J., Waithe, R., McSharry, P. (2010): Quantification and Magnitude of Losses and

Under IPCC A2 (high emissions) and B2 (low emissions) scenarios, projections for mean annual temperature change in the Caribbean region range from an average of 1.78°C and 1.84°C by 2050 above the base period average (1961-1990)⁶ Regional Climate Models predict that Montserrat is likely to experience an increase of between 1.60°C (A2) and 1.65°C (B2) over this period⁷.

There is an approaching consensus that sea level rise in the Caribbean by the end of the 21st Century will be between 1-2m above 2010 levels.⁸

Predictions for changes in rainfall vary wildly between models and it is not possible to predict long term changes with any degree of confidence.

Increases in the frequency and intensity of tropical storms are forecast, but there is no universal agreement on the probability of this occurrence.⁹

Resource Exposure

In 2012 Montserrat was almost entirely dependent upon imported diesel fuel for its energy needs. 100% of electricity generated in 2011 came from diesel generators¹⁰. In 2010 the imported energy mix comprised: 658,600 litres of commercial butane gas; 2,554,900 litres of gasoline (almost 100% use for transportation) and 4,769,100 litres of diesel. 76% of the diesel oil consumption in 2010 was used by the diesel generator sets at the power station. The remaining third of diesel was consumed by road vehicles and water transport.¹¹

Most recently available estimates for per capita energy consumption derive from 2007 and estimate consumption at 5,433 kg oil equivalent.¹²

Domestic water consumption in 2010 was 369,869,260 litres (74.5%) of metred consumption, 200 litres per capita per day.¹³

Montserrat is among the UKOT's that are included within UK reporting on its greenhouse gas inventory.¹⁴ However, the limited input activity data supplied has resulted in a very narrow sector profile. In 2010 20,000 metric tonnes of carbon dioxide were reported from the road transport sector (10,000 from diesel and 10,000 from petrol sources)¹⁵ (agriculture and road transport the only sectors recorded). Local estimates report the total emissions profile to amount to approximately 40,000 metric tonnes of carbon dioxide per year, at 8 to 10 tonnes per person. This is equivalent to around 0.73kilos/EC\$ of GDP.¹⁶

Damages Resulting from the Impacts of Climate Change: Modelling the Transformational Impacts and Costs of Sea Level Rise in the Caribbean, United Nations Development Programme (UNDP), Barbados, West Indies.

⁶ United Nations Economic Commission for Latin America and the Caribbean (2011): "The Economics of Climate Change in the Caribbean" UNEC, Sub-regional Headquarters for the Caribbean, Port-of-Spain, Trinidad and Tobago

⁷ ibid

⁸ Simpson, M.C et al (2010): op cite p13

⁹ Simpson, M.C et al (2010): op cite p13

¹⁰ Montserrat Utilities Limited (MUL) (2011): Communication with Director Peter White documented in preparation of the Physical Development Plan for North Montserrat 2012-2022

¹¹ Reported in the Montserrat Infrastructure Plan (GoM (2012): "Montserrat Infrastructure Plan – Final January 2012 – Appendix B" – IMC Worldwide, for DFID/GoM January 2012) citing communication with MUL

¹² United Nations Statistics Division (2011): "Environment Statistics Country Snapshot – Montserrat" available at http://unstats.un.org/unsd/environment/envpdf/Country_Snapshots_Aug%202011/Montserrat.pdf

¹³ Personal communication, Bill Tonge, Water Division, Montserrat Utilities Limited, 2011

¹⁴ HMG (2011) "National Inventory Report (NIR) for 2009" AEA, accessed via http://uk-air.defra.gov.uk/reports/cat07/1104281001_ukqhqi-90-09_Annexes_issue2.pdf

¹⁵ UK National Atmospheric Emission Inventory (2012): data tables AC7595NW_OTemissions1990-2010.xlsx

¹⁶ Gray, G. A. L., (2010). Montserrat National Climate Change Issue Paper, Montserrat: Ministry of Agriculture, Land, Housing and the Environment

Adaptation and Resilience

Importance to OT

Importance of System to OT

Overview

In the 2010 *Montserrat National Climate Change Issues Paper*,¹⁷ participants of a broad-based consultation identified the main climate change issues using a ranking method. The evaluation criteria included: national significance, certainty of occurrence, severity of threat/impact and urgency of need to respond. National significance was scored against four dimensions: social, environmental, economic and cultural. The priority environmental components and economic sectors were: Agriculture and Fisheries, Biodiversity and Ecosystems, Tourism, Beaches, Coastal zone, Access to Critical Infrastructure, Reefs and other marine life, Human settlements and Water/Hydrology.

Natural : There are three terrestrial protected areas on Montserrat covering an area of 2,851.9 ac (1,155 ha); this represents 11% of the total land area and 30% of the volcano safe zone. The protected areas include (i) the Centre Hills Forest Reserve and protected forest (11.16 sq km)); (ii) Piper's Pond Wildlife Reserve and associated conservation area (0.8ha) and (iii) the Silver Hills Forest Reserve (30.4 ha). The Centre Hills are critical to the sustainability of Montserrat, performing a range of vital functions for the island. As the primary source of all the islands potable water, its vegetative cover is essential for the continued maintenance of Montserrat's key watersheds and springs. It is recognised as a site of international ecological and biodiversity importance, providing habitat to a number of critically endangered flora and fauna, including the Endemic Montserrat Oriole and the world's second largest terrestrial frog, the Mountain Chicken. The Centre Hills are an important part of the national tourism offering. Other aspects of Montserrat's flora and fauna includes at least 795 native plant species, 12 restricted range species of birds and 1,241 invertebrates, which include 718 beetles. In addition to the Oriole and Mountain Chicken, Montserrat is home to the critically endangered galliwasp lizard and several other species are restricted to Montserrat and some nearby islands¹⁸.

Birdlife International have identified and designated three Important Bird Areas (IBA) on Montserrat.¹⁹ These are the South Soufriere Hills, The Centre Hills and the Northern Forested ghauts. The Centre Hills have already been identified as an area of outstanding conservation importance, while the South Soufriere Hills IBA is in Hazard Zone F. The Northern forested ghauts are, therefore, a priority. Montserrat's coastal areas support a range of resident and migratory coastal and wetland birds.

Volcano related sedimentation, combined with poor land and construction management has destroyed large swathes of the marine system, placing a premium on managing the remnants of Montserrat's patch reef system. The reefs and off shore sea grass beds support a wide range of marine life and its beaches important nesting populations of the internationally protected green and hawksbill turtles with occasional loggerhead and leatherback turtles²⁰

There is no perennial surface water runoff from the island, other than from streams that feed directly from spring water in the Centre Hills. Since the evacuation of the southern portion of the island, the naturally occurring springs of the Central Hills provide Montserrat with all of its current water supply. Water is primarily gravity-fed via pipes into a network of 18 tank reservoirs around the island. Approximately 100 million gallons per month is currently extracted from these sources, about 80% of which are used for public supply.²¹

¹⁷ Gray, G. A. L.,(2010). *ibid*

¹⁸ Young R,P (ed)(2008):"A biodiversity assessment of the Centre Hills, Montserrat". Durrell Conservation Monograph 1. Durrell Wildlife Conservation Trust, Jersey

¹⁹ Birdlife International (2011): <http://www.birdlife.org/datazone/sitefactsheet.php?id=19658>

²⁰ Godley BJ, Broderick AC, Campbell LM, Ranger S, Richardson PB (2004): "An Assessment of the Status and Exploitation of Marine Turtles in Montserrat. In: An Assessment of the Status and Exploitation of Marine Turtles in the UK Overseas Territories in the Wider Caribbean" pp 155-179. Final Project Report for the Department of Environment, Food and Rural Affairs and the Foreign and Commonwealth Office

²¹ McCauley, C. & Mendes, S., 2006. *Montserrat Centre Hills Socioeconomic Assessment Report*, Montserrat: Montserrat National Trust.

Economic: The Montserrat economy has been dominated by the effects of the Soufriere Hills volcano. As the island rebuilds, the economy is still dominated by government services (funded by HMG) which resulted in GDP breakdown in 2009 as follows: tourism 20%, Government services 41.5%, real estate and housing 13.6%, banks and insurance 11.7%, construction 9.4% and transport 7.1%.²²

Prior to the volcanic crisis of 1995, tourism was the most important sector of the economy and it remains negatively affected by a range of factors, including limited international transportation links. Traditionally, tourism in Montserrat had primarily been “residential tourism”, with an upscale market of clients generally staying in rental villas or guests houses for longer periods of time than the package-resort tourism that many other islands promote. There is also a modest population of expatriate home-owners who spend all or part of the year in Montserrat. HMG investment in a new port and capital town at Little Bay is the focal point of efforts to stimulate the potential of the tourist economy.

Agriculture was once a mainstay of the economy and it is still important to the island for cultural reasons and the sustainable livelihoods it provides for a segment of the population. Although it contributes less than 2% directly to GDP, the Department of Agriculture reports that there are more than two hundred (200) people directly involved in agricultural production including fishing supported by agricultural labour force of at least an equivalent number. Factoring in the supply chain, around 20 people use local produce for primary processing and a further 50 make a living from selling local produce to consumers.²³

The performance of other economic sectors is strongly linked to HMG investment in infrastructure and services and the prevailing level of volcanic activity. In June 2012 the volcano remained in “paused state” for a second year in succession.

Social: Approximately two-thirds of Montserrat’s resident population evacuated the island following the eruption of the Soufriere Hills Volcano. According to the 2012 census the population of Montserrat is now 4,922, an increase of 457 persons or 10% since the previous census of 2001.²⁴ Very little of the increase since 2001 can be accounted for by returning Montserradians, or from any substantial increase in the birth rate, which remains broadly consistent with overall mortality rate. The increase has come from immigrants arriving from the wider Caribbean region, predominately from Jamaica and Guyana and the Spanish-speaking Dominican Republic. The number of foreign nationals on Montserrat doubled in the five years 2001 to 2006, from 820 (18% of the population) to 1,634 (34% of the population). Many immigrants are now assimilated and have right of residency²⁵.

Social welfare data is limited. The last published poverty assessment was in 2001. There are pockets of deprivation around the island and around 69 families living in government owned accommodation.²⁶

Average life expectancy in 2004 was 78.9.²⁷

Vulnerability

Sensitivity to Climate Exposure

Water supply is a critical issue for any small island. Montserrat relies exclusively on its spring source for current need. If Montserrat does experience a drying weather pattern, spring yields are likely to suffer. If the rain that does fall occurs at an increased level of intensity, ground infiltration rates are likely to fall, levels of

²² Government of Montserrat Ministry of Finance & Economic Management, Statistics Department (2011): “GDP 2000-2009 Tables”, Statistics Department, St Johns, Montserrat

²³ GoM Department of Agriculture (2009) “Food Production Strategy”, Department of Agriculture, Brades, Montserrat.

²⁴ GoM MoFEM Statistics Department (2006): “2006 Montserrat Population Count – Basic Tables” Statistics Department, St Johns, Montserrat/ GoM MoFEM Statistics Department, (2001): “2001 Population & Housing Census - Basic Tables” Statistics Department, St Johns, Montserrat/ GoM MoFEM Statistics Department (2012): “Census 2011 – Montserrat at a Glance”, Statistics Department, St Johns, Montserrat

²⁵ GoM MoFEM Statistics Department (2006): “2006 Montserrat Population Count – Basic Tables” Statistics Department, St Johns, Montserrat

²⁶ GoM MALHE Housing Unit (2011): “Emergency Housing/Shelter Management Occupancy Tables” Unpublished tabular data June 2011; Ministry of Agriculture, Lands, Housing and the Environment Housing Unit, Brades, Montserrat/ GoM Ministry of Youth Affairs, Community Services and Sports (MYACSS) Community Services Department (2011): “Cost of Living Report 7th February 2011”

²⁷ Gom MoFEM Statistics Department (2011): unpublished data tables

surface run off likely to increase, leading to a multitude of effects; among them, a reduction in the capture and storage of water in the Centre Hills catchments²⁸.

The Centre Hills is the heart beat of Montserrat's biodiversity. Changes to temperature and patterns of rainfall are likely to lead to significant changes in the ecosystems it supports.

Settlements and Infrastructure: Montserrat's topography, characterised by steep valleys and gorges (ghauts) has created acute demand for land in the north; vegetation clearance on steep slopes for commercial, residential and agricultural purposes, makes much of Montserrat's service and buildings infrastructure (including housing) prone to any increase in rainfall or frequency and tropical storm intensity.²⁹ Tropical storm related inland flooding and landslides (as demonstrated during Hurricane Earl in 2010) are a particular risk to infrastructure adjacent to or traversing ghauts that radiate from the Centre and Silver Hills.³⁰

Although Montserrat is not especially low lying, sea level rise threatens major public and private investments at Little Bay and Carr's Bay where a new capital town and port are located (though it is understood that these are being climate proofed by design³¹.) Critical infrastructure also at risk of sea level rise (and inland flooding) include the islands Bulk Fuel storage at Carr's Bay. The success of the tourism economy is intrinsically linked to climate sensitive infrastructure assets.

Tourism (both residential and short term) forms an important part of Montserrat's revenue and could be greatly affected by its ability to withstand any increase in intensity of tropical storms and by changes to the tourism product. Estimates suggest that climate related impacts would translate into losses of around 145% of GDP.³²

Energy and Energy Security: Unless Montserrat can transition to geothermal energy any local or global warming trend is likely to lead to an increase in demand for expensive imported fossil fuels, placing a major burden on Government and population.

Agriculture: As a significant sector for sustainable (non-commercial) livelihoods, the island's small holders and backyard farmers are at risk of changes to the hydrological regime and associated risks of soil erosion and flooding³³.

Current Resilience Activities

Montserrat's draft 2011 Climate Change Policy³⁴ was a key outcome of the DFID sponsored ECACC³⁵ project and is complementary and supportive of the 2008 Montserrat Sustainable Development Plan³⁶. The plan is a starting point for all future resilience activities.

The new DFID funded port development at Carr's Bay is being built to withstand storm surge and sea level rise and will protect low lying areas behind³⁷.

The new Master Plan for a capital town at Little Bay has adopted a retreat approach to critical infrastructure by locating government buildings and key government investments on high ground. It has included beach nourishment as part of plans and focused on drainage.³⁸

²⁸ Gray, G. A. L., (2010). *ibid*

²⁹ Smith Warner International (2003) "Integrated Vulnerability Assessment of Montserrat" - submitted to Government of Montserrat June 2003

³⁰ Government of Montserrat (2012): "Physical Development Plan for North Montserrat 2012-2022" Physical Planning Unit, Ministry of Agriculture, Land, Housing and the Environment, Montserrat, April 2012.

³¹ MDC (2012): "Little Bay Draft Master Plan – June 2012" MDC 2012

³² Moore, W., 2011. *Review of Climate Change Project. National Tourism Sector Assessment: Montserrat*. Santiago, Chile: Economic Commission for Latin America and the Caribbean (ECLAC).

³³ Gray, G (2010): *op cite*

³⁴ GoM MALHE (2011): "Transforming to a Climate-Resilient and Low Carbon Economy: Montserrat's Climate Change Policy (DRAFT)" Caribbean Community Climate Change Centre, Belmopan, Belize

³⁵ DFID (2007): "Summary Report ECACC Project Launch, 8-10 November, 2007, Georgetown, Grand Cayman" access via <http://www.dfid.gov.uk/r4d/PDF/Outputs/ClimateChange/ECACCprojectlaunchreport.pdf>

³⁶ GoM Development Unit (2008) *Journey to Sustainable Prosperity: a healthy and Wholesome Montserrat – the Montserrat Sustainable Development Plan 2008-2020*, Development Unit, Brades, Montserrat.

³⁷ Government of Montserrat (2012): "Physical Development Plan for North Montserrat 2012-2022" Physical Planning Unit, Ministry of Agriculture, Land, Housing and the Environment, Montserrat, April 2012.

The upgrading of A01 main road (funded by DFID) includes widening of culverts to accommodate increased surface water from slopes in the Centre Hills. MUL are phasing in a programme of suspending water pipes from cable stays in areas prone to flood risk.

The new National Physical Development Plan has integrated climate change factors into its land use zoning. It has safeguarded vegetation in important drainage catchments and ghauts; it has prevented development on gradients greater than 10%; included development buffers around the Centre Hills and provided indicative standards on passive design for new buildings and guidance on erosion control³⁹.

There is some ad-hoc household level rainwater harvesting but no formalised programme in private or public sectors⁴⁰.

Government has invested heavily in irrigation infrastructure, training of farmers and livestock production units and Fisheries Department is investing in improved fisheries infrastructure and training to improve the efficiency of fisheries operations⁴¹.

Exacerbating Stresses

An island nation, located in close proximity to the subduction zone of the Caribbean Plate boundary necessitates the integration of risks from natural hazards into all aspects of planning. Key natural hazards include hurricane winds, storm surge, inland flooding, tsunami and landslides.⁴² These hazards are in turn exacerbated by a number of anthropogenic factors. These include: alterations to the natural flow of ghauts through inappropriate development practice (building in ghauts and clearing vegetation); under-engineered infrastructure, including undersized culverts at ghaut road crossings, the proximity of residential accommodation and property to ghauts and the general removal of natural vegetation leading to increases in surface water run-off and deposition of sediment in the marine environment.⁴³

The omnipresent threat posed by volcanic activity has the potential to exacerbate a range of impacts. Biodiversity and ecosystems are affected by airborne volcanic ash, ash and debris runoff from the land, which in turn affects marine environments already vulnerable to changes in surface sea temperature. Scientific reports note the potential for a restart of lava extrusion in 2012 of approximately 70%.⁴⁴

Montserrat's import dependency leaves every sector of the economy vulnerable to variations in food prices and oil prices and market shocks.

Future Opportunities

Potential Adaptation Interventions

Short term priority issues and responses are documented in Gray 2010 (unless otherwise stated)⁴⁵. These include:

Biodiversity and Ecosystems:

- Support to the Physical Planning Unit and Department of Environment: The new National Physical Development Plan has developed a pattern of land use zoning which mainstreams adaptation, the

³⁸ Montserrat Development Corporation (MDC) (2012): Draft Master Plan for Little Bay – June 2012

³⁹ GoM MALHE Physical Planning Unit (2012): "op cite".

⁴⁰ Gray, G (2010): op cite

⁴¹ Gray, G (2010): op cite

⁴² Smith Warner International (2003) "Integrated Vulnerability Assessment of Montserrat" - submitted to Government of Montserrat June 2003

⁴³ GoM (2012): "Physical Development Plan for North Montserrat 2012-2022" Physical Planning Unit, Ministry of Agriculture, Land, Housing and the Environment, Montserrat, April 2012.

⁴⁴ Scientific Advisory Committee on Montserrat (2011): "Assessment of the hazards and risks associated with the Soufriere Hills Volcano, Montserrat - Sixteenth Report of the Scientific Advisory Committee on Montserrat Volcanic Activity" Issued 13 December 2011 and downloaded from <http://www.mvo.ms/resources/downloads/finish/53-sac-16/923-sac-16-full-report/0>

⁴⁵ Gray, G. A. L., (2010). Montserrat National Climate Change Issue Paper, Montserrat: Ministry of Agriculture, Land, Housing and the Environment

success of which depends on effective enforcement (in particular the protection and safeguarding of ghauts and vegetative strips from development).

- In situ conservation of endemic species and control of invasive species and research climate-tolerant native species.

Hydrology and Water resources:

- protect groundwater sources from pollution (septic tanks, agricultural management, waste disposal); employ better water harvesting and conservation measures (roof catchment systems, tanks, grey water, dry farming, drip irrigation);
- Support to MUL and GoM to develop better water resource management and allocation systems (reuses); public education and outreach programmes for water conservation and to encourage grey water recycling at the household level (see below); and protect and manage key catchments to maximize storage and yield;
- Rain water harvesting for homes and buildings (providing ash filters can be applied). These are estimated to cost between 3,000-4000 \$EC (GBP700 - GBP930) per unit⁴⁶. There is a particular opportunity to incorporate rainwater harvesting techniques on all new build development at Little Bay and Carr's Bay;
- Network improvements: Montserrat utilities have a proposed forward investment programme to 2016 (EC\$ 33.37million (GBP7.76million)) designed to improve network distribution, storage and supply; and,
- Waste water improvements: MUL are seeking to upgrade waste water systems at Davy Hill and Look Out to cope with peak flow demand which is exacerbated by rainwater infiltration.

Tourism:

- support to GoM to enforce development control measures and coastal setbacks;
- Ensure that the EIA process is followed and recommendations complied with; and
- enhanced reef monitoring systems to provide early warning alerts of bleaching events, the development of artificial reefs (as at Woodlands beach) or fish-aggregating devices.⁴⁷

Agriculture and Fisheries:

- Enforce the provisions of the National Physical Development Plan to safe guard the integrity of land and marine resources; provide financial support for agro-forestry at community and national levels and technical assistance to farmers and backyard farmers.

Human health and livelihoods:

- Enforce and adapt building and planning regulations;
- Strengthen EIA legislation to include climate issues; undertake research into climate-resilient designs; and,
- public education and outreach.

Implementation Capacity

Responsibility for adaptation and low carbon initiatives would fall to numerous government ministries within Montserrat. The Department for Environment (DOE) leads on policy, conservation and research. Limited capacity (both human and financial) hinders the DOE from successfully and efficiently coordinating and facilitating the national environmental portfolio. Opportunities are being missed as the DOE do not have the

⁴⁶ GoM (2012): "Montserrat Infrastructure Plan – Final January 2012 – Appendix B" – IMC Worldwide, for DFID/GoM January 2012

⁴⁷ Moore, W., 2011. *Review of Climate Change Project. National Tourism Sector Assessment: Montserrat*. Santiago, Chile: Economic Commission for Latin America and the Caribbean (ECLAC).

resources to apply for funding. When project funds are secured these are not fully utilised unless the DOE have the requisite resources to carry out the contracted activities and manage partnerships.⁴⁸

Low Carbon Development

Current Emissions

Share of Current Emissions



Montserrat is party to the ratification of the Kyoto Protocol and provides data to DECC. As reported, the limited input activity data supplied has resulted in a very narrow sector profile. In 2010, 20,000 metric tonnes of carbon dioxide were reported from the road transport sector (10,000 from diesel and 10,000 from petrol sources)⁴⁹ (agriculture and road transport the only sectors recorded). Local estimates report the total emissions profile to amount to approximately 40,000 metric tonnes of carbon dioxide per year, at 8 to 10 tonnes per person.

GHG Abatement

Abatement Potential



Although no power is currently generated by MUL from renewable sources the GoM is committed to the development of a low carbon and “green economy” based on existing and emerging energy technologies and the immediate exploitation of wind and geothermal energy, improving energy efficiency and examining the feasibility of low cost solar photovoltaic systems and solid state LED lighting⁵⁰. Constraints on available land for renewable technologies, suggest that in 2012 Geothermal is the only short to medium term option:

Geothermal: The GoM (with support from DFID) is progressing with arrangements to develop geothermal energy in the Delvins Area (Zone C), where initial geological studies have suggested that there is significant potential for geothermal energy of up to 50MW per annum⁵¹.

Wind: Montserrat’s prevailing North-easterly trade wind brings average wind speeds of 15 knots for much of the year⁵². Wind technology has precedent; prior to the volcanic eruption in 1995, 200kW of wind turbine capacity was provided from a site near St Georges Hill. This ceased operation in 1997 due to volcanic activity. Studies in 2008⁵³ and 2010⁵⁴ identified potential sites at locations within the Blakes Estate. They were selected for their high wind speeds, accessibility, size, distance from properties and proximity to the grid. The analysis, however, failed to consider proposed and future development on the island and the land area that would effectively be contaminated by the turbine units. Guidelines for the location of wind turbines suggest that a buffer of between 4 and 600 m is maintained from the nearest residential property, on the grounds of noise pollution and safety. This would require an effective 1km exclusion zone for energy generation by wind. The new National Physical Development Plan for North Montserrat 2012-2022⁵⁵ has zoned these potential locations for residential and recreational tourism in line with a recent policy decision that the potential for Geothermal energy must be explored before any other options

⁴⁸ Gerard Gray (2012), GoM, Director of the Department of Environment, Personal Communication

⁴⁹ UK National Atmospheric Emission Inventory (2012): data tables AC7595NW_OTemissions1990-2010.xlsx

⁵⁰ GoM (2008): “Montserrat National Energy Policy 2008 - 2027”

⁵¹ Brophy (2010) “Geothermal Exploration in Montserrat – Final Report”

⁵² Gray, G. A. L., (2010): “Montserrat National Climate Change Issue Paper”, Montserrat: Ministry of Agriculture, Land, Housing and the Environment

⁵³ Wind Business Support (2008): “Wind Power Potential in Montserrat”, Wind Business Support for DFID/GoM

⁵⁴ Wind Business Support (2010): “Wind Power Potential in Montserrat – Addendum Report”, Wind Business Support for DFID/GoM, June 16 2010.

⁵⁵ GoM (2012): “Physical Development Plan for North Montserrat 2012-2022” Physical Planning Unit, Ministry of Agriculture, Land, Housing and the Environment, Montserrat, April 2012.

Solar: Montserrat has an average of 5-6 kWh per sq. m per day of energy from the sun⁵⁶, but does not have land area for large scale solar energy technology.

Passive building design and energy efficiency: Montserrat has the highest per capita consumption levels of petroleum (high carbon) products when compared with St. Kitts, Antigua, Barbados, Dominica, Grenada, St. Lucia and Anguilla⁵⁷. Existing homes and buildings could be retrofitted with energy saving devices; development of new town at Little Bay and Carr's Bay provides potential for complete low carbon development.

Current Abatement Activities

Montserrat will shortly be upgrading its diesel based power station to more reliable 1.5 MW source⁵⁸. The estimate cost is US\$6.95million. In 2012 the Montserrat Little Bay Master Planning Team were considering passive design principles in the new Master Plan⁵⁹.

Future Opportunities

Potential LCD Intervention

Geothermal - In 2011 DFID reaffirmed their commitment to exploring the real potential for Geothermal Energy on Montserrat. The exploitation of geothermal energy is a stated aim of the National Energy Policy and is growing momentum for the exploitation of this renewable energy source. It is anticipated that in 2012 test drilling will be undertaken. All locations are in hazard zone C. The pump house that would be required has been mooted for the south flank of Garibaldi Hill. The costs for designing and installing a 2MW geothermal plan have been estimated at US\$16 million (£10.5million)⁶⁰ If geothermal energy is proved to be feasible, there is potential to generate up to 50MW of energy, with export of around 40MW to a neighbouring island⁶¹.

Wind – although a stated aim of the national energy policy and although Montserrat has a conducive wind regime, the new Physical Development Plan for North Montserrat highlights the lack of available space for such turbines and has deferred detailed examination of wind energy until geothermal options have been explored.

Solar –No projects identified but there is some potential for the localised use of solar hot water. Units cost approximately 18,000 EC\$ (£4,100) with a five year payback.⁶² Solar power harnessed via photovoltaic panels is considered too expensive with current technology and a solar farm is constrained by the lack of available land area.⁶³

Passive design and new buildings - Major infrastructure works and development of new town at Little Bay creates potential for incorporation of passive design principles. These are being considered in June 2012 in the Master Plan. This involves designing space and buildings to minimise energy consumption (This includes orientation of the building, design of openings and self-shading, and choice of material).

Energy Efficiency in the home – The GoM Infrastructure Plan⁶⁴ includes suite of potential low cost measures: energy efficient fans, water pumps, cooking appliances and behavioural change.

Transport: Short term – there are opportunities to support the private taxi network (minimise use of private cars). In the long-term (and as per National Energy Policy) the introduction of electric vehicles may be feasible (on back of geothermal)⁶⁵

⁵⁶ Gray, G. A. L., (2010): op cite

⁵⁷ GoM (2012): "Montserrat Infrastructure Plan – Final January 2012" – IMC Worldwide, for DFID/GoM January 2012

⁵⁸ DFID (2011): "Montserrat Power Generation Improvement Project - Business Case" – DFID March 2011

⁵⁹ Montserrat Development Corporation (MDC)(2012): personal communication with CEO

⁶⁰ GoM (2012): "Montserrat Infrastructure Plan – Final January 2012" – IMC Worldwide, for DFID/GoM January 2012

⁶¹ ibid

⁶² ibid

⁶³ ibid

⁶⁴ ibid

⁶⁵ GoM (2008): "Montserrat National Energy Policy 2008 - 2027"

Implementation Capacity

There are extremely limited resources across government and private sector. The Montserrat Development Corporation (MDC) that is overseeing development of Little Bay does have the potential to leverage private funding for low carbon development at Little Bay.

UK Exposure

UK Sunk Assets

Total value of UK sunk assets is unknown but there have been major UK infrastructure investments to support economic recovery post 1995-1997 volcanic crisis. Further significant, HMG investments imminent in low lying coastal areas of Little Bay and Carr's Bay (New capital town port).⁶⁶

Absolute Value of UK Transfer

The UK has provided £350 million of assistance since the volcanic crisis of 1995-7 - £250million plus £15million each year in on-going programme funding.⁶⁷

Share of National Budget from UK Transfer

The UK has provided financial support to Montserrat since the start of volcanic activity in 1995. HMG and GoM are working together towards achieving financial self-sufficiency⁶⁸. HMG investments in the new capital town at Little Bay and port at Carr's Bay are central to HMG's strategic plan.⁶⁹

In 2010 DFID contribution to total revenue was 60% of total budget.⁷⁰

Potential Liability

DFID estimated the on-going aid liability to Montserrat at £149 million to 2017 more if volcanic activity becomes serious.⁷¹

As a recipient of ODA support it is likely that any serious natural disaster would affect the whole of Montserrat and HMG would have to respond accordingly. This could include evacuation and repatriation in the UK.

A number of international environmental conventions have been extended to Montserrat, these include:

The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) (CMS) (for Montserrat this includes migratory water birds, turtles and Cetaceans); Ramsar Convention on Wetlands of International Importance (no sites have been designated to date), the Vienna Convention for the Protection of the Ozone Layer (no specific action required), Montreal Protocol on Substances that Deplete the Ozone Layer – committed to reduce consumption and production of o-zone depleting substances, the Convention Concerning the Protection of the World Cultural and Natural Heritage, Protocol relating to intervention on high seas in cases of pollution by substances other than oil, UK Overseas Territories Environment Charter (UKOTEC), St. George's Declaration of Principles for Environmental Sustainability in the OECS, United Nations Convention to combat desertification in those countries experiencing serious drought and/or desertification, particularly in

⁶⁶ DFID (2012) "Operational Plan 2011 – 2015 – DFID Overseas Territories Department" Updated June 2012

⁶⁷ National Audit Office (2007): "FCO – Managing Risk in the UK Overseas Territories" Report by the Controller and Auditor General November 2007

⁶⁸ DFID (2012) "Operational Plan 2011 – 2015 – DFID Overseas Territories Department" Updated June 2012

⁶⁹ *ibid*

⁷⁰ *ibid*

⁷¹ National Audit Office (2007): *ibid*

Africa and Protocol to Amend the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage of 18/2/1971.

Reputational Risks



As an OT that is still eligible for ODA support, failure to act to natural disasters (etc.) would be very high profile. Potential investments in the new town at Little Bay and the construction of a new port, if affected, would not reflect well in the international press.

Annex One: UKOT Climate Change Vulnerability Analysis Matrix
Glossary of Terms

UKOT Climate Change Vulnerability Analysis Matrix Glossary of Terms

Abatement Potential	(Cost effective) technical potential for reducing emissions within sector.
Absolute GHG Emissions	Annual amount of greenhouse gases (GHG) produced by an Overseas Territory. It is measured as metric tonnes of CO ₂ generated per year.
Absolute Value of UK Transfer	Total amount of funding from UK to an Overseas Territory per year.
Adaptation	The extent to which existing initiatives and measures (projects and programmes) are expected to reduce the vulnerability of natural and human systems against actual or expected climate change effects.
Adaptive Capacity	The ability of a social or natural system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change.
Carbon sink	A natural or artificial reservoir that accumulates and stores some carbon-containing chemical compound for an indefinite period. Natural: Absorption of carbon dioxide by the oceans via physicochemical and biological processes and photosynthesis by terrestrial plants. Artificial: include landfill and carbon capture and storage.
Climate Change	A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
Climate Change Impact	Consequences of climate change on social, economic and natural systems without considering adaptation.
Climate Change Exposure	The change in climate with a potential adverse effect on social, economic and natural systems.
Current Abatement Activities	Any action that reduces the emissions or emissions intensity (per unit output) of a given sector on-going or completed in UK Overseas Territories as of March 2012.
Current Resilience Activities	Resilience activities on-going or completed in UK Overseas Territories as of March 2012.
Energy Efficiency	Ratio of energy output of a conversion process or of a system to its energy input: measures taken to reduce demand for energy for the same projected level of development.
Energy Import Dependence	Percentage of energy imported from abroad by the single Overseas Territory.
Exacerbating Stresses	Natural or human factors which in isolation or combination have the potential to lead to a change in the severity or frequency of a climate change threat. This may include inter alia a natural hazard, an extreme weather event, social tension or conflict, demographic trends and population characteristics and institutional and/or societal capacity constraints.
Exposure	The sum of the character, magnitude and rate of climate change variation to which a system is influenced by.
Fossil Fuel Dependence	The percentage of total fuel consumption derived from carbon-based fuels from fossil carbon deposits (including coal, oil, and natural gas) and the percentage of that fuel that is imported.
Frequency and Severity	Occurrence and magnitude of an event in UK Overseas Territories.
Future Opportunities	A territory's ability to reduce greenhouse gas emissions or to enhance carbon sink (Potential LCD Intervention) coupled with its potential to plan adjustment interventions in response to the effects of climate change (Potential Adaptation Intervention).
GHG Abatement (Current)	Potential for reducing emissions within sector coupled with any action already in place that reduces the emissions or emissions intensity of a given sector.

Implementation Capacity	Current (March 2012) capacity to design, implement and monitor all related low carbon / adaptive capacity activities. This includes all current resource constraints (i.e. funding, local personnel capacity, lack of personnel, supportive infrastructure etc.) and opportunities.
Importance of system to OT	The value that society and people in an UK Overseas Territory place on the significance of impacts and vulnerabilities (see Vulnerability) on social, economic and natural systems.
Low Carbon Development (Source)	Actions which include making a contribution towards stabilising levels of CO ₂ and other greenhouse gases at a level that will avoid dangerous climate change, through cuts in emissions, demonstrate a high level of energy efficiency, use low-carbon energy sources and/or utilise and enhance carbon sinks.
Magnitude	The area or number of people likely to be affected as a proportion of total population or land area.
Potential Liability	Legal, Financial, Moral and Political exposure arising from the activities of the UK Overseas Territories. This includes UK commitments to legal treaties that extend to the OTs (e.g European Convention on Human Rights) and response to natural and man-made disasters and terrorist events.
Potential LCD Intervention	A territory's ability to reduce anthropogenic CO ₂ and other greenhouse gas emissions or to enhance carbon sinks, where ability refers to skills, competencies, fitness and proficiencies that a territory has attained and depends on technology, institutions, wealth, equity, infrastructure and information.
Potential Adaptation Interventions	The potential for a planned intervention which constitutes or contributes to an adjustment in natural, social or economic systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.
Reputational Risk	Reputation is defined as the social evaluation of the public towards HMG. Risk is the probability that a failure to act will produce harm to that reputation. This reputation may be defined in terms of the potential: loss of HMG ethical (moral) reputation for safe guardianship of its citizens) disruption or distortion of HMG relationship with its citizens in the OTs withdrawal of private sector investment in UK Overseas Territories (investor flight).
Resilience	The ability of a social or natural system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change.
Resource Exposure	Degree at which a system is influenced by a variation in the availability or the price of resources (specifically water and energy).
Resource Use Efficiency	The effective use of energy and water resources – limiting wastage and maximising usable resources.
Sensitivity to Climate Exposure	Affects the magnitude and/or rate of a climate related perturbation or stress and is the degree to which a system [exposure unit] is affected, either adversely or beneficially, by climate variability or climate change. The effect may be direct (e.g. a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).
Share of Current Emissions	Percentage of OT's Absolute GHG Emissions generated by each sector.
Share of National Budget from UK Transfer	Percentage and amount (at 2011 prices) of the total Overseas Territory Budget which comes from HMG budgetary support.
System (Social, Economic and Natural)	A set of functionally inter-related elements subdivided into Natural (ecosystems and biodiversity) and Social and Economic (Human) elements.
Threat Exposure Analysis	Identification of the threats that may affect a system and evaluation of their frequency and severity.
UK Exposure	Risk to the UK arising from activities in the UK Overseas Territories. It includes UK Sunk Assets, Share of National Budget from UK Transfer, Potential Liability and Reputational Risk.

UK Sunk Assets	UK investments in physical infrastructure in the Overseas Territories which cannot be recovered.
Vulnerability	The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Key:

 Voice reported in VAM

 Additional voice

Annex Two: UKOT Climate Change VAM Systems Definition

SOCIAL, ECONOMIC AND NATURAL SYSTEMS DEFINITIONS	
Biodiversity and Ecosystems (Marine and terrestrial)	<p>Ecosystems – A community of living (plants and animals) and non-living things (climate, landscape) which interact together and affect each other.</p> <p>Biodiversity – The variety of plant and animal life found in an ecosystem and the variation in their genetic makeup. It is a measure of the health of an ecosystem, with healthy ecosystems having greater variety and variation in plant and animal life than unhealthy ones.</p> <p><i>Source: Brown, 2008ⁱ</i></p>
Hydrology and Water resources	<p>Hydrology - The various systems that are involved in the hydrological cycle (water evaporation, atmospheric circulation of water vapour, cloud formation, precipitation, interception by plant life, land surface runoff, soil infiltrations, groundwater recharge, discharge into streams etc).</p> <p>Water resources – The availability of useful water, often a limiting factor for social and economic development. Sources include groundwater, rainwater and surface reservoirs or rivers.</p> <p><i>Source: Gray, 2010ⁱⁱ; Parry et al., 2007ⁱⁱⁱ</i></p>
Tourism	<p>Comprises the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purpose</p> <p><i>Source: UNWTO, 2011^{iv}</i></p>
Transportation	<p>A system of conveying people, goods, etc., from one place to another.</p> <p>The definition includes water, air, and land transport.</p>
Agriculture and Fisheries	<p>Agriculture- The science or practise of cultivating the soil and rearing animals</p> <p>Fisheries – The occupation of catching or rearing fish</p>
Forestry	<p>All economic activities that mostly depend on the production of goods and services from forests including commercial activities that are dependent on the production of wood fibre. It also includes activities such as the commercial production and processing of non-wood forest products and the subsistence use of forest products</p> <p><i>Source: FAO, 2004^v</i></p>
Energy Supply and Use	<p>Energy supply - Extraction, conversion, and transportation of fuels and electricity to ultimate end use</p> <p>Energy use - The amount of fuels and electricity utilized during a period of time to provide a useful service such as heating, cooling, or transportation</p> <p><i>Source: Wilbanks et al., 2008^{vi}</i></p>
Industry and Commerce	<p>Industry - Industry includes manufacturing, mining, construction and related informal production activities. Other categories, such as transport, energy supply & demand and processing of forest products have been included in other sectors.</p> <p>Commerce – Commerce is the exchange or buying and selling of commodities. In our definition it includes trade, retail and other commercial activities.</p>
Human Health	<p>Human health includes physical, social and psychological well-being.</p> <p>Society – Society includes <i>infrastructures, human settlements</i> and <i>social issues</i>.</p> <p><i>Infrastructures</i> are systems designed to meet relatively general human needs, often through largely or entirely public utility-type institutions. <i>Infrastructures</i> for settlements and society include both ‘physical’ (sanitation and communication systems) and ‘institutional’ (shelter, health care, food supply, security and fire services and other forms of emergency protection). <i>Human settlements</i> comprise physical capital (buildings) where most of the world’s population live. <i>Social issues</i> include all the factors relating to human society and its members, concerning the way of life of the local population (livelihoods and welfare).</p> <p><i>Source: Parry et al., 2007</i></p>

HDI/ Livelihoods/ Poverty	<p>HDI (Human Development Index) - A summary composite index that measures a country's average achievements in three basic aspects of human development: longevity, knowledge, and a decent standard of living.</p> <p>Livelihoods - A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living.</p> <p>Poverty – A state or condition in which a person or community lacks the financial resources and essentials to enjoy a minimum standard of life and well-being that is considered acceptable in society.</p> <p><i>Source: Chambers and Conway, 1991^{vii}</i></p>
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Note: The sectors considered as potential sources of greenhouse gases in the Low Carbon Development section are the ones reported by Department of Energy and Climate Change, 2009^{viii}.

ⁱ Brown, N., 2008. *Climate Change in Overseas Territories: An Overview of the Science, Policy and You*, Peterborough, UK: Joint Nature Conservation Committee

ⁱⁱ Gray, G. A. L., 2010. *Montserrat National Climate Change Issue Paper*, Montserrat: Ministry of Agriculture, Land, Housing and the Environment

ⁱⁱⁱ Parry, M., Canziani, O. & Palutikof, J. P., 2007. *Climate Change 2007: Impacts, adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge, UK: Cambridge University Press.

^{iv} UNWTO, 2011. *World Tourism Organisation UNWTO*. [Online] Available at: <http://statistics.unwto.org/en>. [Accessed 12 03 2012].

^v FAO, 2004: Trends and Current Status of the Contribution of the Forestry Sector to National Economies, Rome: FAO, available on <http://www.fao.org/docrep/007/ad493e/ad493e05.htm>

^{vi} Wilbanks T. J. et al., 2008. *Effects of Climate Change on Energy Production and Use in the United States*, Washington, US: US Climate Change Science Programme

^{vii} Chambers, R., & Conway, G. (1991). *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century*. [Online] Available at: <http://www.smallstock.info/reference/IDS/dp296.pdf> [Accessed 28 03 2012].

^{viii} Department of Energy and Climate Change, 2009. *5NC - The UK's Fifth National Communication under the United Nations Framework Convention On Climate Change*. London

Annex Three: UKOT Scoring Matrix

ANNEX III: RAG SCORING FOR UKOT VAM

#		Red	Red/Amber	Amber/Green	Green
Threats Exposure Analysis					
	Exposure: Frequency and Severity of climate effects	Current: High Impact 2050: Impact + Confidence	Current: Medium Impact 2050: Impact + Confidence	Current: Low Impact 2050: Impact + Confidence	Current: No impact 2050: No impact
Resource Exposure					
	Exposure: Fossil Fuel and Energy Import Dependence, Resource Use Efficiency and GHG Emission	High Dependency, Emissions and Low Resource Use Efficiency	Medium Dependency, Emissions and low Resource Use Efficiency	Low dependency, emissions and medium resource use efficiency	Low (or No) dependency, emissions, and high resource use efficiency
Importance to Overseas Territory					
1	Importance of System to OT <i>Natural Systems</i> <i>Economic Systems</i>	Bio-diversity characterised by high levels of endemic / endangered species and / or territory with internationally recognised environmental designation ¹ Critical levels of water stress Dominant contribution to OT GDP (>20%)	Bio-diversity characterised by presence of endemic / endangered species and internationally recognised environmental designation Moderate levels of water stress Significant contribution to OT GDP (5%-20%)	Bio-diversity characterised by low levels of endemic / endangered species and no internationally recognised environmental designation Limited levels of water stress Limited contribution (<5%) to OT GDP	Bio-diversity characterised by very low levels of endemic / endangered species and no internationally recognised environmental designation No water stress No contribution (0%) to OT GDP

¹ As identified by IUCN redbook.

#		Red	Red/Amber	Amber/Green	Green
	<i>Social Systems</i>	Per capita GDP (<\$6000) Low life expectancy / High infant mortality rates	Per capita GDP (\$6001 - \$20000) Medium life expectancy / Medium infant mortality rates	Per capita GDP (\$20001 - \$50000) Medium life expectancy / Low infant mortality rates	Per capita GDP (\$50000 +) High life expectancy / Low infant mortality rates
Vulnerability (Current)					
2.1	Sensitivity to Climate Exposure	High sensitivity to climate change exposure/high potential for irreversible impacts	Medium sensitivity to climate change exposure/medium potential for irreversible impacts	Low sensitivity to climate change exposure/low potential for irreversible impacts	No sensitivity to climate change exposure/no potential for irreversible impacts
2.2	Current Resilience Activities	No resilience planning and/or very limited adaptive capacity	Weak resilience planning and/or adaptive capacity	Moderately effective resilience planning and/or adaptive capacity	Strong resilience planning and/or adaptive capacity
2.3	Exacerbating Stresses	Significant exacerbating stresses	Moderate exacerbating stresses	Limited exacerbating stresses	No exacerbating stresses
Future Opportunities					
3.1	Potential Adaptation Interventions	No technical/programmatic opportunities available.	Limited technical/programmatic opportunities available, and significant work/investment required to develop bankable projects or programmes	Technical/programmatic opportunities exist, but only as pilot projects/strategies and require further investment to develop bankable projects or programmes	Technical/programmatic opportunities exist and bankable investments/projects are available for immediate funding
3.2	Implementation Capacity	No technical, political and financial capacity to	Limited technical, political and/or financial capacity to	Moderate technical, political and/or financial capacity to implement and	Strong technical, political and financial capacity to implement

#		Red	Red/Amber	Amber/Green	Green
		implement and monitor adaptation activities, with full UK input required.	implement and monitor adaptation activities, with significant UK input required.	monitor adaptation activities, with moderate UK input required.	and monitor adaptation activities, with limited UK input required
Current Emissions					
4.1	Share of Current Emissions	High (>30%)	Medium (15%-30%)	Low (5%-15%)	None/Marginal <5%.
GHG Abatement					
5.1	Abatement Potential	No abatement potential <10%	Limited abatement potential identified 10%-25%	Moderate abatement potential identified 25%-50%	Significant abatement potential identified E.g. >50% of current levels
5.2	Current Abatement Activities	No low carbon development planning or investment	Weak low carbon development planning and investment	Moderately effective low carbon development planning and investment	Strong evidence of effective low carbon development planning and investment
Future Opportunities					
6.1	Potential LCD Intervention	No technical/programmatic opportunities available.	Limited technical/programmatic opportunities available, and significant work/investment required to develop bankable projects or programmes.	Technical/programmatic opportunities exist, but only as pilot projects/strategies and require further investment to develop bankable projects or programmes.	Technical/programmatic opportunities exist and bankable investments/ projects are available for immediate funding.
6.2	Implementation Capacity	No technical, political and financial capacity to implement and monitor low carbon activities, with full UK input required.	Limited technical, political and/or financial capacity to implement and monitor low carbon activities, with significant UK input required.	Moderate technical, political and/or financial capacity to implement and monitor low carbon activities, with moderate UK input required.	Strong technical, political and financial capacity to implement and monitor low carbon activities, with limited UK input required.

UK Exposure (2012)					
7.1	UK Sunk Assets	>£100m	£20-£100m	£5-£20m	£0-£5m
7.2	Absolute Value of UK Transfer	£500,001 - £1,000,000	£250,001 - £500,000	£100,001 - £250,000	>£100,000
7.3	Share of National Budget from UK Transfer	75%> of national budget for specific system from UK transfer	51% to 75% of national budget for specific system from UK transfer	26% to 50% of national budget for specific system from UK transfer	25%< of national budget for specific system from UK transfer
7.4	Potential Liability	Cost of honouring and implementing legal treaties and other HMG commitments (>£200m)	Cost of honouring and implementing legal treaties and other HMG commitments (>£50m)	Cost of honouring and implementing legal treaties and other HMG commitments (>£10m)	Cost of honouring and implementing legal treaties and other HMG commitments (<£10m)
7.5	Reputational Risks	Irreparable reputational risk in terms of loss of: HMG reputation for safeguarding citizens / climate change and ecosystems; HMG disruption to the relationship with its citizens; and potential to severely disrupt private sector investment in the UKOTs related to specific system.	Serious but not irreparable reputational risk in regards to loss of HMG safeguarding reputation, HMG relationship with citizens or private sector investment related to specific system.	Limited reputational risk in regards to loss of HMG safeguarding reputation, HMG relationship with citizens or private sector investment related to specific system.	No reputational risk in regards to loss of HMG safeguarding reputation, HMG relationship with citizens or private sector investment related to specific system.

Annex Four: Montserrat - Scored VAM

RED
RED/AMBER
GREEN/AMBER
GREEN

Threat Exposure Analysis		
	Frequency and Severity	
	Current	2050
Climate Change Exposure		
1 Increase in temperature	GREEN/AMBER	RED
2 Increase/decrease/variability in precipitation	RED/AMBER	RED
3 Decrease in snow cover and ice	GREEN/AMBER	RED
4 Heat waves	RED/AMBER	RED
5 Heavy precipitation events/floods	RED	RED
6 Extreme storm events	RED	RED
7 Rising sea levels	GREEN/AMBER	RED
8 Ocean acidification	GREEN/AMBER	RED

Resource Exposure	Current
1 Fossil Fuel Dependence	RED
2 Energy Import Dependence	RED
3 Resource use efficiency	RED
4 Absolute GHG emissions	GREEN

Low Carbon Electricity Resource Potential	Share of Current Electricity Production Potential	
	% of buildings	Potential
1 Wind	X	Medium
2 Hydro	X	X
3 Solar PV	X	Low
4 Geothermal	X	High
5 Biomass	X	X
6 Waste (solid, liquid)	X	Medium
Low Carbon Heat Potential		
% of buildings Potential		
1 Solar Thermal	X	Medium
2 Biomass	X	X
Liquid Fuels		
% of consumption Potential		
1 Bioethanol	X	X
2 Bio diesel	X	X

Montserrat

Summary
<p>General Information: Montserrat has a tropical climate, is entirely volcanic (the Soufriere Hills volcano became active in 1995), is mountainous in topography, is richly bio diverse and supports restricted species of birds and invertebrates as well as endangered species which are only found on Montserrat (and others which are found on other islands). Montserrat has limited economic activity due to its remoteness, import dependency, and constrained land resources.</p> <p>Threat Exposure Analysis Small island aid dependent economy, vulnerable to effects of annual tropical storms and hurricanes and a range of other natural hazards. Particularly vulnerable to threat of rising temperatures (atmospheric and sea), variable patterns of precipitation and sea level rise.</p> <p>Adaptation and Resilience Omni present risk of volcanic activity (70% chance of lava extrusion in 2012) raises spectre of multi hazard event and reduces overall resilience to climate change impacts. The fragile economy is highly vulnerable to long term effects of climate change. Water scarcity and dependence on the centre hills for all water supply exacerbate the risk of a warming temperature pattern. Traditional livelihoods are dependent on biodiversity and marine resources which are susceptible to warming seas and changes in patterns of precipitation. Draft climate change policy in place but all responsibility falls on Department of Environment, which has very limited resources. New HMG supported infrastructure investments (port at Carrs Bay and New Town at Little Bay) climate proofed against storm surge and sea level rise.</p> <p>Low Carbon Development The GoM (with support from DFID) is progressing with arrangements to develop geothermal energy and National Energy Policy sets out vision for low carbon future. GHG emissions reported as part of UK ratification of Kyoto Protocol</p> <p>UK Exposure In 2012 aid dependent and vulnerable to impacts of natural disaster. Significant HMG investment in new infrastructure.</p>

Additional Potential Classification

High	High levels of cost effective technical potential identified, with strong evidence of associated planning and investment
Medium	Medium cost effective resource potential identified, with medium evidence of associated planning and investment
Low	Limited cost effective technical potential identified, with limited evidence of associated planning and investment
None	No cost effective technical potential identified.

Adaptation and Resilience		Importance to OT	Vulnerability (Current)			Future Opportunities	
		Importance of System to OT	Sensitivity to Climate Exposure	Current Resilience Activities	Exacerbating Stresses	Potential Adaptation Interventions	Implementation Capacity
Natural	Biodiversity and Ecosystems						
	Hydrology and Water resources						
Economic	Tourism						
	Transportation						
	Agriculture and Fisheries						
	Energy Supply and Use						
Social Systems	Industry and Commerce						
	HDI/Livelihoods/Poverty						
	Human Health						

UK Exposure (2012)				
UK Sunk Assets	Absolute Value of UK Transfer	Share of National Budget from UK Transfer	Potential Liability	Reputational Risks
X	X	X		
X	X	X		
X	X	X		
X	X	X		
X	X	X		
X	X	X		
X	X	X		
X	X	X		
X	X	X		

Low Carbon Development (Source)	Current Emissions	GHG Abatement (Current)		Future Opportunities	
	Share of Current Emissions	Abatement Potential	Current Abatement Activities	Potential LCD Intervention	Implementation Capacity
Energy Supply	X				
Transport	X				
Public	X				
Business	X				
Residential	X				
Industrial Processes	X				
Agriculture	X				
Waste management	X				
Land Use, Land Use Change and Forestry	X				

Annex Five: UKOT Potential Programme Approaches – Preliminary Sectoral & Geographical Analysis

	Programme Approach	Sectoral and OT Relevance		Activities	
		Sectors	OTs	Current	Potential
1	Adaptation: Needs Focus	Energy Supply and Use	Gibraltar	Replacement of power plants with a power station powered by diesel engines.	n/a
2	Adaptation: Effectiveness Focus	Biodiversity and Ecosystems	Bermuda	Bermuda Biodiversity Action Plan - Activity report 2010; The Bermuda Plan 2008	Stringent water conservation practices; environmentally-sound desalination operations; better weather forecasting; coastal zone management plan (building on Draft Planning Statement (2008))
			Gibraltar	Management and Action Plan for the conservation of Sites of Community Importance enforced; Marine Special Area of Conservation designated; Catalogue of living resources; Habitat and Species Action Plans.	Dolphin study; climate change studies.
3	Mitigation: Needs Focus	Energy Supply	Bermuda	Electricity for the entire Island is produced at BELCO's Pembroke location.	Public land/seabed allocated for utility-scale renewable electricity generation projects; generation licences for power producers and comprehensive interconnection standards; quality standards specifically for distributed renewable energy systems included in building codes; expedited planning processes for small-scale renewable generation; efficiency standards; energy auditing.
			Gibraltar	Replacement of power plants with a power station powered by diesel engines.	The use of biofuels to be encouraged by selling at lower price in petrol stations; adopt biofuels for Govt fleet.
		Transport	Gibraltar	New bus transport system introduced; free to children.	Reduction in the energy used for road transport (9% target for 2016); Car park and park and ride bus shuttle service construction planned; Increase in public transport times/routes; More free public transport.
4	Mitigation: Emissions Reduction Potential Focus	Energy Supply	Gibraltar	New power station has the capability to run on biofuels.	Adoption of renewable energy resources: wind, energy from waste and tidal current all considered technically viable.
			Montserrat	2008 Montserrat Sustainable Development Plan; shortly be upgrading its diesel based power station to more reliable 1.5 MW source	Exploitation of geothermal energy is a stated aim of the National Energy Policy; test drilling 2012; Geothermal energy is proved to be feasible, there is potential to generate up to 50MW of energy, with export of around 40MW to a neighbouring island; potential wind turbine sites at locations within the Blakes Estate although the new National Physical Development Plan for North Montserrat 2012-2022 zones this land for residential and recreational tourism;
		Transport	Gibraltar	Use of private vehicles discouraged	Car park and park and ride bus shuttle service constructed; increase in public transport times/routes; more free public transport.
		Business	Montserrat	New port development at Carr's Bay	Development of new town at Little Bay creates potential for incorporation of passive design principles; GoM Infrastructure Plan includes suite of potential low cost measures: energy efficient fans, water pumps, cooking appliances and behavioural change.
		Land Use, Land Use Change and Forestry	Montserrat	2008 Montserrat Sustainable Development Plan; New National Physical Development Plan for North Montserrat	National Physical Development Plan for North Montserrat 2012-2022
5	Mitigation: Effectiveness Focus	Business	BVI	National Tourism Policy & Development Master Plan; strengthening Building Regulations; Climate Change risk management protocols, Disaster Relief Fund, micro insurance schemes and mutual/cooperative insurance schemes, financing options for renewable energy installations.	Climate Change Trust Fund - funds would meet costs associated with diversifying tourism product; sub-regional/domestic emissions trading scheme that will ensure benefits are flowing from the UK and European carbon trading scheme; Carbon Levy on guests of hotels and charter yachts; Climate Change Financial Risk Management Levy on foreign registered companies and ships
		Residential	BVI	A National Physical Development Plan, Local Area Plans	Medium/long term implementation A National Physical Development Plan, Local Area Plans
		Waste Management	BVI	Energy & water conservation/efficiency standards;	n/a
		Land Use, Land Use Change and Forestry	BVI	National Tourism Policy & Development Master Plan; expanded protected areas; building & disaster management criteria; National Physical Development Plan; Local Area Plans	Medium/long term implementation A National Physical Development Plan, Local Area Plans

6	Standardised Policy Focus	Relevant to all sectors	Relevant to all OTs	Possibilities are: FCO sponsored pilot on environmental mainstreaming; Scaling up of FCO approach to	Mainstream climate change into existing policies and plans	
7	Capacity Building Focus	Relevant to all sectors	Relevant to all OTs	Possibilities are: BAT: provision for staff education under the Carbon Reduction Strategy. DFID support via	Prioritise interventions in the draft climate change policy and develop programme of capacity support to take forward	
8	Next Step Approach	Relevant to all sectors	Relevant to all OTs	Possibilities are: Falklands: scale up wind farm technologies; Gibraltar: renewable energy legislation. DFID support via the ECACC programme and	Prioritise interventions in the draft climate change policy and develop programme of capacity support to take forward	
9	UK Exposure Approach	Biodiversity and Ecosystems	Anguilla	Designation of one nationally protected (wetland) area and allocation of 7.5acre demonstration area for Department of Environment; draft climate change policy drafted and to be adopted in 2012;	Conserve existing wetland (saltpond) ecosystems and encourage wetland migration strategies; approve and implement a National Wetlands Policy; continuous monitoring and development of comprehensive bio-diversity baseline; development of an integrated coastal zone management plan which includes understanding the risk of flooding due to sea level rise and improvements to the national coastal monitoring system and system of beach profile data collection; implement schemes for re-vegetation and re-nourishing beaches	
			BAT	26 Specially Protected Areas and Marine Protected Area designated; Penguin distribution study; Wildlife awareness manual; Toolkit for the management of Protected Areas; Identification of important bird areas; Polar Science for Planet Earth project	Proactive management of key Protected Areas; Continuation of the penguin distribution study	
			Falklands	Bio-diversity strategy in place. FIG sponsored environmental research, awareness raising, conservation and management activities. OTEP projects to conserve or collect species or restore plant habitats.	Species monitoring and species action plans in place.	
			Montserrat	Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention); Vienna Convention for the Protection of the Ozone Layer;	protected areas/zoning; in situ conservation of endemic species and control of invasive species; revise port legislation re discharge; ensure protection of ghauts and vegetative strips and enforce all aspects of land use planning	
			Gibraltar	Management and Action Plan for the conservation of Sites of Community Importance enforced; Marine Special Area of Conservation designated; Catalogue of living resources; Habitat and Species Action Plans.	Dolphin study; climate change studies	
			SBAs	Special protection Areas designated; Turtle projects; Acacia Control Project	Designation of Special Areas of Conservation; MoU for Conservation of Migratory Birds of Prey in Africa and Eurasia	
			Hydrology and Water Resources	Anguilla	New desalination water plant	Water harvesting, increased water storage and more effective maintenance of distribution network to reduce leaks; promote the use of water savings devices (low flush toilets etc); develop and implement national outreach and educational programmes; bring efficiencies to water desalination as technology improves and bring renewable energy sources on stream (wind and solar).
			BAT	Introduction of more efficient reverse osmosis plants; Introduction of water saving flow reduction valves	Implementation of a programme of water efficiency technology changes	
			Falklands	n/a	Climate change modelling based on collected data.	
			Gibraltar	Modernisation of fresh water distribution (saving of energy during desalination; seawater used for conveyance of sewage and other non-domestic purposes; Replacement of sea defences	Flood defences; Improvement of drainage infrastructure.	
		Montserrat	Some adhoc water harvesting, (minidams, roof rainwater harvesting). Many assets not maintained and now in disrepair.	Protect groundwater sources from pollution; develop better water resource management and allocation systems; Opportunity for all new build at Little Bay and Carr's Bay.		
		SBAs	n/a	Adoption of Concentrating Solar Power technologies for water desalination		

		Tourism	BAT	n/a	Enhancement of UK expertise on tourism management
			Montserrat	Potential investments in the new town at Little Bay and the construction of a new port, if affected, would not reflect well in the international press.	Fiscal incentives to encourage sustainable tourism; integrate mainstream CC issues (Impact, responses, opportunities) into tourism development strategy; recommended design speeds increased for new tourism-related structures; enhanced reef monitoring systems to provide early warning alerts of bleaching events, and; artificial reefs or fish-aggregating devices
			Gibraltar	n/a	n/a
		Transportation	SBA	n/a	n/a
			Montserrat	Potential investments in the new town at Little Bay and the construction of a new port, if affected, would not reflect well in the international press.	Integrate CC issues into current port design and the master plan development at Little Bay and other infrastructural development projects.
			Gibraltar	New bus transport system introduced; free to children.	Car park and park and ride bus shuttle service construction planned; Increase in public transport times/routes; More free public transport.
		Energy Supply and Use	Anguilla	n/a	Enhance efficiency of diesel power generation. Link into regional sources of energy arising from potential geothermal networks on Nevis and Montserrat. Customer educational policies to encourage energy efficiency; promote energy efficient technologies such as energy efficient light fittings and solar hot water heaters.
			BAT	Solar heating systems installed at 2 stations; Introduction of sub-metering more effective monitoring of energy consumption; Introduction of LCD screens	Adoption of renewable energy sources: wind turbine and solar photovoltaic systems; Energy efficient retrofits for research ships; use of unmanned aerial vehicles
			Montserrat	2008 Montserrat Sustainable Development Plan; shortly be upgrading its diesel based power station to more reliable 1.5 MW source.	Exploitation of geothermal energy is a stated aim of the National Energy Policy; test drilling 2012; Geothermal energy is proved to be feasible, there is potential to generate up to 50MW of energy, with export of around 40MW to a neighbouring island; potential wind turbine sites at locations within the Blakes Estate although the new National Physical Development Plan for North Montserrat 2012-2022 zones this land for residential and recreational tourism.
			Gibraltar	Replacement of power plants with a power station powered by diesel engines.	The use of biofuels to be encouraged by selling at lower price in petrol stations; adopt biofuels for Govt fleet; Adoption of renewable energy resources: wind, energy from waste and tidal current all considered technically viable.
		Industry and Commerce	BAT	All infrastructures constructed with best practices in low energy design.	n/a
			Montserrat	Potential investments in the new town at Little Bay and the construction of a new port, if affected, would not reflect well in the international press.	n/a
			Gibraltar	n/a	Incentives for import and use of highly efficient equipment.
		Livelihoods/Poverty	Anguilla	n/a	n/a
			Montserrat	Invested heavily in irrigation infrastructure, training of farmers, livestock production units and a farmer's resource centre.	Government is investing in improved fisheries infrastructure and training to improve the quantity, quality and presentation of produce.
			Falklands	n/a	n/a
			Gibraltar	n/a	n/a
		Human Health	Anguilla	n/a	n/a
			Montserrat	n/a	Public education and outreach; forecasting systems for Dengue Fever and other vector-borne diseases.
			Falklands	n/a	n/a
			Gibraltar	n/a	n/a
10	Do Nothing Approach	n/a	n/a	n/a	n/a

Annex Six: Emissions Data

