Assessment of Energy, Water and Waste Reduction Options for the Proposed AMISOM HQ Camp in Mogadishu, Somalia and the Support Base in Mombasa, Kenya

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Cover photo: UNAMID peacekeepers assist with water distribution in a water-scarce region of Northern Darfur

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Rationale

The Environmental Policy for UN Field Missions, applying to both the Department of Peacekeeping Operations (DPKO) and the Department of Field Support (DFS), came into effect on 1 June 2009. This policy, developed in cooperation with UNEP, provides a minimum set of environmental standards and objectives for UN Field Missions. These standards have been developed to minimise the environmental footprint of peacekeeping operations while maximizing the efficient use of natural resources. Application of these standards should reduce the overall consumption of natural resources and production of wastes, thereby reducing potential conflicts with local communities and enhancing the reputation of the UN as a leading organization in green practices, technology and sustainability. In some cases, the application of greener technology also improves the self-sufficiency of bases, for example through energy and water production, thereby reducing dependency on external supplies.

Given its environmental mandate, UNEP has been requested by DPKO and DFS to provide technical assistance in the implementation of this policy in the field. As an initial pilot operation, UNEP undertook a preliminary assessment of the resource-demand and operating practices of two proposed African Union Mission to Somalia (AMISOM) camps, in Mogadishu (HQ Camp), Somalia and Mombasa, Kenya (Support Base) in June 2009. Each camp has been designed for 200 person occupation over a period lasting 10 years. The assessment compared the existing design parameters and operational specifications for each site and screened 132 potential resource efficiency measures that could be applied to achieve a reduction in energy and water consumption as well as waste production and disposal. Each option was ranked using a traffic light system of green (these are considered as feasible), yellow (further study required) and red (not feasible) according to practicality, technical robustness and financial implications. This ranking of potential resource efficiency measures was designed as an initial input to the DFS/UNSOA engineering team for further consideration and costing during the elaboration and finalization of the designs and subsequent procurement process. This report summarizes the outcomes of this assessment and provides a set of immediate, medium and long-term recommendations to DPKO and DFS for reducing energy, water and waste footprints at the two sites considered as well as in the design of future camps in other countries.

Findings

- **Energy:** A total of 64 resource efficiency measures were considered in order to reduce energy consumption at the two sites. For the HQ Camp, 41 were ranked as green, 17 as yellow and 6 as red. For the Support Base, 37 were ranked as green, 22 as yellow, and 5 as red. Of the green ranked options, the analysis found that energy consumption could be reduced by 26% at the HQ Camp and by 32% at the Support Base if the green ranked resource efficiency measures were adopted. Based on the calculated reduction in energy consumption, the carbon footprint of the HQ Camp could be reduced by 994 tonnes/year while the Support Base could be reduced by 673 tonnes/year. The most significant savings at both sites come from the adoption of technologies for solar thermal cooling (or use of waste heat for cooling from diesel generators), solar water heating and external lighting based on solar or wind energy. Evaporative cooling, such as the Coolerado-type cooling system could also be considered at the Support Base. While significant on-site renewable energy could be produced by large solar panel arrays, wind turbines, fuel cells, and waste to energy systems, they require further study and cost modelling to ensure compatibility in a military setting.

- **Water:** A total of 18 resource efficiency measures were considered in order to reduce water consumption at the two sites.

10 were ranked as green and 8 as yellow. Of the green options, the analysis found that water consumption could be reduced by 42% at both sites through the adoption of the identified measures. The most significant savings come from the use of waterless urinals, high-efficiency toilets, and aerated shower heads. While composting toilets could significantly reduce water use, they were ranked as a yellow option as they are untested in a peacekeeping camp. In terms of potential water production, rainwater harvesting, grey water recycling and solar distillation all offer good potential. However, they also require further study and should be tested on a trial basis before being adopted within the standard design.

- **Solid waste:** A total of 48 resource efficiency measures were considered to reduce solid waste production at the two sites. For the HQ Camp, 23 were ranked as green, 15 were ranked as yellow, and 10 as red. For the Support Base, 23 were ranked as green, 20 as yellow, and 5 as red. With regard to the safe disposal of waste, the adoption of the waste protocols established for the United Nations Mission in Sudan (UNMIS) and adopted on 4 March 2009 is strongly recommended. These serve as a good baseline of best practice against which further work can be carried out. Existing waste generation profiles collected from UNMIS suggest that on average, peacekeeping staff produce 1.2 kg of waste per day. The analysis found that at both locations the estimated total volume of waste produced can be reduced by 15% through a combination of food waste reduction measures and improvements in the supply chain. At the HQ Base, the total amount channelled to landfill can be reduced by up to 61% and at the Support Camp up to 88% based on the adoption of waste management measures including segregating and recycling commodity waste in local markets, composting, and incineration. At the Support Camp only, anaerobic digestion was deemed to be a suitable measure for waste disposal.

- **Liquid waste:** Only two resource efficiency measures were considered to address liquid waste production and disposal at the two sites. At both locations, the analysis found that grey water disposal to soakaway ponds could be reduced by 66% by recycling grey water for toilet flushing, vehicle washing and other non-sensitive uses. At the Support Base, anaerobic digestion was deemed to be a suitable measure for addressing black water disposal. The analysis found that black water requiring treatment could be reduced by up to 30% through the use of anaerobic digestion. A detailed feasibility analysis is required to evaluate technologies that could be used to produce a "closed-loop" system to help manage energy, water and waste in a more sustainable fashion, and in particular to assess waste to energy systems.

The unique security profile and environmental conditions at each site resulted in two major differences in the suite of proposed resource efficiency measures. First, the energy efficient but water-intensive Coolerado-type cooling system was deemed suitable for only the Support Base due to possible water scarcity at the HQ Camp. Second, security concerns at the HQ Camp relating to the presence of methane gas may also prevent the successful use of the recommended waste reduction technologies (anaerobic digestion) – this risk would require additional assessment before the recommended technology is precluded. Given the differences in the operational conditions of the camps, the Support Base would be the preferred location for conducting pilot testing of new resource efficiency technologies.

Priority recommendations

This assessment provides a series of immediate, medium and long-term recommendations which can contribute to the successful implementation of the DPKO-DFS Environmental Policy for UN Field Missions and will help to reduce the resource-consumption, waste production and greenhouse gas emissions of peacekeeping operations. The five most important recommendations are:

- **Immediate review and adoption of green ranked measures:** Green ranked measures

have been assessed as being feasible on the basis of their cost (both capital and operational), robustness for use in the field and ease of use. In this respect they are considered to be suitable for immediate deployment into the design of new camps and the operation of existing camps. The DFS/UNSOA engineering team should conduct a technical review of the green ranked resource efficiency measures listed in this report in order to identify the measures that can be immediately adopted in the design of the HQ Camp and Support Base. This selection process should also be complimented by a comprehensive modelling exercise to ensure that optimum use of resources and technical feasibility are addressed. Resource savings may be realised outside of those identified in this report through such a modelling exercise.

- **Further study and pilot testing of yellow ranked measures:** The DFS engineering team should further assess the yellow ranked measures identified in this report, including a detailed cost-benefit analysis as well as operational feasibility studies. If possible, lessons learned from the adoption of these technologies in other peacekeeping operations should be collected and reviewed for best practice. Ideally, a selection of yellow ranked options including large solar panel arrays, wind turbines, composting toilets, grey water recycling, rain water harvesting and solar distillation should be pilot tested at the Support Base given its lower security profile. This could be followed by a pilot hand-over and training of the technology to the host government and local community.

- **Feasibility study on closed loop bioenergy production:** A detailed feasibility study should be undertaken to evaluate optimum processes and technologies that could be integrated to produce a "closed loop" bioenergy system to better manage energy, water and waste in peacekeeping missions. Such a study should consider solid and liquid waste volumes, calorific value, storage and treatment, as well as potential energy yields from anaerobic digestion processes in the form of biogas. Further, it would evaluate conversion of biogas to electrical and heat energy using conventional engines and alternative technologies such as fuel cells.

- **Environmental impact assessments:** Prior to the installation of the HQ Camp and Support Base, an environmental baseline study should be undertaken in order to record the baseline environmental conditions. In addition an environmental impact assessment should be performed. These assessments will also facilitate the development of an appropriate environmental management plan and subsequent mitigation measures for anticipated impacts.

- **Development of a Sustainability Appraisal Camp Toolkit (SACT):** A dedicated "how to" toolkit is needed for UN peacekeeping activities that would help deliver sustainability objectives in a practical manner on the ground. It is important that a holistic approach is formulated covering the five main phases of a camp lifecycle: identification of sites, planning, set up, management and decommissioning/ liquidation. Such a tool kit should be aligned with existing UN policies, procedures and tools and also include case studies of best practice.

Acronyms List

AC	Air Conditioning
AMISOM	African Union Mission in Somalia
BMS	Building Management System
BREEAM	Building Research Establishment Environmental Assessment Method
CASBEE	Comprehensive Assessment System for Building Environmental Efficiency
CEB	UN Chief Executive Board
DFS	Department of Field Support
DPKO	Department of Peacekeeping Operations
EIA	Environmental Impact Assessment
EBS	Environmental Baseline Study
EMP	Environmental Management Plan
FOI	Swedish Defence Research Agency
GHG	Greenhouse Gas
GRI	Global Reporting Initiative
HLCM PN	High-Level Committee on Management Procurement Network
HQ	Headquarters
IT	Information Technology
LED	Light Emitting Diode
LSD	Logistics Support Division
LEED	Leadership in Energy and Environmental Design
MDG	Millennium Development Goal
MSW	Municipal Solid Waste
ODS	Ozone-Depleting Substance
Pa	Per annum
PCDMB	Post-Conflict and Disaster Management Branch
PIR	Passive Infra-Red
PV	Photovoltaics
REAP	Re-engineering Assessment Practices
REEIO	Regional Economy Environment Input Output model
SACT	Sustainability Appraisal Camp Toolkit
SUN	Sustainable United Nations
UNEP	United Nations Environment Programme
UNHCR	United Nations High Commissioner for Refugees
UNMIS	United Nations Mission in Sudan
UNSOA	United Nations Support Office for AMISOM
VSD	Variable Speed Drive

1 Introduction

UN peacekeeping camps make an important contribution to the recovery and sustainability of zones impacted by conflicts. However, the introduction of troops and support infrastructure can place considerable demands on natural resources. Additional stress, ranging from environmental pollution to resource degradation, can also be placed on the poverty and health of local populations if environmental impacts are left unmanaged.

DPKO and DFS are keen to develop a practical approach to the identification of sites, planning, set up, management and decommissioning/ liquidation of peacekeeping camps which will minimise potential impacts on the environment, maximize economic efficiency and base security, and enhance the lives of people living around these installations.

In response to a growing recognition of the importance of environmental management in peacekeeping operations, the DPKO/DFS Environmental Policy came into effect on 1 June 2009. The policy, developed in cooperation with UNEP, was intended to minimise the environmental footprint of UN Field Missions and maximize the efficient use of natural resources within each phase of a mission. Given its environmental mandate, UNEP has been requested by DPKO and DFS to provide technical assistance in the implementation of this policy in the field. As an initial pilot operation, a team of UNEP experts worked with the UNSOA team (UN Support Office to AMISOM) and assessed the design parameters and operational specifications relating to the construction and operation of two proposed African Union Mission to Somalia (AMISOM) camps, in Mogadishu, Somalia (HQ Camp) and Mombasa, Kenya (Support Base). The methodology and assumptions used to conduct the assessment is presented in chapter 2.

The first objective of the assessment was to determine baseline figures for energy and water consumption as well as waste production based on the existing designs and standards. Projected carbon footprints for each site were