

WHO Carbon Footprint Study FY2008

Final Report V2

October 2009

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WHO Carbon Footprint Study FY2008

Final Report

October 2009

REVISION RECORD

Revision	Date	Comments
00	26.06.09	Draft for internal reveiw
01	29.06.09	Revised draft for internal review
02	29.06.09	Issued to World Health Organisation
03	30.07.09	Issued to World Health Organisation
04	25.08.09	Final Report Issued to World Health Organisation
05	23.10.09	Final Report V2 Issued to World Health Organisation
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For and on behalf of Environmental Resources Management Approved by: Marinda van der Merwe Signed:  Position: Partner Date: 25/08/2009
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EXECUTIVE SUMMARY

INTRODUCTION

Environmental Resources Management Southern Africa (Pty) Ltd (ERM) was commissioned to support the World Health Organisation (WHO) in the development of a global framework to facilitate the reduction of the carbon footprint and total environmental impact of its offices and operations globally. The project covered the following offices:

- WHO Head Quarters Geneva, Switzerland;
- WHO Addis Ababa, Ethiopia;
- WHO Kobe, Japan; and
- WHO Kuala Lumpur, Malaysia.

The project aim was to develop a high level strategy for reducing the impact of WHO operations on the environment which can be assessed against a baseline of existing performance with regard to carbon emissions, water consumption and waste management.

CARBON FOOTPRINT RESULTS

*The WHO Carbon Footprint refers only to those offices included in this study. The WHO Carbon Footprint for the period 1 January 2008 – 31 December 2008 is **23,668 tonnes carbon dioxide equivalent (tCO₂e)**.*

TableE.1 Summary of WHO Carbon Footprint

Site	Employee numbers	Total Emissions (Scope 1 +2 + 3) (tCO ₂ e)	Total Emissions Scope 1 (tCO ₂ e)	Total Emissions Scope 2 (tCO ₂ e)	Total Emissions Scope 3 (tCO ₂ e)
WHO HQ Geneva	2,258	22,309	4,659	292	17,358
WHO Addis Ababa	5	23	3	0	20
WHO Kobe	21	385	7	31	347
WHO Kuala Lumpur	209	950	2	781	167
TOTAL	2493	23,668	4,672	1,104	17,892*
% of total	-	100%	20%	5%	75%

** Approximately 2 - 3% of flight data was removed from the data set due to inaccurate flight path data*

The greatest contributor to the WHO Carbon Footprint is WHO HQ Geneva (22,309t CO₂e; 94%). The office with the largest amount of CO₂e / person is WHO HQ Geneva (9.88) while the office with the largest amount of CO₂e / area of office space (m²) is WHO Kobe. Scope 1 emissions (related to power generation, fuel combustion and refrigerant use) account for 20% of the total WHO Carbon Footprint; scope 2 emissions (related to purchased electricity consumption) account for 5%, while scope

3 emissions (air and rail travel) account for 75%. Scope 3 emissions contribute by far the greatest proportion of emissions, predominantly from flight travel by WHO HQ Geneva.

WATER AND WASTE

The WHO offices consumed 49,256,029L of water. A total of 484,250 kg of waste was generated by the WHO. Of the 237,934 kg of waste that was recycled, 209,844 kg was from the WHO HQ Geneva office.

CARBON MITIGATION AND REDUCTION STRATEGIES

Options for mitigation, reduction and offsetting of the carbon footprint, along with associated costs and benefits are discussed. These include engineered solutions (installation of equipment to improve energy efficiency), behavioural changes (education) and offsetting through purchasing carbon credits. High level costs and estimated CO₂e savings are presented for the different carbon mitigation options.

Primary Recommendation

It is recommended that WHO focusses on the reduction of air travel as the means to reduce their footprint in the most cost effective manner. A reduction in air travel can be achieved through the increased use of videoconferencing facilities (already in place at WHO HQ Geneva) and a policy change. A reduction in air travel related emissions could be achieved through changing the policy of the use of business class flights (for example, by changing business class to economy class flights for those flights less than 9 hours).

Other Recommendations

Engineered solutions offering the greatest potential for CO₂e savings at WHO, and in particular at the WHO head office, include:

- Reducing the need for refrigerants through the Geneva-Lake-Nations Project;
- Replacement of R404a refrigerant gases with R410a;
- Upgrading power generation systems through installation of control systems, replacement or switching to lower CO₂e emitting fuel;
- Improving insulation;
- Improving lighting efficiency; and
- Installing energy efficient IT systems, such as 1E Nightwatchman.

Carbon Offset

Purchasing carbon credits in order to offset the carbon footprint emissions is an option to consider once an organisation has done all it can to reduce their carbon footprint. The price of carbon credits varies depending on whether Certified Emissions Reductions (CERs) or Voluntary Emissions Reductions (VERs) are bought. If WHO were to offset their footprint of approximately 23,668 ton CO₂e with CERs it would cost in the region of **\$497,028** (using a current market price of \$21/CER).

A STRATEGY GOING FORWARD

A strategy for addressing environmental issues, focussing on waste, water, energy and carbon emissions, should be developed by WHO which should focus on the following key areas:

- Identify and include all buildings under WHO's control in the calculation;
- Ensure the accuracy of all of the existing WHO flight data to ensure completeness in the air flight emissions calculation;

- *Quantify the emissions associated from staff travelling on statutory travel that WHO is responsible for;*
- *Develop a system to ensure that accurate, reliable and complete data is gathered and reported for each WHO office on a regular basis, e.g. quarterly. A web-based online data collection tool may assist the UN in simplifying the time-consuming data collection process;*
- *The development of a 'Carbon Reporting Operating Manual', such as a customised version of The United Nations Greenhouse Gas Calculator, User Manual 1.0 to ensure a robust monitoring and reporting methodology;*
- *Assign roles and responsibilities at office level, including the formation of a green task team at head office level, to ensure effective implementation of carbon and environmental reporting requirements;*
- *Implement and build on already existing energy saving, water use and waste reduction projects to help achieve the targets discussed in this document as well as use the KPIs to monitor performance;*
- *Review procurement practices and implement a more sustainable approach along the lines of the soon to be published United Nations (UN) guidance on sustainable procurement; and*
- *In particular, concentrate on reducing the amount of air flight travel, which makes up the largest portion of the WHO footprint.*

In order to ensure that the environmental targets are achieved, it is recommended that WHO consider detailed green building audits, which will be able to identify and cost specific energy, water, waste and carbon emission reduction opportunities for each facility.

LIST OF ABBREVIATIONS

ERM	Environmental Resources Management Southern Africa (Pty) Ltd
WHO	World Health Organisation
HQ	Head Quarters
GHG	Greenhouse Gas
UN	United Nations
UNEP	United Nations Environmental Program
ICAO	International Civil Aviation Organisation
WBCSD	World Business Council on Sustainable Development
WRI	World Resources Institute
IPCC	Intergovernmental Panel on Climate Change
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide equivalent
CH ₄	Methane
N ₂ O	Nitrous Oxide
KPI	Key Performance Indicator
kg	Kilograms
L	Litres
m ²	Square metres
p.a.	Per Annum
GBCA	Green Building Council of Australia
VAV	Variable Air Volume
HVAC	Heating, Ventilation and Air Conditioning
GWP	Global Warming Potential
CER	Certified Emissions Reductions
CDM	Clean Development Mechanism
VER	Voluntary Emissions Reductions

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1 INTRODUCTION

1.1 PROJECT OBJECTIVES AND SCOPE

Environmental Resources Management Southern Africa (Pty) Ltd (ERM) was commissioned to support the World Health Organisation (WHO) in the development of a global framework to facilitate the reduction of the carbon footprint and total environmental impact of its offices and operations globally. The project covered the following offices:

- WHO Head Quarters Geneva, Switzerland;
- WHO Addis Ababa, Ethiopia;
- WHO Kobe, Japan; and
- WHO Kuala Lumpur, Malaysia.

The project aim was to develop a high level strategy for reducing the impact of WHO operations on the environment which can be assessed against a baseline of existing performance with regard to carbon emissions, water consumption and waste management.

The objectives of the project were:

- To develop an inventory of WHO carbon emissions using the Greenhouse Gas (GHG) Protocol;
- To undertake an economic analysis, and establish cost effective mitigation options to reduce emissions;
- To draft WHO environmental management policies and objectives in relation to climate change related impacts of WHO operations; and
- To set targets for future emissions reductions of the WHO office's carbon footprints.

This study makes use of the carbon footprint calculators developed by the United Nations Environmental Program (UNEP). This includes both the UN Carbon Footprint Calculator as well as the International Civil Aviation Organisation (ICAO) Flight Calculator.

This study covers carbon emissions ⁽¹⁾ that arise due to activities under the direct operational control of WHO. This includes emissions over which the organisation's offices have influence as well as various, but not all, indirect carbon emissions that arise due to its activities:

¹ The terms 'carbon emissions', 'carbon footprint' and 'Carbon Footprint' are used to describe the greenhouse gas (GHG) emissions arising from WHO activities. Emissions in this report are quantified in tonnes of carbon dioxide equivalent (tCO₂e). One tonne of carbon is equivalent to 3.67 tons of CO₂

- Vehicle use;
- Power generation;
- Refrigeration / air conditioning;
- Purchased electricity;
- Purchased heat / steam; and
- Air, road and rail business travel.

The Carbon Footprint is based on data provided by individual WHO offices mentioned above.

It was originally requested that direct and indirect emissions from procurement, waste generation and management, and water consumption be included. Determination of emissions of the above would have required a complex, site specific life cycle type assessment in order to determine the associated embedded GHG emissions. Therefore, in agreement with WHO, ERM developed alternative indicators to measure improvements in performance with regard to waste and water. Due to the complexity surrounding the collection of data from procurement activities, and ongoing work within the UN on sustainable procurement practices, ERM and WHO agreed to exclude this indicator from the study.

A detailed cost-benefit analysis of potential energy efficiency opportunities was not undertaken by ERM under this scope of work.

1.2 *STRUCTURE OF THE REPORT*

Section 2 presents an outline of the reporting framework and methodology used to calculate the Carbon Footprint.

Section 3 presents the results of the Carbon Footprint, as well as the water and waste results for WHO, and provides a comparison of the data against benchmarks.

Section 4 presents an assessment of mitigation and carbon reduction strategies.

Section 5 presents specific energy, water and waste mitigation measures.

Section 6 outlines an environmental and carbon strategy for WHO.

2 CARBON FOOTPRINT METHODOLOGY

2.1 INTRODUCTION

This study makes use of the carbon footprint calculators developed by the United Nations Environmental Program (UNEP). This includes both the UN Carbon Footprint Calculator as well as the International Civil Aviation Organisation (ICAO) Flight Calculator. These calculators are developed in accordance with the *Corporate Accounting & Reporting Standard* (The Greenhouse Gas (GHG) Protocol) developed by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI). The GHG Protocol provides comprehensive guidance on accounting and reporting corporate GHG emissions. It is the most widely used standard for mandatory and voluntary GHG programmes and makes use of the Intergovernmental Panel on Climate Change (IPCC) GHG Inventory guidelines for specific heating values, carbon content, densities and emission factors.

2.2 SCOPE OF EMISSIONS

The boundaries within which a Carbon Footprint is calculated are fundamental to the project. This includes the determination of both *organisational* and *operating boundaries*.

2.2.1 Organisational Boundaries

Organisational boundaries determine whether reporting is done according to the “equity share approach” (different economic interest is reflected by companies being wholly owned, incorporated or non incorporated joint ventures or subsidiaries) or the “control approach” (emissions accounted for from operations under the direct operational control of the parent company).

For the purposes of this project, the control approach has been taken and emissions from sites under the direct operational control of WHO have been included in the Carbon Footprint.

2.2.2 Operating Boundaries

Operating boundaries determine which emission causing activities will be included in the carbon footprint. The GHG Protocol divides emissions into three categories:

- Scope 1 – direct emissions from sources owned or under the operational control of the company;
- Scope 2 – indirect emissions from the consumption of purchased electricity; and
- Scope 3 – an optional reporting category allowing for other indirect emissions associated but not controlled by the company to be included.

These Scopes are illustrated in *Figure 2.1* while emission sources are summarised in *Table 2.1*.

Figure 2.1 *Summary of GHG Protocol Emission Scopes*

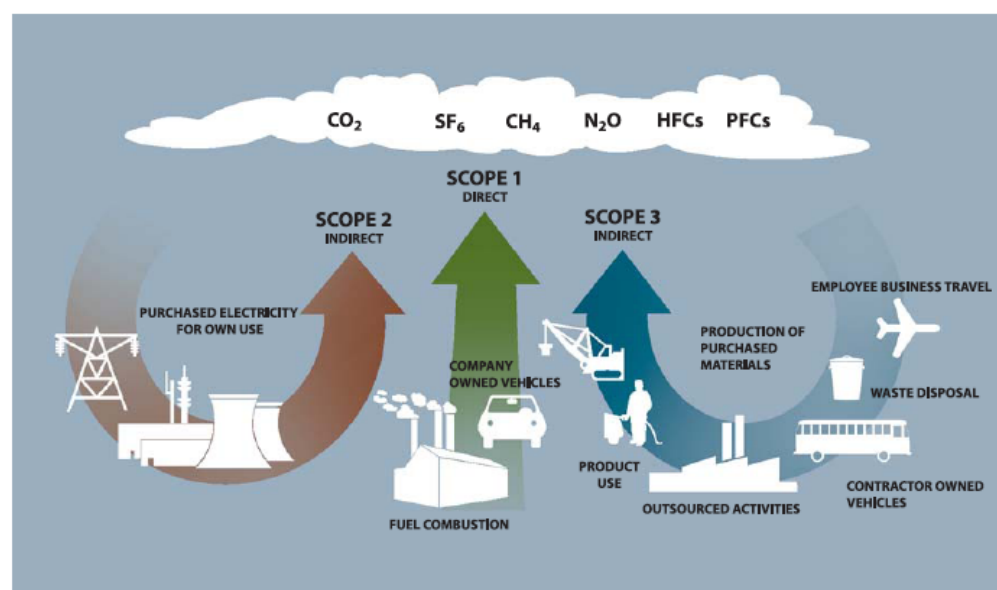


Table 2.1 *Emission Sources included in the WHO Carbon Footprint*

Scope	Emission sources included
Scope 1 – Direct Emissions	<ul style="list-style-type: none"> the consumption of fuel on site for the operation of generators, boilers, furnaces, or vehicles on site; the consumption of fuel in vehicles owned by WHO; refrigeration and air conditioning equipment ;
Scope 2 – Indirect Emissions	<ul style="list-style-type: none"> the consumption of purchased electricity on site; the consumption of purchased heat or steam on site; and
Scope 3 – Indirect Emissions	<ul style="list-style-type: none"> business air and rail travel.

2.3 DATA COLLECTION

ERM developed a Background Information Document and Data Collection Template which were circulated to site contacts in March 2009. The aim of this activity was to familiarise the individuals responsible for collecting the information with the purpose of the project and the nature of the information required.

All of the WHO offices were requested to provide monthly data for the period 1 January 2008 – 31 December 2008. The data collection process revealed that not all offices had the requisite systems to provide the data for the footprint. Subsequently, the footprint was restricted to the facilities listed in 1.1 above.

Once all the data had been submitted, data gaps were filled, quality checked and data entered into the Carbon Footprint Calculator.

2.4 CARBON FOOTPRINT CALCULATOR

The Carbon Footprint calculators are designed to calculate the estimated GHG emissions by using emission conversion factors and a range of other parameters such as fuel type, volume/weight of fuel consumed, carbon content of the fuel being used, the type of technology being employed, etc.

Excel based Carbon Footprint Calculator sheets for WHO were used to calculate emissions from the following sources, and as per the requirements of the UN Calculator:

- CO₂ and non-CO₂ emissions from stationary combustion;
- CO₂ and non-CO₂ emissions from mobile combustion;
- Non-CO₂ emissions from refrigerant use;
- CO₂ emissions from electricity consumption;
- CO₂ emissions from heat and/or steam consumption; and
- CO₂ emissions from air, rail and vehicle travel.

Furthermore, in order to assess the total environmental impact of the WHO operations in the scope of this project, data was collected for:

- Quantity of water purchased at each site;
- Quantity of bottled water purchased at each site;
- Quantity of recycled water used;
- Quantity of waste generated at each site; and
- Quantity of waste that is disposed of by various methods.

Determination of emissions of the water and waste information above would have required a complex, site specific life cycle type assessment in order to determine the associated embedded GHG emissions. Therefore, in agreement with WHO, ERM developed alternative indicators to measure improvements in performance with regard to waste and water.

It was anticipated that a high level assessment of the environmental impact of WHO existing procurement process will be carried out. However, due to the complexity surrounding the collection of data from procurement activities, and ongoing work within the UN on sustainable procurement practices, ERM and WHO agreed to exclude this indicator from the study.

The following factors and parameters were used in the Carbon Footprint Calculator:

- IPCC 2006/ GHG Protocol default calorific values, carbon content values, oxidation values and emission factors for fuel use, and business air travel;
- Standard conversion factors for global warming potentials of non-CO₂ greenhouse gases (CH₄, N₂O, refrigerants); and
- Local emission conversion factors were used for electricity use.

A separate spreadsheet developed by ERM was designed to allow the manual import of the individual excel based UN Carbon Calculators on an annual basis and the subsequent calculation of the carbon footprint for future years. The tool is designed to allow the carbon footprint to be segmented by site, emission source and scope and generates graphical outputs which can be used for annual reporting purposes as illustrated in *Section 3*.

3 WHO CARBON FOOTPRINT, WATER AND WASTE RESULTS

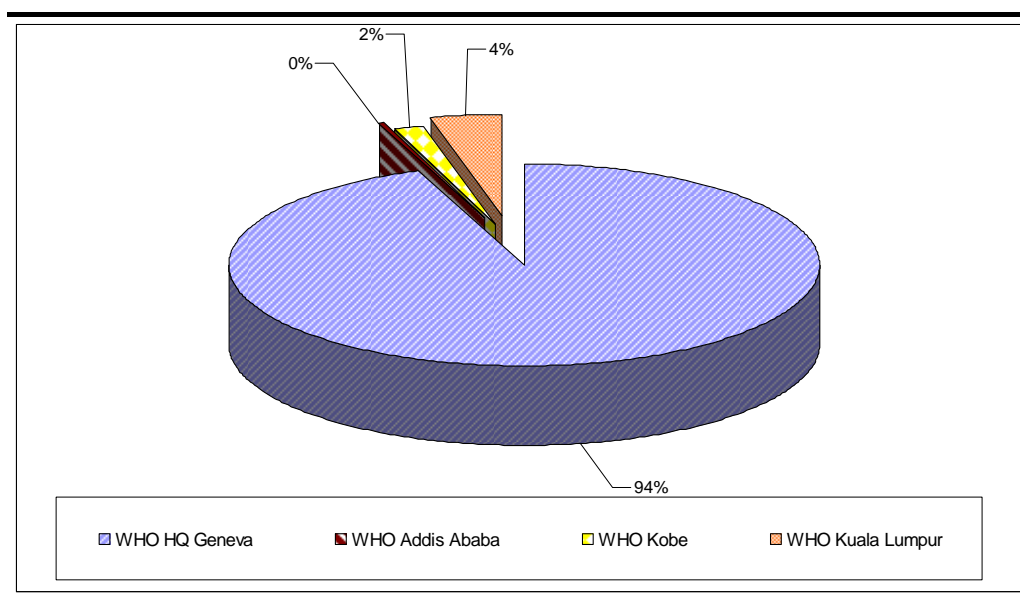
3.1 INTRODUCTION

This section provides a detailed summary of the WHO carbon footprint, as well as the WHO water and waste results. The WHO data is then compared against benchmarks for energy, water and waste.

3.2 SUMMARY OF WHO CARBON FOOTPRINT RESULTS

The WHO Carbon Footprint refers only to those offices included in this study and listed under 1.1 *Project Objectives and Scope*, namely WHO HQ Geneva, Addis Ababa, Kobe and Kuala Lumpur. The WHO Carbon Footprint for the period 1 January 2008 – 31 December 2008 is **23,668 tonnes CO₂e** ⁽¹⁾. Figure 3.1 below covers emissions from the four WHO offices included in this project.

Figure 3.1 Summary of WHO Carbon Footprint (tons CO₂e) (%)



The greatest contributor to the WHO Carbon Footprint is WHO HQ Geneva (22,309t CO₂e; 94%). The smallest contributor is WHO Addis Ababa (23 tCO₂e; <1%).

A high level summary of the results of the study is presented in Table 3.1 overleaf which breaks this footprint down by site and scope ⁽²⁾. Graphical representations of this information are provided below. Detailed results by site and scope, baseline data and calculations are set out in the WHO Carbon

(1) tCO₂e - carbon dioxide equivalent - non-CO₂ greenhouse gases are converted to CO₂e based on their global warming potential (e.g. 1tCH₄ = 21tCO₂e)

(2) The Carbon Footprint includes emissions from Air travel (scope 3) whose emissions are not calculated using the UN calculator but using the ICAO developed calculator for the UN

Footprint Summary excel spreadsheet and in the individual Carbon Footprint Calculators per office as provided to WHO.

Table 3.1 *Summary of WHO Carbon Footprint*

Site	Employee numbers	Total Emissions (Scope 1 +2 + 3) (tCO ₂ e)	Total Emissions Scope 1 (tCO ₂ e)	Total Emissions Scope 2 (tCO ₂ e)	Total Emissions Scope 3 (tCO ₂ e)
WHO HQ Geneva	2,258	22,309	4,659	292	17,358
WHO Addis Ababa	5	23	3	0	20
WHO Kobe	21	385	7	31	347
WHO Kuala Lumpur	209	950	2	781	167
TOTAL	2,493	23,668	4,672	1,104	17,892*
<i>% of total</i>	-	100%	20%	5%	75%

* Approximately 2 - 3% of flight data was removed from the data set due to inaccurate flight path data

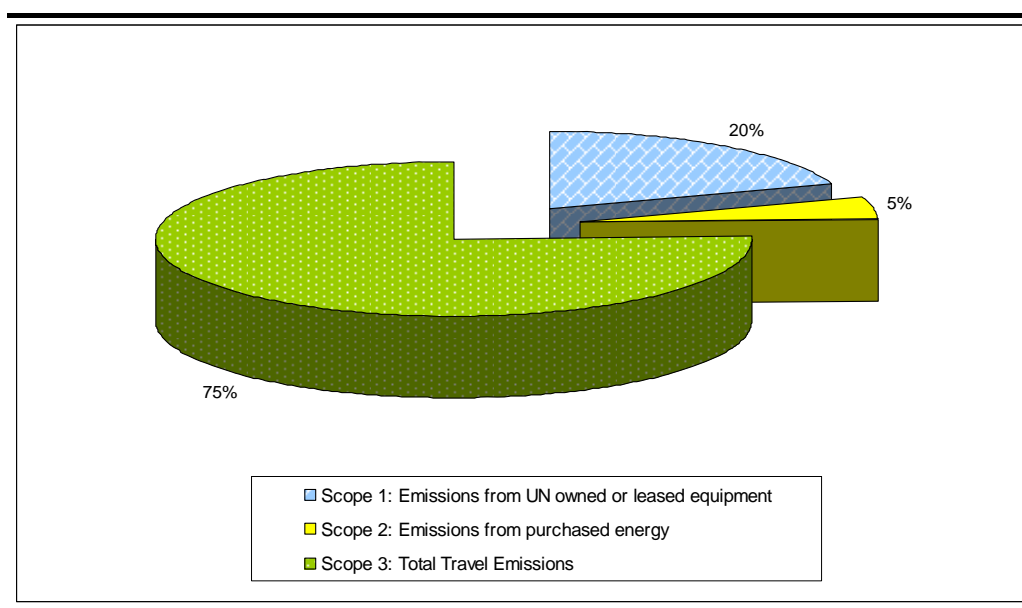
Table 3.2 below details the facility data (number of staff and area of building) of the WHO offices, as provided to ERM and the associated Key Performance Indicators (KPIs) of carbon emissions per person and per m² of building. The office with the largest amount of CO₂e / person is WHO HQ Geneva (9.88tCO₂e) while the office with the largest amount of CO₂e / area of office space (m²) is WHO Kobe (0.33tCO₂e).

Table 3.2 *Summary of WHO office details and Carbon KPIs*

Office		WHO HQ Geneva	WHO Addis Ababa	WHO Kobe	WHO Kuala Lumpur
Measure	Units				
Headcount	Number	2,258	5	21	209
Area of building	m ²	109,006	254	1,180	4,000
CO ₂ e / person		9.88	4.65	1.11	4.55
CO ₂ e / area of office space (m ²)		0.20	0.09	0.33	0.24

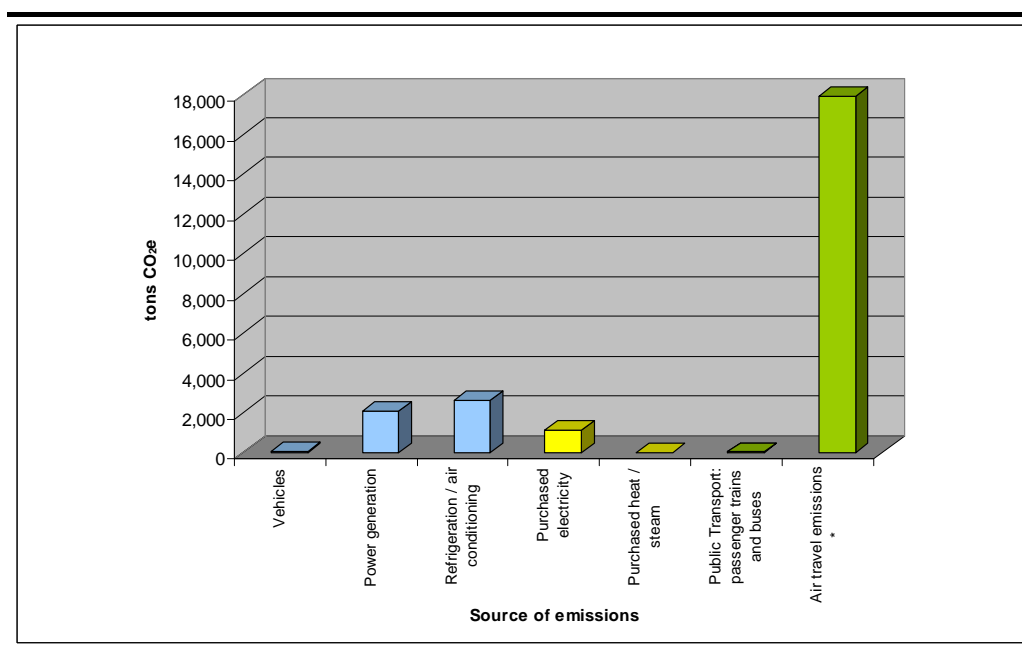
Scope 3 emissions also exclude employee statutory travel when funded via a direct lump-sum payment to the employee and therefore not currently tracked. Statutory travel includes recruitment travel, home leave travel, education travel etc.

Figure 3.2 WHO Carbon Footprint by Scope (%)



Scope 1 emissions (direct emissions related to power generation, fuel combustion and refrigerant use) account for 20% of the total WHO Carbon Footprint; scope 2 emissions (indirect emissions related to purchased electricity consumption) account for 5%, while scope 3 emissions (emissions from air and rail travel) account for 75. Scope 3 emissions contribute by far the greatest proportion of emissions, predominantly from flight travel by WHO HQ Geneva (fig. 3.3).

Figure 3.3 WHO Carbon Footprint by Source (tCO₂e)

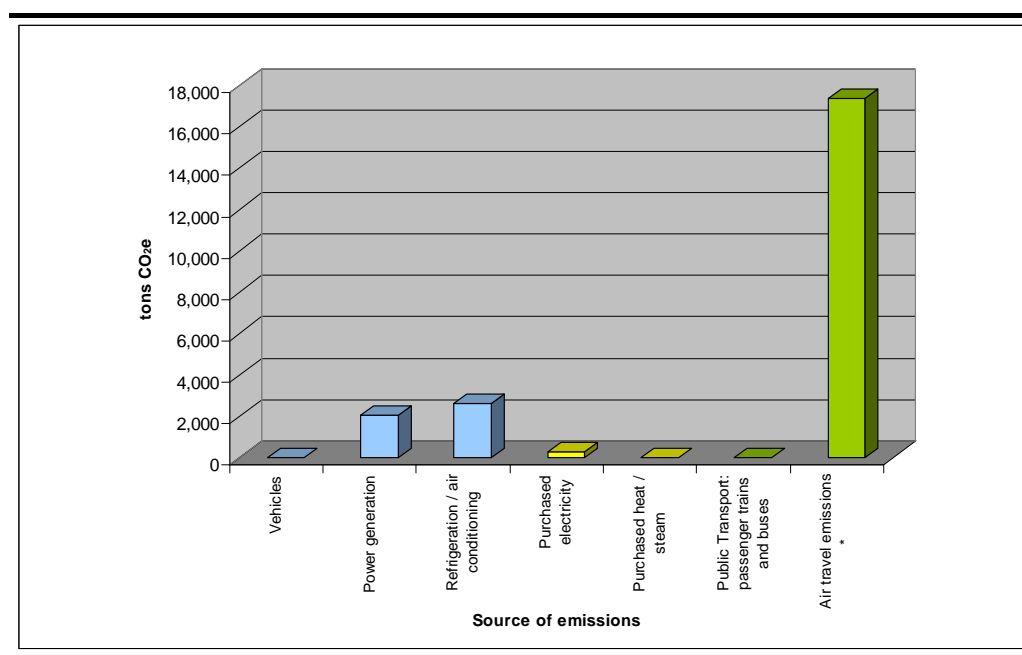


In terms of source, air travel is by far the greatest source of emissions for WHO. Within Scope 1 emissions, refrigeration and power generation are the largest contributors.

3.4 CARBON FOOTPRINT RESULTS BY SITE

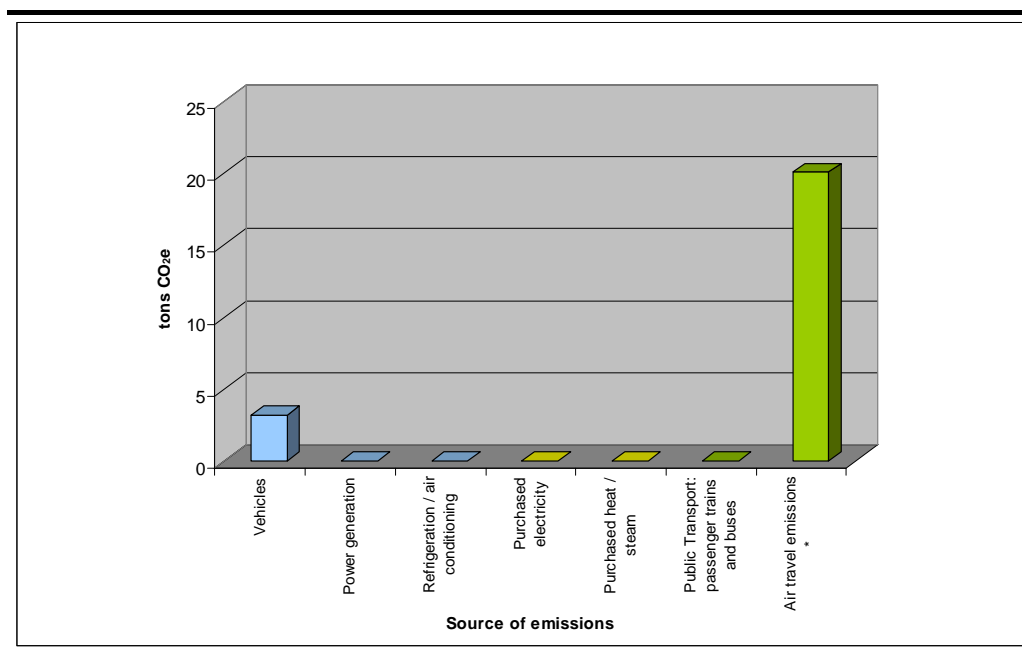
3.4.1 WHO HQ Geneva

Figure 3.4 WHO HQ Geneva Carbon Footprint by Source (tCO₂e)



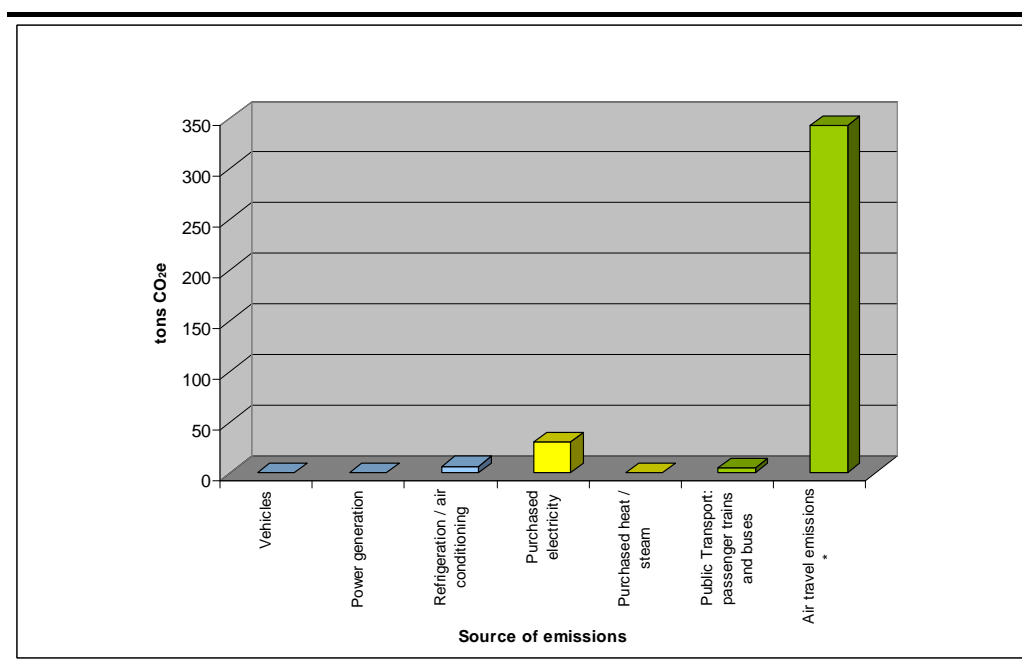
In terms of scope 1 emissions for WHO HQ Geneva the largest source is power generation and refrigeration. In total however, flight travel is responsible for the majority of the emissions (>75%).

Figure 3.5 WHO Addis Ababa Carbon Footprint by Source (tCO₂e)



Once again, as per WHO HQ Geneva, air travel is responsible for the largest amount of emissions (>85%) for WHO Addis Ababa. Within scope 1, fuel used in vehicles owned by WHO Addis Ababa is the largest source of emissions.

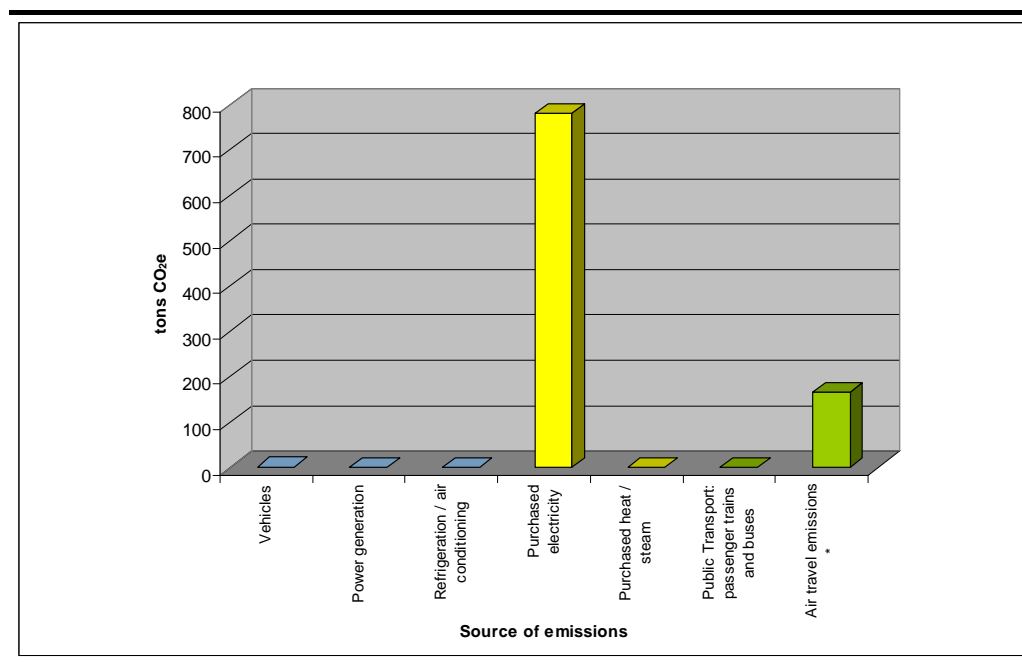
Figure 3.6 WHO Kobe Carbon Footprint by Source (tCO₂e)



As per the other WHO offices, air travel is responsible for the largest amount of emissions (~90%) for WHO Kobe. This is followed by scope 2 emissions from purchased electricity.

3.4.4 WHO Kuala Lumpur

Figure 3.7 WHO Kuala Lumpur Carbon Footprint by Source (tCO₂e)



Scope 2 emissions (purchased electricity) account for approximately 80% of emissions for WHO Kuala Lumpur. This is followed by emissions from air travel.

3.5 WATER AND WASTE RESULTS

3.5.1 Introduction

WHO water and waste data for the period 1 January 2008 – 31 December 2008 is presented in *Table 3.3* below. The table outlines both the quantity of water consumed as well as the waste generated and recycled by WHO offices.

To summarise, the WHO offices consumed 49,256,029 Litres of water. A total of 484,250 kg of waste was generated by WHO. A total of 237,934 kg of waste was recycled, of which 209,844 kg was from the WHO HQ Geneva office.

Figures for Key Performance Indicators (KPIs) of water use per square metre and per employee, and waste per square metre and per employee are provided below to compare WHO offices on a like for like basis. Please note their may be inaccuracies associated with the data as determining water and waste use for certain offices was relatively difficult (some offices determined their water use using calculations involving entire building water use and

entire building size). This is a common problem when organisations rent office space in a large building, and do not have control over the utility (water and electricity) bills.

Table 3.3 WHO Water and Waste Data for the Period 1 January - 31 December 2008

Environmental Indicator	Total (WHO)	WHO HQ Geneva	WHO Addis Ababa	WHO Kobe	WHO Kuala Lumpur
	Total	Total	Total	Total	Total
Water consumption					
Quantity of water purchased (L)	49,246,621	49,077,167	n/r	13,604	155,850
Quantity of bottled water purchased (L)	9,408	0	n/r	2,568	6,840
Total (L)	49,256,029	49,077,167	n/r	16,172	162,690
Waste generation					
Paper (kg)	247,845	204,880	n/r	42,215	750
Glass (kg)	2,901	2,728	n/r	173	0
Plastic (kg)	1,606	1,426	n/r	0	180
Metal (kg)	810	810	n/r	0	0
Other (kg)	231,413	228,360	n/r	3,053	0
Total (kg)	484,575	438,204	n/r	45,441	930
Waste recycled					
Paper - recycled (kg)	232,970	204,880	n/r	27,670	420
Glass - recycled (kg)	2,728	2,728	n/r	0	0
Plastic - recycled (kg)	1,426	1,426	n/r	0	0
Metal - recycled (kg)	810	810	n/r	0	0
Total - recycled (kg)	237,934	209,844	n/r	27,670	420

Key: n/r = Not reported

Figure 3.8: Water consumption (L) in comparison to office space (m²).

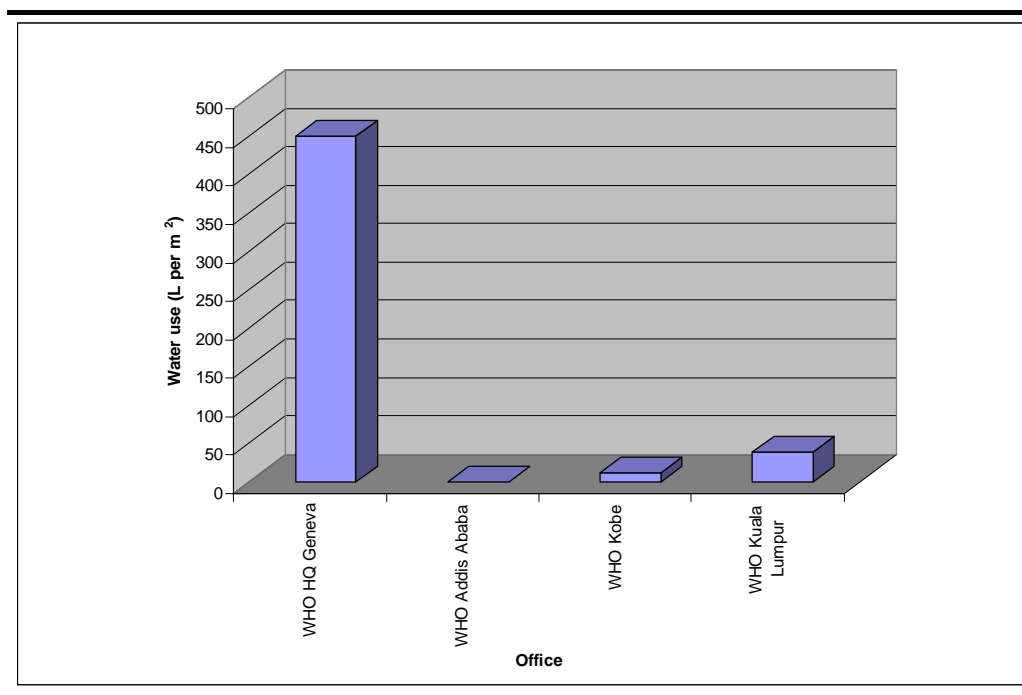


Figure 3.8 above provides an indication of the water use (L) per square metre of office space, excluding bottled water purchased. It is clear that WHO Kuala Lumpur has the highest relative water use per square metre, whilst Geneva has the lowest (WHO Addis Ababa did not provide water use data).

Figure 3.9 Water consumption (L) per person (employee).

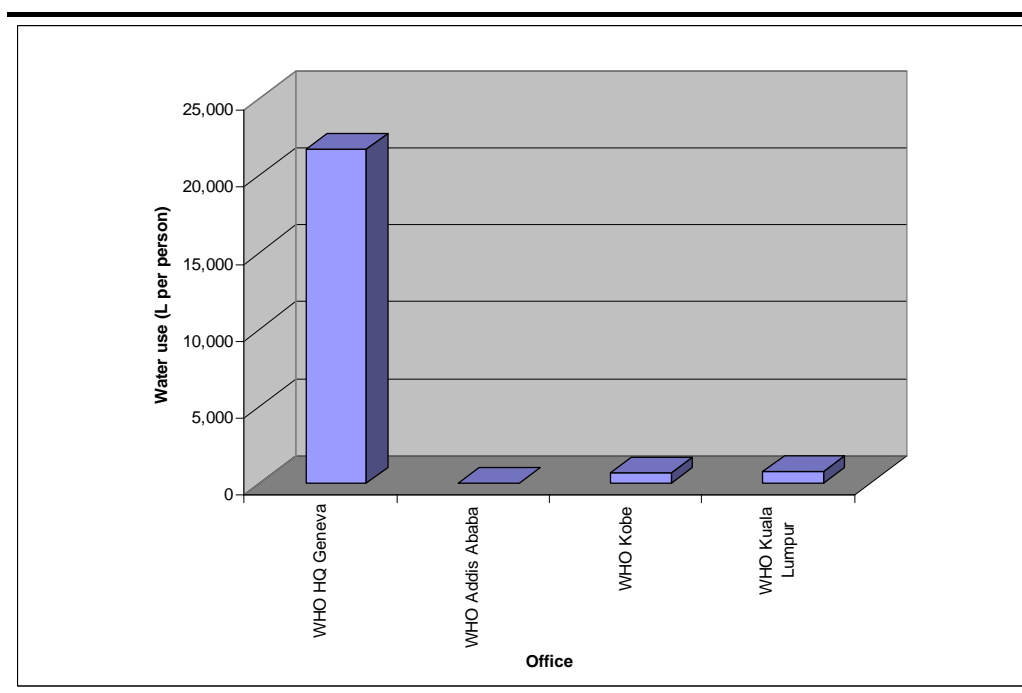


Figure 3.9 above provides an indication of the water use (L) per employee, excluding bottled water purchased. It is clear that WHO HQ Geneva has the highest relative water use per employee (21,735 L/person). WHO Kobe (648 L/person) and WHO Kuala Lumpur (746 L/person) are fairly similar while WHO Addis Ababa did not provide water use data.

3.5.3 Waste Results

Figure 3.10: Waste generation (kg) in comparison to office space (m²)

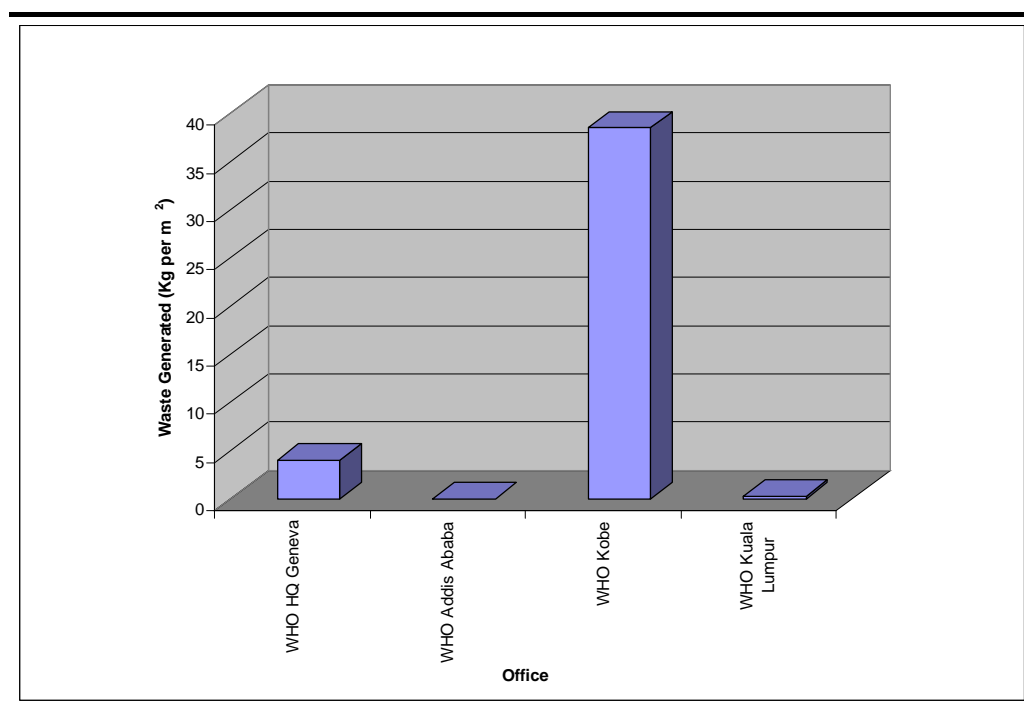


Figure 3.10 indicates that WHO Kobe has the highest waste generation per square metre, with WHO Kuala Lumpur the lowest. WHO Addis Ababa, did not provide data.

Figure 3.11 Waste generation (kg) per person (employee).

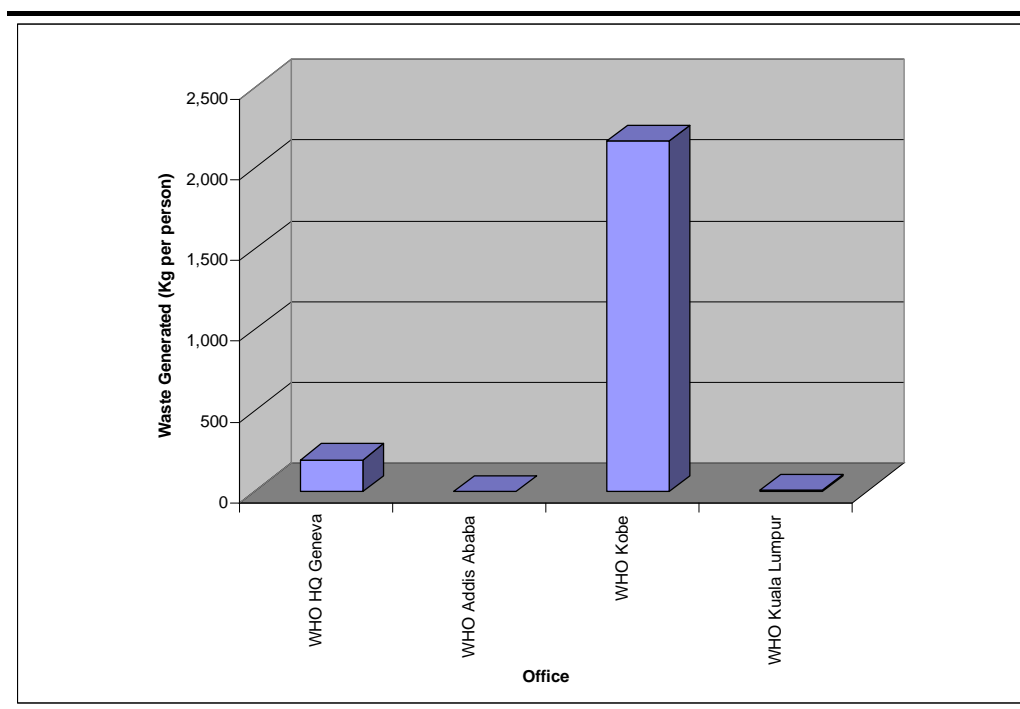


Figure 3.11 indicates that WHO Kobe has the highest waste generation per employee (kg/person), with WHO Kuala Lumpur the lowest. WHO Addis Ababa, did not provide data.

3.6 *BENCHMARKING WHO*

3.6.1 *Comparison against other organisations*

There are no other UN organisations that have completed their 2008 carbon footprint, but it has been estimated that UNEP's GHG emissions in 2007 were approximately 11,508 tonnes CO₂e. This figure was calculated on 13 offices sampled, totalling approximately 715 staff members. On a per capita basis UNEP's emissions were approximately 16.1 tCO₂e/person, which is higher than the WHO equivalent of approximately 9.5 tCO₂e/person.

3.6.2 *Comparison against benchmarks*

Benchmarking an organisation in terms of emissions, energy, waste and water is a useful way of comparison, and provides an organisation with an indication of what measures to take up to reduce these indicators. WHO's emissions, energy, waste and water data is compared against two benchmarks below, on a per capita and per m² of office space basis:

1. Energy, water and waste benchmarks provided by the Green Star Rating System which recognises environmental excellence in buildings, developed by The Green Building Council of Australia (GBCA).
2. Action Energy (formerly the Energy Efficiency Best Practice Programme) produced an Energy Consumption Guide in which energy use in offices was benchmarked in European conditions. Offices are broken down into

four generic groups each with certain characteristics and specific energy consumption benchmarks.

Table 3.4 below compares the WHO data against The Green Building Council of Australia benchmarks while Table 3.5 provides details on the Action Energy benchmarks. Table 3.6 provides descriptions of the different office types as described by Action Energy.

Table 3.4 *Existing WHO data and GBCA benchmarks*

WHO Office	Energy use (kWh/m ² /yr)	Water Use (kL/ m ² /yr)	Waste (kg/employee/yr)
Geneva	173	0.45	194
Addis Ababa	No data	No data	No data
Kobe	61.5	0.01	2,164
Kuala Lumpur	350	0.04	4.4
Green Building Council of Australia benchmark	155 (direct electrical heating) 185 (gas heating)	0.75	156

Table 3.5 *Action Energy - Energy Use Benchmarks*

Office Type	Good Practice Fossil Fuel (KWh/m ² /yr)	Good Practice Electricity (KWh/m ² /yr)	Typical Fossil Fuel (KWh/m ² /yr)	Typical Electricity (KWh/m ² /yr)
1 Naturally Ventilated Cellular	79	33	151	54
2 Naturally Ventilated Open Plan	79	54	151	85
3 Air Conditioned Standard	97	128	178	226
4 Air Conditioned Prestige	114	234	210	358

Table 3.6 *Action Energy Office Types*

<p>Naturally Ventilated Cellular</p> <ul style="list-style-type: none"> • A simple building often (but not always) relatively small and sometimes in converted residential accommodation. • Typical size ranges from 100m² to 3000m². <p>The domestic approach, with individual windows, lower illuminance levels, local light switches and heating controls helps to match the operation with the needs of occupants and tends to reduce electricity consumption in particular. There also tend to be few common facilities. Catering often consists of the odd sink, refrigerator and kettle.</p> <p>Air-conditioned Standard</p> <ul style="list-style-type: none"> • Largely purpose-built and often speculatively developed. • Typical size ranges from 2000m² to 8000m². <p>This type is similar in occupancy and planning to building type 2, but usually with a deeper floor plan, and tinted or shaded windows which reduce daylight still further. These buildings can often be more intensively used. The benchmarks are based on variable air volume (VAV) air-conditioning with air-cooled water chillers; other systems often have similar overall consumption but a different composition of end use.</p>	<p>Naturally Ventilated Open-plan</p> <ul style="list-style-type: none"> • Largely open-plan but with some cellular offices and special areas. • Typical size ranges from 500m² to 4000m². <p>This type is often purpose built, sometimes in converted industrial space. Illuminance levels, lighting power densities and hours of use are often higher than in cellular offices. There is more office equipment, vending machines etc., and more routine use of equipment. Lights and shared equipment tend to be switched on in larger groups and to stay on for longer because it is more difficult to match supply to demand.</p> <p>Air-conditioned Prestige</p> <ul style="list-style-type: none"> • A national or regional head office or technical or administrative centre. • Typical size ranges from 4000m² to 20000m². <p>This type is purpose built or refurbished to high standards. Planned running hours are often longer to suit the diverse occupancy. These buildings include catering kitchens (serving hot lunches for about half the staff); air-conditioned rooms for mainframe computers and communications equipment; and sometimes extensive storage, parking and leisure facilities. These facilities may be found in offices of other types, and if so, can be allowed for by adding together energy consumption by appropriate end uses from different office types.</p>
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It is clear from the benchmarking results that there is variation in the results between the different WHO offices in terms of energy, waste and water. The Geneva office is in line with the benchmarks provided for energy. It is likely that the Geneva office would be compared with an air-conditioned prestige office, as described by the Action Energy Office Types. The variation in energy use between the Kobe office and the Kuala Lumpur office could be explained by climatic variation, i.e. Kuala Lumpur would require large amounts of energy for air conditioning, thus pushing up the energy use per kWh.

All of the offices shown are below the Australian benchmark for water use per m².

In terms of waste use per employee, again there is considerable variation in the results, with Kobe considerably higher than the benchmark and Kuala Lumpur considerably lower.

4.1

INTRODUCTION

This section provides detail on a series of options for mitigation, reduction and offsetting of a carbon footprint. Specific opportunities for energy efficiency and emissions reductions, for an organisation such as WHO, are detailed in the table below, with relative costs and benefits associated with each, where applicable. Please note that due to the nature and scope of this project, and the fact that no detailed audits of any WHO facilities were conducted, detailed feasibility and cost benefit analyses for each mitigation measure are not described.

Section 5 analyses the carbon footprint further, by recommending specific measures that WHO should undertake, based on the specific make-up of the footprint, and the information presented in the table below.

Options for reducing emissions can be grouped in the following three categories:

- Engineered mitigation solutions that involve the installation of equipment to improve energy efficiency, and reduced personal and organisational energy use and resulting carbon emissions.
- Behavioural changes which involves the use of education, including training and outreach, to encourage people to modify their personal actions to reduce energy use and resulting carbon emissions. Policy changes can aid the changes of behaviour within an organisation.
- Offsetting activities which involve investing in carbon offset programmes to offset carbon emissions.

4.1.1 *Engineered Solutions*

A common misconception about mitigation strategies is that it is costlier than the “business-as-usual” scenarios. When considering the rising costs of energy, the payback on energy efficiency projects is becoming shorter thus making energy efficiency projects more viable and economically feasible.

Table 4.1 outlines potential high-level emission reduction opportunities, including costs and benefits that could be explored further at WHO operations. In many cases, the options outlined below will result in efficiencies with the added benefit of reduced fuel and energy requirements and associated cost savings. The options discussed below focus on the following:

- Travel;
- Heating, ventilation and air conditioning (HVAC);

- Power generation (e.g. boilers);
- Insulation; and
- Lighting.

Detailed energy audits will be able to identify specific measure for each building that can be implemented to reduce energy use and carbon emissions. A good energy audit should identify energy savings of 20 to 30% with payback periods of less than 3 years.

Table 4.1 *Potential WHO Carbon Reduction Opportunities*

No	Emission source	Description of mitigation method	Reduction opportunity	% Reduction in the carbon Footprint	Energy saving (kWh)	Estimated Cost	Pay-back
1.	Aeroplane flights	Increased use of video conferencing	<p>Encourage the reduction in number of flights by promoting the use of video conferencing through:</p> <ul style="list-style-type: none"> • Stricter policy measures in place with regards to approval of flights; • Promotion of video conferencing – this can be assisted by the correct scheduling of meetings between time zones to ensure uptake of the facilities; • Policy change with regards to the use of business class, which emits more emissions per person (see <i>Section 4.1.2</i> below). <p>This should be assisted through promoting behavioural change by educating employees around the impact of travel.</p> <p>A 10% reduction in flights can be achieved through this mechanism.</p>	<p>Air travel makes up ~75% of carbon footprint. Geneva office responsible for >75% of these emissions.</p> <p>Geneva took approximately 40,440 flights. A 10% reduction of these (4,040 flights) will result in approximately 1,800 tCO₂e reduction from Geneva alone, a saving of 8% of the total footprint.</p>	n/a	<p>WHO HQ Geneva has videoconferencing facilities already installed.</p> <p>There will be a 10% cost saving in the total travel bill of WHO, if air travel is reduced by 10% though the increased use of video conferencing, which has not been quantified.</p>	Immediate – cost savings will result from a reduction in travel.
2.	Refrigeration, air conditioning and heating	Replacement of gases	WHO currently use the R404a refrigerant gas in the HQ building air conditioners. This gas has a high Global Warming Potential (GWP) and replacement with R410a could reduce emissions from refrigeration and air conditioning by 53%.	This can result in approximately 1,300 tCO ₂ e savings, a 5% reduction in the total footprint.	n/a	R404a can be approximately 5 – 10% more expensive than R410a. There will also be a minimum retrofit cost (e.g. condensor coils) and replacement of systems may have to occur.	Undertake a feasibility study to determine cost benefit analysis of replacement of gases.

No	Emission source	Description of mitigation method	Reduction opportunity	% Reduction in the carbon Footprint	Energy saving (kWh)	Estimated Cost	Pay-back
3.	Refrigeration and air conditioning	Geneva Lake Nations project - water cooling and heating system	The implementation of the Geneva Lake Nations project will use water of Lake Geneva to cool or heat the WHO and other UN buildings. Connection to the Geneva Lake Nations system may cover all cooling requirements and remove the need for air conditioning. The system will also use heat pumps to replace oil-fired boilers.	Approximate 8% reduction in the total WHO footprint (2,000 tCO ₂ e). Refrigerants may still be required for essential services such as server rooms, and therefore will not be completely eliminated. Note that this may be conservative as emissions from heating have not been quantified in the 8% reduction estimate as it is unknown what the energy and associated GHG emissions would be from the heat pumps themselves.	Assumed negligible as there will be energy required for the operation of the pumps for the new chiller system.	Not quantified in the scope of this project but will depend on the implementation cost.	Undertake a feasibility study to determine payback.

No	Emission source	Description of mitigation method	Reduction opportunity	% Reduction in the carbon Footprint	Energy saving (kWh)	Estimated Cost	Pay-back
4.	Power generation – gas / diesel boilers	Boiler upgrade, installation of control systems, replacement or switching to lower CO ₂ e emitting fuel.	<p>Existing boilers can be improved in terms of efficiency, combustion process and control system. The following can be implemented with respect to this:</p> <ul style="list-style-type: none"> The combustion process in boilers can be improved by reducing excess air with oxygen trim controls. Older boilers can be replaced with multiple high efficiency condensing boilers or upgraded to use a lower CO₂e emitting fuel – e.g. natural gas or biodiesel. This should be considered only after a feasibility study is undertaken to determine cost/benefit. Optimise the boiler energy use, by setting the control system to switch off boilers under no load conditions. This will reduce cycling and purging losses. 	<p>This will depend on the energy reduction that can be achieved, but will be between 1 to 8% as power generation makes up 10% of the total footprint for WHO.</p>	Undertake feasibility study to determine this.	<p>Installation of oxygen trim control is approximately \$10,000 (for 2.9 MW (300 horsepower) boiler) – \$35,000 (very large installed boiler).</p> <p>Timing equipment: Stand alone package (only boiler) approximately \$100 - \$1,000. Integration into full building management system approximately \$5,000 - \$200,000 (dependant on building size).</p>	Undertake a feasibility study to determine payback

No	Emission source	Description of mitigation method	Reduction opportunity	% Reduction in the carbon Footprint	Energy saving (kWh)	Estimated Cost	Pay-back
5.	Heating Ventilation & Air Conditioning	Operational changes in use, replacement or upgrade of air handling systems. Improve air conditioning controls.	<p>Replacement or upgrade of air handling systems should focus on matching the supply to the required demand. Operational behaviour changes that can ensure energy savings such as the following should be implemented:</p> <ul style="list-style-type: none"> • Ensure that HVAC system is operational only during building occupancy time periods. • Ensure that the HVAC system start/stop periods are adjusted to incorporate seasonal use, public holidays and weekends. <p>Typical improvements can include:</p> <ul style="list-style-type: none"> • Installation of programmable zone thermostats. • Lock out simultaneous heating and cooling. • Reduce zone thermostat heating set point and raise cooling set point. • Optimum start/stop algorithms should be implemented. • After hours operation by manual override, occupancy sensor or security. • Unoccupied zone temperature setback or shutoff. 	<p>Depends on scale of optimisation, behaviour changes and maintenance programme implemented, but can reduce energy consumption by 10%. This translates into a 500 tCO₂e reduction (1% of the WHO footprint).</p>	<p>A rule of thumb is: for every HVAC operating hour that is reduced, associated energy consumption will drop by 5 to 10%.</p> <p>Typical energy saving that can result from HVAC tune up is 10%.</p>	<p>Adjusting control algorithm: costs are usually low and often these changes will simply require adjustment of existing controls. Integration into the full building management system is approximately \$5,000 - \$200,000 (dependant on building size). It is recommended that WHO commission an HVAC engineer to determine feasibility and cost effectiveness of the improvements.</p>	<p>Short to medium term, but will need to be determined through a detailed feasibility analysis.</p>

No	Emission source	Description of mitigation method	Reduction opportunity	% Reduction in the carbon Footprint	Energy saving (kWh)	Estimated Cost	Pay-back
6.	Power Generation	Reducing the demand on the hot water system.	<p>Energy use and carbon emissions can be reduced if the demand on the hot water system is reduced. This can be done by:</p> <ul style="list-style-type: none"> • Considering not supplying hot water to hand basins in summer. • Installing instantaneous hot water heaters (gas or electric) at remote locations. • Installing aerated or low flow showerheads and tap ware. • Turning off the hot water boiler early manually or user a timer control 	Will depend on the energy savings that can be achieved and the concurrent CO ₂ e emissions that the energy savings will result in. It is estimated that the CO ₂ e savings will be between 100 to 200 tCO ₂ e, less than 1% of the WHO footprint.	Domestic hot water use accounts for approximately 4 to 5% of overall energy consumption or 16% of gas consumption.	Will depend on the measure that is implemented. Typical cost for low flow tap ware is between \$285 and \$550, toilet flushes between \$360 and \$600, and aerated/low flow shower head costing less than \$30 each.	<p>Determine for each measure.</p> <p>Pilot studies have shown less than a year payback for low flow showerheads. This will be dependent on electricity prices and fuel type used.</p>

No	Emission source	Description of mitigation method	Reduction opportunity	% Reduction in the carbon Footprint	Energy saving (kWh)	Estimated Cost	Pay-back
7.	Reduce heat losses/ insulation	Insulation to prevent thermal heat loss.	<p>Heat loss is fastest through windows and then any un-insulated ceiling, walls and floors of a building.</p> <p>Installation or upgrading insulation to the ceiling/roof, wall panels, floors, water heaters and tanks and metal window frames will assist in saving energy.</p> <p>Installing geyser blankets on hot water cylinders/ water heaters can reduce heat losses.</p> <p>If replacing windows then double glazing should be considered, along with a high performance low energy coating.</p>	<p>Will depend on the energy savings that can be achieved and the concurrent CO₂e emissions that the energy savings will result in. This may potentially reduce the footprint by a maximum of 2000 tCO₂e, or 8%, but estimated to be less, as the insulation in the largest WHO building in Geneva is fair.</p>	Insulation has the potential to reduce the heating and cooling energy costs by 50%.	<p>Installed costs of window glazing can be \$10 to \$20 per m² and it will depend on the type and quality of glazing chosen. Secondary glazing can cost as little as \$1-2 per m².</p> <p>Insulating piping is in the region of \$25/meter, and approximately \$30/valve jacket.</p>	<p>Payback on insulation will depend on the installed heating and cooling systems and can be as quick as 3 years or as long as 15 year. This will need to be determined through a detailed feasibility analysis of each facility though</p>

No	Emission source	Description of mitigation method	Reduction opportunity	% Reduction in the carbon Footprint	Energy saving (kWh)	Estimated Cost	Pay-back
8.	Energy efficiency (lighting)	Installation of lighting controls to improve efficiency, selective de-lamping and replacement of inefficient lamps.	<p>Lighting power usage can be between 40 and 70% of an office's power usage. Selective de-lamping to reduce light levels to those required for effective usage of an area will improve on electricity usage.</p> <p>Methods of improving lighting efficiency include:</p> <ul style="list-style-type: none"> • Installing high efficiency light reflectors. • Replacing or removing cloudy diffusers. • Reducing general light levels but providing task lighting. • Ensuring light fittings are clean and replacing old tubes with blackened ends. • Retrofitting incandescent light bulbs with compact fluorescent bulbs (CFLs). CFLs can produce the same amount of light as incandescent globes but with approximately four to five times less energy required. • Installing lighting control units such as push button timers, motion detectors and infra red sensors which controls the lighting depending on whether people are occupying a room or not. 	<p>Will depend on the energy savings that can be achieved and the concurrent CO₂e emissions that the energy savings will result in. There would be maximum footprint savings of between 900 to 1600 tCO₂e for WHO, representing 4-7% of the footprint.</p>	<p>Depends on scale of optimisation/improvement programme.</p> <p>T8 and T5 lamps with electronic high frequency ballasts use 30% less energy than magnetic ballasts.</p>	<p>Lighting controls per room can be in the region of \$400, which would increase to approximately \$700 if the controls were wired back to a central control unit.</p> <p>Lighting replacement would be approximately \$240 per fitting, plus a daily rate for an electrical contractor.</p>	<p>The payback to cover the new purchase costs can be 3 to 8 years as part of a relamping exercise, but will need to be determined through a detailed feasibility analysis.</p>

No	Emission source	Description of mitigation method	Reduction opportunity	% Reduction in the carbon Footprint	Energy saving (kWh)	Estimated Cost	Pay-back
9.	Energy efficiency – computers and servers	<p>Use of software and virtualisation to reduce energy demand and carbon emissions.</p> <p>Train and inform employees to change behavioural patterns for shutting down monitors and desktop computers at night.</p>	<p>Desktop computers and servers are one of the biggest users of energy and are in most cases energy inefficient as losses from processes and applications can waste as much as 90% of energy use. 1E's Night Watchman. is a management software that automatically shuts down networked desktop computers in the evenings and weekends when they are not in use.</p> <p>This can be supplemented by virtualisation, or consolidation of servers, which can achieve the following:</p> <ul style="list-style-type: none"> • Consolidates workloads onto fewer servers when a cluster needs fewer resources. • Places unneeded servers in standby mode. • Brings servers back online as workload needs increase. 	1E Night Watchman indicates that 0.5ton of CO ₂ can be saved per PC. This may reduce the WHO footprint by approximately 3%, based on a predicted 25% energy consumption saving.	Energy consumption can be reduced by up to 25% for energy efficient use of IT.	<p>Zero external cost for informing and educating employees about efficient energy use of computers.</p> <p>Capital cost for installing 1E Nightwatchman and for server consolidation is dependent on scale of IT system, and will need to be determined by requesting a quote from the supplier.</p>	1E Night Watchman indicates that the software can produce a Return on Investment within 1 year.
10.	Mobile combustion (efficient vehicles)	Replacement of vehicle fleet with more efficient/ lower CO _{2e} emitting vehicles, such as low CO _{2e} emitting small cars or hybrids.	Start a replacement program to switch in-efficient vehicles fleet with electric vehicles, fuel cells and hybrid electric.	Less than 0.1% as emissions from vehicles contribute less than 1% of WHO's footprint.	n/a	This will depend on the type of vehicle being replaced and what the replacement is. A cost benefit feasibility analysis should be undertaken before starting replacement program.	This will be determined by the feasibility study.

No	Emission source	Description of mitigation method	Reduction opportunity	% Reduction in the carbon Footprint	Energy saving (kWh)	Estimated Cost	Pay-back
11.	Renewable Energy	Active renewable energy systems include wind, solar and micro-hydro.	Solar: Photovoltaics, Solar walls, Solar thermal, Solar Pumps Wind: Micro turbines Hydro: Micro-hydro Renewable energy supplies may require back-up from more traditional sources.	This will depend on how much and what type of fossil fuel based power can be replaced, but it is unlikely to reduce the footprint by more than 5% given that travel emissions contribute greater than 75%.	This will depend on how much energy can be produced from green energy.	Photovoltaics - \$10,000 - \$14,000 per installed kW for roof mounted cells Wind turbines - \$5,000 - \$10,000 per installed kW Micro-hydro - \$2,000 per installed kW	High

4.1.2 Behavioural and Policy Change

Technology tends to be the first course of action when looking to implement mitigation strategies and energy efficiency projects. However, behaviour of the occupants of a building can have as much of an impact on energy consumption as new technology and efficiency of equipment. Energy consumption is governed by information or awareness of the full costs associated with energy use.

Persuading people to change the way they work can be difficult and not necessarily achieved in the short term. It requires widespread changes in habits and information exchange and education are key to encouraging action. Some activities which could reduce energy consumption include turning off appliances when not in use (e.g. monitors, photocopiers), switching off lights when offices are unoccupied, wearing additional clothing rather than turning up heating etc.

Expert advice from professionals, energy audits, training and information exchange may be necessary to help people become aware of possible energy savings and measures. Conveying the building users' energy consumption figures on a regular basis in comparison to benchmarked buildings may kick-start a change in behavioural pattern.

Policy changes can aid the changes in behaviour of employees within an organisation. By making a policy change regarding air travel, WHO could make a relatively large reduction in the associated emissions. If WHO made a policy that all flights of less than 9 hours (approximately less than 8,000km) be made in economy class (instead of the current policy of flights less than 6 hours) then WHO HQ Geneva could achieve approximately a 14% reduction in their total carbon footprint. WHO HQ Geneva took approximately 19,000 business class flights (7,880 tCO₂e). If those business class flights of less than 8,000km were changed to economy class flights it would result in a saving of approximately 3,380 tCO₂e. There is no cost associated with this change in policy but savings will occur due to the downgrading of tickets from business class to economy class.

4.1.3 Offsetting activities

Offsetting emissions is an attractive option for an organisation to lower its emissions to more suitable levels, or if desired, become 'carbon neutral'. An advantage of offsetting, without giving anyone the license to pollute, is that it enables an organisation to cost effectively manage its net emissions and demonstrate clear environmental benefits through responsible investment in emission reduction projects.

Carbon offsetting involves the purchase of 'credits' from emission reduction projects that have prevented or removed the emission of an equivalent

amount of greenhouse gas (measured as carbon dioxide equivalent (CO₂e)) elsewhere. There are numerous projects and activities which generate credits that can be used to offset emissions. These options include:

- Certified Emissions Reductions (CERs) from projects that fall under the Clean Development Mechanism (CDM). The CDM is a market mechanism under the Kyoto Protocol allowing industrialised countries with a greenhouse gas reduction commitment to meet their targets by buying carbon reduction credits generated in developing countries as an alternative to more expensive emission reductions in their own countries.
- Voluntary Emissions Reductions (VERs). Numerous voluntary emissions reduction projects are taking place globally which are not registered as CDM projects. These include projects that take place in industrialised countries, projects that are too small for CDM to be cost effective or that do not meet the stringent criteria set by the United Nations Framework Convention on Climate Change. VERs generated by these projects cannot be used for compliance purposes but can be purchased by organisations which wish to make voluntary emission reductions for Corporate Social Responsibility reasons, or individuals wishing to offset their personal carbon footprint.

The use of offsetting projects should be regarded as the final step when an organisation has done everything possible to reduce their own carbon footprint. The price of carbon credits varies depending on whether you buy CERs or VERs and what type and what quality of projects you buy VERs from. It is reasonable to use a price of approximately \$21/CER in any potential offsetting planning currently while VERs can range in price from approximately \$7/VER to much more than a CER. If WHO were to offset their footprint of approximately 23,668 ton CO₂e it would cost in the region of approximately **\$497,028**.

When looking to purchase and use carbon credits, it is important to investigate each opportunity on a project by project basis, as irresponsible investing can have the opposite effect of the intended investment. For example, investing in a tree planting exercise that does not result in the intended carbon capture benefits. Therefore, investment in emission reduction projects, although encouraged, should be conducted in a responsible manner that enables WHO to realise real, measurable, low risk and high quality verifiable emission reductions.

5.1 RECOMMENDED EMISSION REDUCTION ACTIONS

Section 4 (*Table 4.1*) provides specific measures that WHO can look to in order to reduce their carbon footprint. The starting point for reducing the Carbon Footprint of WHO is to look at the current largest source of emissions. Activities with the highest associated carbon footprint are air travel, refrigeration/air conditioning, power generation and purchased electricity, as indicated in *Table 5.1* below (data originating from *Table 3.1*).

Table 5.1 *WHO Footprint broken down by emission source*

Emissions source	Total Tons CO ₂ e
Total CO₂e	23,668
Scope 1: Emissions from UN owned or leased equipment	4,672
Vehicles	11
Power generation	2,045
Refrigeration / air conditioning	2,616
Scope 2: Emissions from purchased energy	1,104
Purchased electricity	1,104
Purchased heat / steam	0
Scope 3: Total Travel Emissions	17,892
Public Transport: passenger trains and buses	5
Air travel emissions	17,887

Table 5.2 below summarises the recommended actions WHO should pursue in reducing the Carbon Footprint, with further detail on each of these provided in *Table 4.1*. Estimated savings as a percentage of the footprint are provided, along with an estimate, where possible of the cost implications. The costs are based primarily on average costs estimated by ERM's energy experts in the United Kingdom. Actions which are estimated to reduce the footprint by less than 1% are not detailed below, but are described in *Table 4.1*.

Detailed feasibility analyses for each of the recommended actions will be required in order to accurately quantify both the emission savings, and the cost implications. This is usually conducted through a green building audit.

Table 5.2 *Recommended Carbon Footprint actions, with estimate CO₂ savings and costs**

	Recommended Action	Estimated tCO ₂ e savings	Estimated % reduction in the carbon Footprint	Estimated Cost
1	Video conferencing	1,800	8	No capital cost as video conferencing already in place. There will be cost savings of approximately 10% of the total air travel costs to WHO if the amount of air travel is reduced by 10%, through the increased use of video conferencing.
2	Policy change in the use of business class and economy class.	3,380	14	None – there will be cost savings due to down grading business class flights.
3	Replacement of refrigeration gases	1,300	5	R404a can be approximately 5 – 10% more expensive than R410a. There will also be a minimum retrofit cost (e.g. condensor coils) and replacement of systems may have to occur.
4	Water cooling system	2,000	8	Not quantified.
5	Boiler upgrade, installation of control systems, replacement or switching to lower CO ₂ e emitting fuel.	200-2,000	1-8	Installation of oxygen trim control is approximately \$10,000 (for 2.9 MW boiler) – \$35,000 (very large installed boiler). Timing equipment: Stand alone package (only boiler) approximately \$100 - \$1,000. Integration into full building management system approximately \$5,000 - \$200,000 (dependant on building size).
6	Insulation to prevent thermal heat loss.	2,000 max	8 max	Installed costs of primary window glazing can be \$10 to \$20 per m ² . Secondary glazing can cost as little as \$1-2 per m ² . Insulating piping is in the region of \$25/meter, and approximately \$30/valve jacket. Total cost estimated at between \$30,000 – \$300,000, depending on the intervention.
7	Installation of lighting controls to improve efficiency, selective de-lamping and replacement of inefficient lamps.	900-1,600	4-7	Lighting controls per room can be in the region of \$400, which would increase to approximately \$700 if the controls were wired back to a central control unit. Lighting replacement would be approximately \$240 per fitting. The costs associated are due to the fact that the fittings are completely redone, and are not just a simple globe replacement, and includes both the fitting and labour cost. Total cost estimated at between \$70,000 – \$700,000, depending on the intervention.

	Recommended Action	Estimated tCO ₂ e savings	Estimated % reduction in the carbon Footprint	Estimated Cost
8	Use of software and virtualisation to reduce energy demand and carbon emissions.	700	3	Capital cost for installing 1E Night Watchman and for server consolidation is dependent on scale of IT system, and will need to be determined by requesting a quote from the supplier.

* Costs are estimated by ERM energy experts based in London

It is recommended that WHO focuses on the reduction of travel as the means to reduce their footprint in the most cost effective manner. Possible travel reduction opportunities would include:

- Enhancing the use of video conferencing by scheduling meetings so that they are held over time zones which are suitable to all staff;
- Changing policy with regards to sign-off of air travel. WHO could consider a system whereby motivation for all international travel is a requirement and will only be signed off if there is a clear business need for the travel;
- Changing the policy with regards to business class travel from flights longer than 6 hours to flights longer than 9 hours;
- Educating employees about the impacts of travel. A strategy to educate and inform employees needs to be developed, and it is recommended that this strategy focuses on the effects of travel on carbon emissions.
- Part of the awareness raising should include recommendations such as leaving the car at home and either walking, cycling or using public transport for work. Trains, for example, are the best low carbon travel option, as on average trains create one third of the CO₂ emissions of a plane.
- Introducing policy that staff need to use either small low CO₂e emitting or hybrid vehicles when hiring cars for business related purposes.

5.2 *RECOMMENDED WASTE AND WATER REDUCTION ACTIONS*

5.2.1 *Waste*

Recycling does take place within the WHO offices, especially within the Geneva offices where almost all of the waste is recycled. However, the other offices have not implemented recycling initiatives, other than some paper recycling, and need to follow the lead set by WHO HQ Geneva. A good place to start would be to provide separate bins for each type of waste (paper, plastic, metal, glass etc.) in a central area in order to enhance or implement the concept of central waste disposal (while at the same time removing all bins from 'beside your desk').

The reduction of paper use in an office environment is also vital when 'greening the office'. Recommendations are to print and copy double sided, use less virgin white paper and make use of more scrap paper. It is also recommended to have a centralised printing point to incentivise the reduction of paper consumption, as this requires staff to walk to pick up their printing. Passwords (or similar methods such as scanning access passes) are an ideal way to monitor the amount of paper used per person / department.

The use of non-disposable cups or mugs for coffee and water is another option in terms of reducing plastic/paper waste. This initiative is happening at WHO HQ Geneva, but should be rolled out to the other offices.

5.2.2 *Water*

The following initiatives can be considered in terms of water saving:

- Install water efficient taps (low-flow/aerated taps and showerheads). Typical tap flow rate is 10-12 L/minute which can be reduced to 2.5 L/minute. Water efficient taps not only reduce the amount of both hot and cold water use, they also reduce the energy used to heat water;
- Install water efficient or water-less urinals. Standard urinals uses 6L per flush, while a water efficient urinal uses 2.8 L per flush;
- Install flow control valves to all fittings, such as taps to achieve an equivalent saving to new fittings at low cost;
- Educate staff on water saving practices;
- Use sensors and timers in high use areas;
- Grey water collected from showers, hand basins, and kitchens can be treated and reused for cleaning, toilet flushing, fire-protection or sub-surface irrigation. This can reduce water use by up to 50%, but requires capital installation costs, and may depend on local legislation with respect to re-use of water;
- Water used in fire tests can also be stored and reused; and
- Consider sub-metering in large buildings, which enables early detection of leaks and water wastage which can also cause building damage.

5.3 *EXISTING WHO INITIATIVES*

The recommended actions should be seen in light of the environmental and carbon initiatives already in place at WHO. The following, as provided by WHO, is a summary of those initiatives already in place.

For all scheduled maintenance and repair work at WHO HQ, the organisation routinely ask how they can improve the energy efficiency of the buildings, cut down on wastage of water and energy, and improve procedures for recycling waste products. WHO have also started to use environmental criteria in the contractor selection process and in the choice of materials used. This criterion is set to become increasingly important.

As part of the task of maintaining an ageing building stock (the main building dates from 1966), major renovation works must be contemplated for the main

building (initially it was planned to concentrate on the heating system) and the annexes.

Following a survey of the existing installations and the fabric of the building, and in the light of changes in applicable building standards, it is planned to completely renovate the thermal envelope of the main building and the annexes to comply with requirements in respect of energy efficiency and greenhouse gas emissions. The thermal studies that will be carried out in the near future should, among other things, identify renewable energy solutions and consistently promote minimal energy consumption:

- Geneva-Lake-Nations Project for heating (heat pumps to replace oil-fired boilers); and
- Geneva-Lake-Nations Project for cooling IT sites and offices (with subsequent reuse for watering parks and gardens).

Improving the thermal envelope should not only generate energy savings but also avoid the need to install new cooling equipment for summertime use.

Other steps that have been or will shortly be taken include:

- Installation of an on-site sorting and recycling point (from 1 July 2009);
- Installation of a centralized lighting system to improve efficiency and avoid wastage of electricity;
- Installation of heat pumps to produce hot water in the main restaurant;
- Elimination of plastic cups (from 1 August 2009) and phasing out of all plastic cutlery (e.g. glasses made from real glass will be reintroduced in conference rooms);
- Refurbishment of the ornamental basin to collect rain water for watering the gardens; and
- Switching lawns to native grasses and flowers.

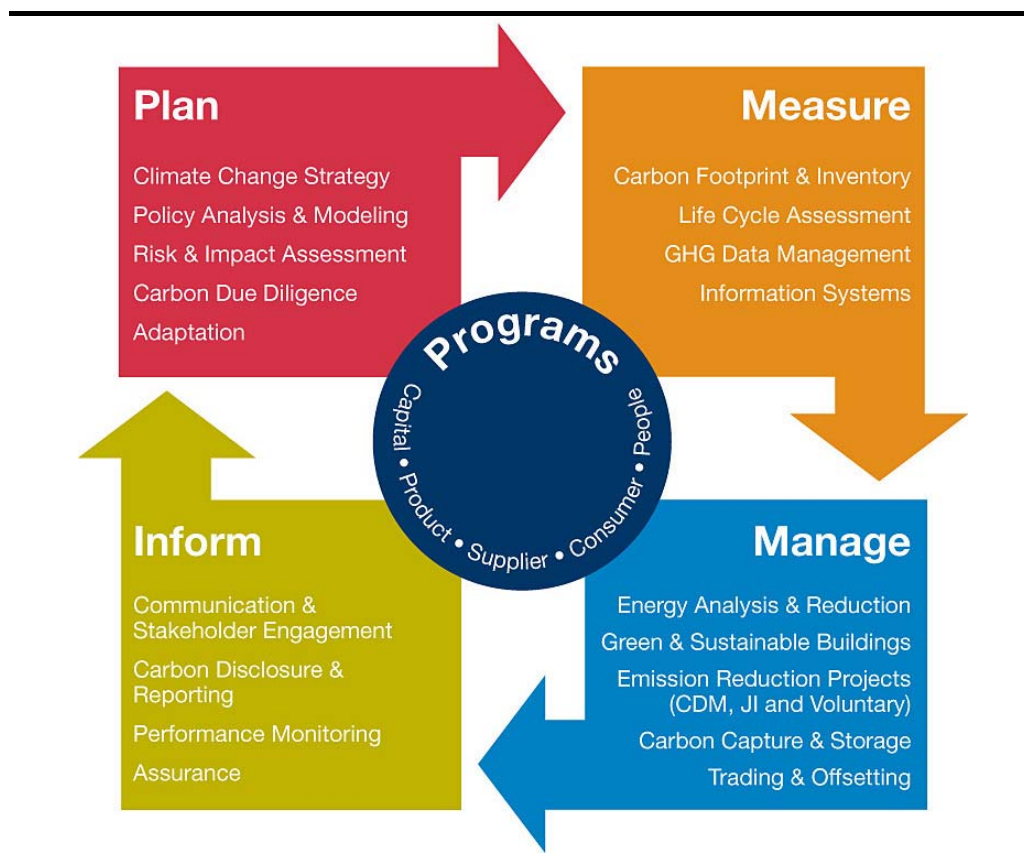
6.1 INTRODUCTION

This section presents the framework for the development of an environmental and carbon strategy for WHO.

6.1.1 Development of a strategy

Figure 6.1 outlines the core elements of a climate change strategy. It is considered best practice to embed climate change into existing strategies rather than develop a separate stand alone strategy as this will facilitate the incorporation of climate change planning in all aspects of the business.

Figure 6.1 *Elements of a Climate Change Strategy*



Developing the systems to monitor, manage and report greenhouse gas emissions is the first step towards developing a climate change strategy. Understanding these emissions through an effective energy and carbon management programme is key to identifying cost savings which have the added benefit of reducing the organisational carbon footprint.

It is recommended that WHO develop an environmental and carbon management strategy structured around the following framework:

1. Develop a **management and reporting policy** to provide direction and commitments to sustainable development and carbon reporting. It is vital that the leadership within WHO provide the necessary commitment in the organisation to improving environmental performance. This is usually communicated to the organisation through the policy. The policy may be influenced by the direction the United Nations is taking at a global level in terms of environmental policy.
2. Review existing **reporting procedures** in light of this policy and revise as necessary.
3. Assign **roles and responsibilities** at office level to ensure effective implementation of carbon and environmental reporting requirements. Developing a green task force or team, at the head office level, with responsibilities for environmental management delegated to staff at the individual office level, is recommended as the structure by which environmental and carbon management is implemented.
4. Define **timing for data reporting** - quarterly reporting of data will enable WHO to monitor progress against targets and facilitate effective progress on annual reporting and carbon management.
5. Compile a '**Carbon Reporting Operating Manual**' to provide guidance on data requirements, achieve consistency in definition interpretation and to form the foundation for establishing an audit trail for future verification of data. This will include the development of a robust **monitoring and reporting methodology** detailing calculations and measurements, estimations, assumptions, definitions, conversion factors etc. The United Nations Greenhouse Gas Calculator, User Manual 1.0 already contains a significant amount of information required for a Carbon Reporting Operating Manual. This document should be reviewed and supplemented, where necessary, for WHO, to ensure that it covers all elements specific to their operations. For example, it may be expanded to include various water and waste reporting requirements.
6. **Data collection** - The data collection process in the development of the carbon footprint was time consuming, incomplete (e.g. data was not available from all offices, nor for all emissions sources, water and waste), erroneous (approximately 2 - 3% of flight data was removed from the data set due to inaccurate flight path data) and site representatives had difficulty identifying the source of some pieces of information. Development of an organisation wide data collection framework and management system, such as a web-based online system, will facilitate the WHO in simplifying the time-consuming data collection process and assist

in the roll out of this project to other WHO HQ offices and to country operations globally.

7. **Key Performance Indicators and Targets** - Achievable and realistic key performance indicators and targets to reduce carbon emissions must be set. Detail on recommended key performance indicators and targets is provided below:

Key Performance Indicators

Key Performance Indicators (KPIs) are a useful tool for assessing emissions, waste and water intensity against the production or use of products or services and allows for the measurement of relative reductions against a baseline.

Due to the nature of the work undertaken by WHO, and their geographical spread, measuring environmental intensity against a particular product or service, may not be applicable. It is recommended that intensity is measured at an office level against head count, area (m²) and year. Utilising these measures will allow a comparison of offices globally, and will allow WHO to identify offices which are more energy/carbon, water and waste intensive than the others, indicating areas which can be targeted for improvement.

Table 6.1 lists the recommended KPIs to be used as a starting point. These can be developed as the quality of data increases or if there is a particular product or service that WHO would like to measure their environmental data against.

Table 6.1 *Recommended Key Performance Indicators*

Category	Unit
Total emissions per annum	tCO ₂ e/p.a.
Total emissions per person, per annum	tCO ₂ e/person/p.a.
Total emissions per square metre of office space, per annum	tCO ₂ e/m ² /p.a.
Total water use per annum	L/p.a.
Total water use per person, per annum	L /person/p.a.
Total water use per square metre of office space, per annum	L/m ² /p.a.
Total waste generated and recycled per annum	Kg/p.a.
Total waste generated and recycled per person, per annum	Kg/person/p.a.
Total waste generated and recycled per square metre of office space, per annum	Kg/m ² /p.a.
Total energy use per square metre of office space, per annum	kWh/m ² /p.a.

Targets

The development of targets for carbon and other environmental indicators is usually an iterative process, which requires buy-in from all stakeholders within an organisation, and leadership from top management. Furthermore, the targets need to be developed based on an accurate baseline assessment, and need to be measurable and achievable. To ensure that these targets are achieved, they need to be accompanied by specific programmes which can deliver the necessary savings on energy, water and waste.

Benchmarks are provided in Section 3.6, which provide WHO with a basis with which to set their targets for emissions, energy, water and waste. It is recommended that WHO use these benchmarks as a basis for developing specific targets for their organisation, based on the organisation's ability to achieve these. However, given that there is significant regional variation in the data between offices, it is recommended that WHO strive towards a % reduction of each of these measures.

8. Changing behaviour

In order to reduce the amount of energy used, the amount of water used and the amount of waste generated, and to increase the amount of waste recycled it is vital that employees are informed. Buying energy efficient appliances and the installation of sub meters to measure energy consumption for various different consumers for example, is important but advertising campaigns on energy efficiency, energy labelling of appliances, employee training on energy efficiency and expert advice are vital in order to change behaviour and making a lasting impression.

It is recommended that an awareness programme is developed and rolled out to all employees in order to ensure that they are fully trained in efficiently using the building. Monthly energy demand profiles of the building placed on notice boards will inform employees how their patterns affect energy use. Innovative ways in which to encourage efficiency could be implemented such as competitions between teams/buildings/floors to reduce per capita energy/emissions.

9. Implementation of specific actions

Based on the results of the WHO carbon footprint, information presented in *Table 5.1* and ERM's understanding of environmental and carbon issues, it is recommended that WHO develop action plans or programmes, or build on the existing programmes already in place and discussed under Section 5.3, focusing on:

- Travel reduction;
- Reducing the need for refrigerants through the Geneva-Lake-Nations Project;

- Replacement of R404a refrigerant gases with R410a;
- Upgrading power generation systems through installation of control systems, replacement or switching to lower CO₂e emitting fuel;
- Improving insulation;
- Improving lighting efficiency; and
- Installing energy efficient IT systems, such as 1E Nightwatchman.

It is recommended that these engineered solutions are accompanied by the promotion of staff behavioural changes through the use of education and awareness.

Once WHO has implemented all of the feasible options for reducing their emissions internally based on cost, then the organisation should consider offsetting the remaining carbon emissions.

10. Undertake Detailed Green Building Audits

Due to the nature and scope of this project, and the fact that no detailed audits of any WHO facilities were conducted, detailed feasibility and cost benefit analyses for each mitigation measure could not be developed. In order to ensure that the environmental targets are achieved, it is recommended that WHO consider detailed green building audits, which will be able to identify and cost specific energy, water, waste and carbon emission reduction opportunities for each facility. This exercise will enable WHO to accurately quantify the cost and potential savings associated with a number of the mitigation measures provided.

11. Develop Green Procurement Practices

Environmental or green procurement is an important component of a comprehensive environmental strategy for an organisation. Environmental or green procurement is defined as the purchase of products and services which have less impact on the environment and human health compared with competing products or services that serve the same purpose.

The following steps, as per the Canadian Standard – Environmentally Responsible Procurement (Z776-95), are recommended when setting up a strategy for green procurement:

- **Organisational support:** Implementing a green procurement programme means changing policies and procedures. For it to be successful, it is essential that management support the initiative fully. In addition, those charged with making purchasing decisions must be involved in the implementation process. Their suggestions and support are critical. It is recommended that WHO leverage off the work done in the soon to be published UN Sustainable Procurement Guide, so as to maximise organisational support.

- **Self-evaluation:** An important step in implementing green procurement is conducting an evaluation of present purchasing practices. This process will help to clarify what is purchased, in what quantities, from where and at what price. The evaluation will provide a baseline, in order to measure future success and to focus the development of green procurement goals.
- **Set goals:** A broad policy should be established, and specific priorities and targets set.
- **Develop a strategy:** It is now to time to identify and implement changes, both short and long-term, identify suitable products and services, and evaluate the environmental performance of suppliers.
- **Run a pilot project:** A pilot project can provide practical experience in purchasing green products and services, by applying green procurement principles to a specific product or service. Pilot projects can be used to generate more detailed guidance on purchasing practices.
- **Implementation:** Implementing the green procurement programme will require an assignment of accountability, plus a well designed communications plan addressing employees, customers, investors, suppliers and the public.
- **Sustainability:** As with all business practices, it is important that a systematic review of the green procurement programme be carried out, in order to establish whether the scheme is meeting its goals and objectives. The review should take into account changing environmental goals.

The decision on which green products or services to purchase may consider the source of raw materials, production, manufacturing, packaging, distribution, potential for reuse and recycling, operation, maintenance, or disposal of the product.

This can be done through assessing:

- Energy-efficient and carbon neutral products.
- Products that are water efficient and reduce water use.
- Less toxic products to reduce health effects.
- Products using less packaging or with a provision for packaging take-back.
- Products that use fewer resources or in other ways create reduced environmental impacts throughout their life cycle.
- Products made from recycled materials.
- Products manufactured locally, so as to avoid emissions from travel.

Emissions from contractors have not been thoroughly quantified in the carbon footprint process, and may be a large source of emissions. A procurement strategy may consider requesting contractors to calculate and submit their carbon footprint to WHO, if they wish to do business with them. This would become part of the Terms of Business, and would go a long way to influencing the whole supply chain within the United Nations.

12. Health Benefits

The implementation of such a strategy will facilitate in making the WHO buildings more 'green'. Recent studies reveal that buildings with good overall environmental quality can reduce the rate of respiratory disease, allergy, asthma, sick building symptoms, and enhance worker performance. Four of the attributes associated with green building design – increased ventilation control, increased temperature control, increased lighting control and increased daylighting – have been positively and significantly correlated with increased productivity¹.

(1) ¹ Green Building Costs and Financial Benefits, Gregory H. Kats, 2003.

As this is the first year of its development, we consider the carbon footprint figure of 23,668 metric tonnes of CO₂e a fair reflection of WHO's greenhouse gas emissions for the year January to December 2008. It must be remembered that the Carbon Footprint refers only to those offices included in this study and listed under *1.1 Project Objectives and Scope*.

However, improvements can be made in the following areas that will incrementally help in improving the accuracy and completeness of the carbon footprint over time:

- Identify and include all buildings under WHO's control in the calculation;
- Ensure the accuracy of all of the existing WHO flight data to ensure completeness in the air flight emissions calculation;
- Quantify the emissions associated from staff travelling on statutory travel that WHO is responsible for;
- Develop a system to ensure that accurate, reliable and complete data is gathered and reported for each WHO office on a regular basis, e.g. quarterly. A web-based online data collection tool may assist the UN in simplifying the time-consuming data collection process;
- The development of a 'Carbon Reporting Operating Manual', such as a customised version of The United Nations Greenhouse Gas Calculator, User Manual 1.0 to ensure a robust monitoring and reporting methodology;
- Assign roles and responsibilities at office level, including the formation of a green task team at head office level, to ensure effective implementation of carbon and environmental reporting requirements;
- Implement and build on already existing energy saving, water use and waste reduction projects to help achieve the targets discussed in this document as well as use the KPIs to monitor performance;
- Review procurement practices and implement a more sustainable approach along the lines of the soon to be published UN guidance on sustainable procurement; and
- In particular, concentrate on reducing the amount of air flight travel, which makes up the largest portion of the WHO footprint.

In order to ensure that the environmental targets are achieved, it is recommended that WHO consider detailed green building audits, which will be able to identify and cost specific energy, water, waste and carbon emission reduction opportunities for each facility.