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ZAMBIA

TECHNOLOGY NEEDS ASSESSMENT AND TECHNOLOGY ACTION PLANS FOR CLIMATE CHANGE MITIGATION

PART IV: PROJECT IDEAS

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DRAFT

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Preface
Zambia

Information page with Title

Disclaimer

This document is an output of the Technology Needs Assessment project, funded by the Global Environment Facility (GEF) and implemented by the United Nations Environment Programme (UNEP) and the UNEP Risoe Centre (URC) in collaboration with the Regional Centre (from the corresponding region), for the benefit of the participating countries. The present report is the output of a fully country-led process and the views and information contained herein are a product of the National TNA team, led by the Ministry of Lands, Natural Resources and Environmental Protection.

Foreword

As a non-Annex I country to the UNFCCC, Zambia is not subject to binding greenhouse gas emission reduction commitments under the Kyoto Protocol. Our contribution to global greenhouse gas emissions is small in the energy sector but relatively high under agriculture and land use and forestry. Although not bound compulsory, as a country, vulnerable country to the impacts of climate change, Zambia takes its responsibilities seriously and it will continue to do its part in the global efforts to address climate change.

Climate variability and change has become major threats to sustainable development in Zambia. Evidence suggests that the country is already experiencing climate –induced hazards such as droughts, floods and extreme temperatures. Without urgent and coordinated action, climate change and related disasters could negate decades of development progress and undermine the efforts to attain MDGs which may eventually result in failure to sustain Zambia's recently attained low-medium income country status.

Zambia has had some success in mainstreaming climate change in its Sixth National Development Plan and in developing National Programme of Action (NAPA). Zambia has also developed a draft National Climate Change Response Strategy (NCCRS) focusing on capacity development for mainstreaming climate change into policies and programmes. However, most of the projects identified have not been implemented due to scarcity of detailed information and bankable proposals.

The Technology Needs Assessment initiative and its objectives of "(i) identifying and prioritizing through country-driven participatory processes, technologies that can contribute to mitigation and adaptation goals of the participant countries, while meeting their national sustainable development goals and priorities, (ii) identifying barriers hindering the acquisition, deployment, and diffusion of prioritized technologies, (iii) developing technology action plans (TAP) specifying activities and enabling frameworks to overcome the barriers and facilitating the transfer, adoption, and diffusion of selected technologies in the participant countries, and present project ideas", has resulted in the development of concrete detailed action plans that can help decision makers to identify, create, and expand adaptation technologies and market for identified mitigation technologies.

This Technology Needs Assessment project considered several adaptation technologies related to water and agriculture, some of the most vulnerable sectors in Zambia, and developed concrete action plans to increase the resilience of these sectors in facing the expected adverse effects of climate change. Additionally, the TNA report has developed mitigation option in energy supply, energy efficiency, sustainable charcoal production and sustainable agriculture. The project ideas developed will serve as an input into development of bankable proposal for financing from various climate related funding under the UNFCCC and other bilateral and multilateral arrangement.

Minister of Lands, Natural Resources and Environmental Protection

ACKNOWLEDGEMENTS

We would like to thank all the project partners that worked closely on this project, namely the UNEP RISOE Center and ENDA Senegal for their constructive review and follow-up, the Global Environment Facility for their financial support, and the Ministry of Lands, Natural Resources and Environmental Protection for hosting and implementing this project.

We would also like to express our gratitude and appreciation to the contributors of this report, participants of consultation meetings, experts assisting in document reviews, and input guidance from related projects draft Second National Communication, draft National Climate Change Response Strategy, Sixth National Development Plan, in addition to academic institutions, and private companies, whose proactive participation was fundamental to the completion of the Technology Needs Assessment report.

Last but not least, we would like to thank the main authors of these report, Prof F D. Yamba and Dr. D Chiwele for their professionalism, friendship and patience throughout the project process.

The TNA Project Team(Mitigation and Adaptation).

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ABBREVIATIONS

DOE	Department of Energy
ERB	Energy Regulation Board
FNDP	Fifth National Development Plan
GART	Golden Valley Research Institute
GDP	Gross Domestic Product
MFI	Micro Financial Institution
MLNREP	Ministry of Lands, Natural Resource and Environmental Protection
NAMA	Nationally Mitigation Actions
NGO	Non Governmental Organisation
NPV	Net Present Value
R&D	Research and Development
RTSA	Road Transport and Safety Agency
SNDP	Sixth National Development Plan
TAP	Technology Action Plan
TNA	Technology Needs Assessment
UNZA	University of Zambia
ZARI	Zambia Agriculture Research Institute
ZACCI	Zambia Chamber of Commerce and Industry
ZEMA	Zambia Environmental Management Agency
ZNFU	Zambia National Farmers Union

Executive Summary

This part of the report outlines project profiles based on technology action plans elaborated in part III on (i) geothermal for electricity generation, (ii) biomass gasifier for off grid electricity, (iii) energy efficiency and management systems, (iv) sustainable charcoal value chain, (v)biofuels, development – biodiesel, and (vi)sustainable agriculture . The project profile briefly discusses the estimated budget, rationale, brief technology description, objectives and strategies, actors, timing and keys for success for the prioritized technologies.

1.0 Background

This part of the report outlines project profiles based on technology action plans elaborated in part III on (i) geothermal for electricity generation, (ii) biomass gasifier for off grid electricity, (iii) energy efficiency and management systems, (iv) sustainable charcoal value chain, (v) biofuels, development – biodiesel, and (vi) sustainable agriculture . The project profile briefly discusses the estimated budget, rationale, brief technology description, objectives and strategies, actors, timing and keys for success for the prioritized technologies.

1.0 Technology Action Project Profiles

1.1 Geothermal for electricity generation

Technology Action Title	Development of geothermal for electricity generation into the national grid
Estimated budget	US$ 470,000
Rationale	Zambia's electricity supply mix is predominantly hydro at 99.9%. Recent studies have indicated that runoff is expected to be affected in the future due to variations in climate change affected by drought in some critical years. This will lead to interruptions in the electricity supply. For example in the drought year of 1991/1992, there was immense load-shedding of electricity in the country which affected the economic wellbeing. Further, electricity demand in Zambia is projected to increase at 4% per annum. This will lead to exhaustion of the electricity potential estimated at 6000 megawatts in the year 2030. In view of the aforegoing, it is important that Zambia starts integrating renewable energy into the national grid aimed at broadening the energy mix and enhance make it more secure. Zambia has reasonable renewable energy resources. For example, Zambia is through a private company conducting field reconnaissance including hydrochemistry on all identified geothermal targets, geophysics on the more prospective sites and is planning to conduct preliminary drilling at its first target, a low enthalpy system in a shallow sedimentary setting.

Brief technology description	Geothermal energy is thermal energy generated and stored in the earth. This energy can be used to generate electricity using technologies such as dry steam power plants, flash steam power plants and binary cycle power plants. Geothermal uses no fuel, and is therefore immune to fuel cost fluctuations. Geothermal electricity production has been successfully developed in regions with hydrothermal manifestations (e.g., geysers and hot springs). For example the rift valley where Kenya is currently producing electricity around 250 MW. Zambia lies in the rift valley and has similar manifestations like Kenya and therefore has good potential which warrants serious investigations. Geothermal power is a stable source of energy as it is independent of weather circumstances. It is therefore a reliable source of energy and commonly has a high capacity factor of between 70 and 90% of installed capacity, which makes it applicable for both base and peak load. Geothermal power production has the environmental benefit of being a relatively clean. The contribution to greenhouse gas emission reduction from geothermal.
Objectives and strategies	The main objective of the action is to deploy geothermal for electricity generation into the national grid. The main strategies include; (i) development of framework for provision of financing for geothermal exploration, (ii) capacity development on specialized skills on geothermal exploration and development, (iii) formulation of support policies through provision of fiscal incentives and public finance, (iv) establishment of appropriate legal and regulatory framework for geothermal exploration and development
Actors	DOE, REA,ZDA, private sector, Bilateral and Multilateral organizations Geological department , NISIR, UNZA, private sector, Ministry of Mines, Energy and Water Development, Ministry of Finance, consultants and stakeholders
Timing	36 months
Keys for success	Engagement of all stakeholders and actors, monitoring and evaluation.

1.2 Biomass Gasifier for off grid electricity generation

Technology Action Title	Deployment of biomass gasifier for off grid electricity generation
Estimated budget	US$ 120,000
Rationale	Rural electrification rate in Zambia is relatively low estimated at 4%. Current efforts to increase rural electrification access focus on grid extension. Despite these efforts few of population living in rural areas of Zambia will be served by grid connections during the next decade Although, generally grid extension is possibly the lowest cost per kWh delivered for many remote populations, grid extension becomes less cost effective due to longer distances and load loads prevailing in such locations. In such situations, RE is becoming increasingly more competitive. Some of the renewable energy technologies which can contribute to increase access in rural areas serving as off-grid systems include micro/pico hydro, biogas digesters, small gasification systems, village scale mini grids/ hybrid system and solar PV. In this case, biomass gasifier has been prioritized as a technology which can contribute to increased rural electrification in Zambia, in particular to meet REAs strategic objective of "Rural Electrification for all by 2030''
Brief technology description	Biomass gasification for off grid applications involves production of gaseous fuel called producer gas used in a gas engines and modified gasoline and diesel internal combustion engines for electricity generation. Producer gas can also be used to produce steam which is then expanded on a steam reciprocating internal engines to produce electricity. Besides providing electricity to isolated areas in rural areas, it has the additional benefit of creating employment for the feedstock providers who are mostly small and medium scale farmers and foresters.

Objectives and strategies	The main objective of the action is to develop an implementation program for biomass gasifier dissemination in deserving locations. The main strategies include; (i) create awareness and information program for small scale project developers and entrepreneurs for biomass gasifier, (ii) techno-economic assessment of off-grid systems to ascertain their availability, (iii) resource assessment and logistics and assess suitability for use in biomass gasifier, (iv) implementation program and support policies for biomass gasifier dissemination .
Actors	DOE, REA, ZDA, Consultants, Private sector, Financial institutions, Project developers
Timing	36 months
Keys for success	Involvement of all stakeholders.

2.3 Energy Management – Energy Efficiency

Technology Action Title	Development of energy efficiency and management systems to industry commercial/ services entities and municipalities
Estimated budget	US$ 470,000
Rationale	Zambia has an installed capacity of 1812MW, out of which 1300MW is available based on 2010 statistics, and maximum demand is 1500MW. In terms of energy supply/demand situation, demand has outstripped supply since 2008. The electricity generation/sales was given as 9631GWh and according to projections, it is forecasted that energy sales will increase to 16000GWh in the year 2020 and to 20000GWh in the year 2030. The energy supply having outstripped demand has resulted in load shedding activities to all sectors of the economy to include: households, industry/commercial and to some extent mining which has resulted in inhibiting economic growth and development. Although, efforts are underway to develop new energy infrastructure to meet growing demand which is increasing at an annual rate of 100MW per annum, these projects will take relatively longer to complete in the range of between 7 to 10 years. During this period, the energy supply deficit will continue and hence the need to introduce energy efficiency and management which can go a long way in reducing the pressure on energy supply.
Brief technology description	This measure involves introduction of energy efficiency and management tools aimed at improving energy use in industrial, commercial/services and household. Under industry, technologies include on site electricity generation, energy system optimisation and energy management standards This measure is relatively low cost and contributes to reduced cost and hence enhanced competitiveness of affected industrial concerns in addition to reduction of GHG emissions. Under commercial/ services, the technologies include air conditioning efficiency, load control measures, and ripple control technologies.. Under household use, the measures include use of Compact Fluorescent Lights (CFL) or Light Emitting Diodes lights (LEDs) and solar water heater (for domestic and commercial entities). All these measures contribute to reduction in electrical energy demand and avoids premature investments in energy supply in addition to reducing GHG emissions and air pollution
Objectives and strategies	The main objective of the action is to develop energy efficiency and management systems to industry commercial/ services entities and municipalities. The main strategies include; (i) creating awareness and information program for industrial and commercial entities and municipalities, (ii) introduction of energy management program to industrial and commercial entities and municipalities, (iii) provision of financial mechanisms and incentives, (iv) formulation of a national energy efficiency and management policy, strategy, and action plan
Actors	DOE, Ministry of Commerce, Trade and Industries, ZACCI and ZAM, Bureau of Standards, Zesco, Financial institutions
Timing	36 months
Keys for success	Involvement of all stakeholders.

2.4 Sustainable Charcoal Value Chain

Technology Action Title	Development of a sustainable charcoal value chain framework for implementation.
Estimated budget	US$ 1,200,000
Rationale	Charcoal is an important energy source in Zambia. It ranks second to firewood in terms of primary energy supply. In 2000 it accounted 33% of total primary energy supply while fuelwood accounted for 43%, electricity and petroleum 10% each and coal 4%. In Zambia most of the charcoal is produced in earth-mound kilns of various sizes. Currently there is no standardized wood conversion fuel efficiency, but it is estimated to line between 10 to 20% depending on the source of reference. In the year 2008, total charcoal production was estimated at 1,000,000 tonnes, contributing to 10,000,000 tonnes of wood cultivated for purpose of charcoal production. Charcoal production is one of the drivers to deforestation and forest degradation, in addition to land clearing for agriculture, infrastructure development and timber harvesting. Between 2005 and 2010, annual deforestation rate was estimated to between 250,000 to 300,000 hectares per year. Once the charcoal is produced, it is used in inefficient cooking stoves with an estimated thermal efficiency of 10%. In view of above,, there is need to introduce a holistic approach on sustainable charcoal value chain.
Brief technology description	Sustainable charcoal involves both sustainable forest management, and use of efficient improved kilns and stoves. The basic components of sustainable charcoal systems include supply and demand side interventions. Supply side interventions are aimed at managing forest resources for charcoal production to include: (i) agro forestry, (ii) woodlot management, (iii) controlled exploitation of forestry resources, (iv) improved carbonization skills and technologies. Demand side interventions include: promote use of improved cookstoves and briquetting, (ii) create awareness on energy conservation, and encourage use of eco-charcoal concept of certification.
Objectives and strategies	The main of the project is to a sustainable charcoal value chain framework for implementation. The main strategies include; (i) strengthen forest resources legal framework for charcoal production, (ii) Improved harvest and conversion technologies for charcoal production, (iii) specification of appropriate modes of transport with restrictions and regulations, (iv) specification of modes for marketing, (v) introduction of design standards for improved cookstoves and awareness program, development of innovative financing mechanism for charcoal producers and end-users of charcoal.
Actors	Forestry Department, Local Government, Charcoal producers Association, DOE, ZEMA, District Councils , Traditional leadership , civil society, Ministry of transport, Transport associations, Charcoal traders, Zambia Police, RTSA, Bureau of Standards, artisans, R&D community, Financial institutions, MFIs, philanthropic finances , donor funding and dedicated fund.
Timing	36 months
Keys for success	Involvement of all stakeholders.

2.5 Biofuels Development - Biodiesel

Technology Action Title	Formulation of a conducive framework for biofuels development and implementation
Estimated budget	US$ 500,000
Rationale	Zambia has a wide variety of crops suitable for bioenergy production due to its suitable climatic and soil conditions. The large areas of currently unutilised arable land places Zambia in a strategic position as a country with enormous potential for biofuels production. Of great importance is the need to address sustainability and cost effectiveness issues. Sustainability of feedstock production requires assessment of land availability and suitability which takes account of land requirement for food production and biodiversity.Another important issue is that of development of standards and regulations for the biofuels industry. In the last few years, good progress has been made in Zambia on the promotion of biofuels industry in the country. Biofuels industry has been added to a list of priority industry to benefit from incentives under Zambia Development Agency. At the regulatory level. Biofuels have been allowed to be traded, and ethanol and biodiesel standards are now available. However, there still remain issues that need to be addressed including financing, cost effectiveness, sustainability issues, and transportation and storage issues and, pricing in particular.
Brief technology description	Biodiesel fuel can be produced from oilseed plants such as sunflower, soy beans, and jatropha. Bio Diesel can be used alone or mixed in any ratio with mineral oil diesel fuel. Biofuels production chain is characterized by the cultivation, production, gathering and transport of feedstock, and its conversion to yield biofuels as an energy carrier, distribution and end-use. To arrive at sustainable biofuel production requires (i) assessing what bioenergy technology and feedstocks options are available, (ii) identifying suitable areas for production, (iii) assessing impacts to include environmental and natural resources impacts, socio-economic effects, and food security impacts, (iv) develop risk mitigation measures
Objectives and strategies	The main objective of the project is to formulate a conducive framework for biofuels development and implementation. The main strategies include; (i) benchmark pricing, awareness program to financial institutions and specific investment framework, (ii) undertake a study on cost effectiveness of feedstocks for biofuel-biodiesel productions and associated logistics for supply chain and (iii) formulate a comprehensive legal and regulatory framework.
Actors	DOE, ERB, BAZ, financial institutions, private sector and ZNFU
Timing	12 months
Keys for success	Involvement of all stakeholders.

2.6 Sustainable agriculture

Technology Action Title	Development of sustainable agriculture framework for implementation
Estimated budget	US$ 1,000,000
Rationale	Agriculture in Zambia's supports the livelihoods of over 70% of the population. Zambia's economy has grown steadily in real terms since 2000. However, the percentage contribution of agriculture sector to GDP had declined from 16% in 2001 to 12.6% in 2009. There are three main categories of farmers in Zambian agriculture; small, medium and large scale. Small scale farming systems in Zambia are overwhelmingly dominated by single crop maize. In 2009/2010 81.72% of all small scale farmers grew maize, which is the staple food for the country. Yield for maize is below global average and is estimated at 1.2 tonnes per hectare. This low yield is attributed to no or less use of fertilizers by the majority of small scale farmers since most of them is unable to afford. Despite this low yield they, produce about 50% percent of the total maize supply in the country. Although there is a Government program "Farm Input Support Program"which supports small scale farmers with fertilizer and seed, it does not cover the majority of small scale farmers. Some of the small scale farmers who have benefited from the farmer input support program have increased yields to 2-3 tonnes per hectare, but the number is significantly low. The intention of the program was to support more small scale farmers once in a given season and encourage them to stand on there on in the following farming season without this subsidy. However, this has not realized due to relatively low floor maize prices and in some cases poor management practices. In view of the above short comings, the Government is encouraging sustainable agriculture which has an advantage of increasing the yield without the use of fertilizer and a relatively lower cost.
Brief technology description	Sustainable agriculture is a widely recognized technology which enhances crop adaptation to climate variability and reduces GHG emissions. Sustainable agriculture has an advantage of increasing the yield without the use of fertilizer and a relatively lower cost. Sustainable agriculture involves a number of practices to include; (i) development of green manure and cover crops for soil improvements (ii) conservation tillage (iii) use of organic manure (iv) application of lime, (v) control of weed
Objectives and strategies	The main objective of the project is to develop a sustainable agriculture framework for implementation. The main strategies include; (i) need for development resources, (ii) use of appropriate machinery, (iii) awareness and information program, (iv) developing the program as a mitigation option to benefit from carbon financing
Actors	Ministry of Agriculture, ZARI, UNZA, ZNFU, GART, Bilateral and Multilateral institutions , Financial institutions
Timing	36 months
Keys for success	Involvement of all stakeholders

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Annex I. List of stakeholders involved and their contacts

Group	Technology	Personnel	Institution	E-mail
1	Geothermal Electricity	Ms B Muyunda	Zesco	bmuyunda@zesco.co.zm
	Off- grid	DoE	DoE	
	Energy Management	Dr Kwenda kwema	Lloyds	
		Mr G Kayawe	Ash Field	georgekayawe@yahoo.co.uk +260976317107
2	Improved cook stoves	Mr Luwaya	UNZA	
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		DoE	DoE	
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		DoE	DoE	