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DEVELOPING NATIONAL CAPACITY TO IMPLEMENT CLEAN DEVELOPMENT MECHANISM PROJECTS IN A SELECTED NUMBER OF COUNTRIES IN AFRICA

CONTRACT NO. 200/056

PROJECT NO. YA/RAF/01/405

FINAL REPORT

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LIST OF ABBREVIATIONS

AREED	African Rural Energy Entrepreneurship Development
CC	Climate Change
CDM	Clean Development Mechanism
CEEEZ	Centre for Energy, Environment and Engineering Zambia
CER	Certified Emissions Reductions
CEST	Condensing Extraction Steam Turbines
COMFAR	Computer Model for Feasibility Analysis and Reporting
CO	Carbon monoxide
CO_2	Carbon Dioxide
ECZ	Environmental Council of Zambia
ERB	Energy Regulation Board
GACMO	Greenhouse Gas Abatement Costing Model
GDP	Gross Domestic Product
HFO	Heavy Fuel Oil
ICE	Internal Combustion Engine
IPCC	Inter-governmental Panel on Climate Change
IRR	Internal Rate of Return
LFO	Light Fuel Oil
LPG	Liquefied Petroleum Gas
MENR	Ministry of Environment and Natural Resources
MESAP	Modular Energy Systems Analysis and Planning
NCCSC	National Climate Change Steering Committee
NGO	Non-Governmental Organisation
NO_x	Oxides of Nitrogen
NPV	Net Present Value
OPPPI	Office for Promotion of Private Power Investment
O_2	Oxygen
O + M	Operations and Maintenance
PV	Photovoltaic
SUSAC	Start-up Clean Development Mechanism in ACP Countries
TAZAMA	Tanzania Zambia Pipelined Ltd
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organisation
ZACCI	Zambia Association of Chambers of Commerce and Industry

SUMMARY

This report presents the work carried out during the second phase of the UNIDO project on Africa, industry and climate change (Clean Development Mechanism) undertaken in Ghana, Kenya, Nigeria, Senegal, Zambia and Zimbabwe from 2000 – 2001. The project in Zambia was led by a team of national experts under the guidance of the Centre for Energy, Environment and Engineering Zambia Limited (CEEEZ).

The objectives of the project were to:

- Identify and implement a strategy to remove barriers to the transfer of climate-friendly industrial technologies;
- Develop and monitor industrial projects under the CDM in line with methodologies to be established by the UNFCCC parties;
- Increase the flows of energy-efficient industrial technology; and
- Absorb and manage the technologies to be transferred under the CDM

The report begins with Chapter 1, which considers the formulation of a Zambian Core Group (team) that was tasked to facilitate execution of the project. It proceeds to discuss how the team worked in collaboration with stakeholders representing various interests to identify and review barriers to the implementation of industrial CDM projects. Stemming from the identified barriers are the proposed appropriate strategies, which are presented in Chapter 3. In order to realise the strategies proposed, a national programme was formulated and is presented in Chapter 4. The core purpose of CDM preparedness being implementation of CDM projects, the last Chapter deals with identification of potential projects, including a section on preliminary baseline issues and calculations. Appendices mark the end of the report.

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Chapter 1

Team Work and Dialogue With Stakeholders

1.0 INTRODUCTION

This chapter deals with the formation of the local Project Core Group, and how dialogue with the stakeholders was realised. This was the basis for accomplishing the objectives of the project.

The Chapter further includes the development of a database for the stakeholders, and ends with a section on CEEEZ's synergy with other projects relevant to the objectives of the UNIDO Phase III project.

The successful completion of the project involved the formation of a local UNIDO Core Group – the Team. The team comprised staff with different backgrounds, filling the gaps necessary to effectively meet the objectives of the project.

In order to obtain the information for the report, stakeholders from various sectors were identified to participate in the project. While some declined to take part, most were willing and collaborated by participating in workshops and personal dialogue. A database was developed in order to have contact information for the stakeholders on one hand, and enable them to access the UNIDO Web board on the other.

1.1 TEAM WORK

1.1.1. Formation Of Core Group

A multi-disciplinary core group for undertaking the project was formed and comprises the following:

Prof. F. D. Yamba	National team coordinator/transfer of technology
Mr. D. J. Mbewe	Energy expert
Mr. A. Phiri	Financial Analyst/COMFAR Analyst
Mr. E. Matsika	Information Systems/ Modelling

On March 8, 2001, an initial meeting was held where the team met with Dr. Peter Pembleton of UNIDO and Dr. Pim Kieskamp of ETC Energy, Netherlands. A briefing was made on the objectives of Phase I of the project before discussing the details of the current Phase II. The future of the project (Phase III) was also briefly covered.

The database for the project team was sent to Vienna using the format that was prescribed. Further, the user Ids and passwords from Vienna were communicated to the team members. This was accompanied by instructions on how to login to the web board. This applied to stakeholders as well.

1.1.2 Roles of the Core Group

The roles of the Team were to:

- Formulate the scope of activities and work plan (shown in Appendix A)
- Identify stakeholders and develop a database
- Plan and manage data collection

- Make follow up on the stakeholders, and assisting them with the interpretation of questionnaires where necessary
- Analyse the results of the questionnaires
- Identify potential industrial CDM Projects and make preliminary baseline and additionality assessments
- Produce an overall report

1.2 DIALOGUE WITH STAKEHOLDERS

1.2.1 Identification of Stakeholders

Fifty-four stakeholders representing various interests including government, NGOs and private sector were identified and comprised of the following:

Government

(i). Ministry of Commerce, Trade and Industry*
(ii). Ministry of Environment and Natural Resources*
(iii). Department of Energy (Ministry of Energy and Water Development)*
(iv). Mines Safety Unit (Ministry of Mines and Minerals Development)*

NGOs

(i) Institute of Waste Management – Zambia Chapter, Lusaka*
(ii) Copperbelt University, Kitwe*
(iii) School of Engineering, University of Zambia, Lusaka*

Private Sector

(i) Zambia Association of Chambers of Commerce and Industry (ZACCI), Lusaka *
(ii) Zambia Association of Manufacturers (ZAM), Lusaka
(iii) Zambian Breweries Limited, Lusaka
(iv) High Protein Limited, Lusaka*
(v) Golden Breweries Limited, Lusaka
(vi) Tobacco Association of Zambia (TAZ), Lusaka
(vii) British American Tobacco Ltd*
(viii) Amanita Premium Plc, Lusaka*
(ix) City Breweries Limited, Lusaka
(x) Citizen Breweries Ltd*
(xi) Zambia Sugar Plc, Mazabuka
(xii) Zambia Bottlers Ltd, Lusaka
(xiii) Kembe Meat Corporation, Lusaka
(xiv) Trade Kings Limited, Lusaka
(xv) Parmalat – Bonnita Limited, Lusaka
(xvi) Makeni Breweries Limited, Lusaka
(xvii) Seba Foods Limited, Lusaka
(xviii) Zambia Pork Products Limited, Lusaka*
(xix) Zambezi Breweries Limited, Lusaka
(xx) Kariba Breweries Limited, Lusaka
(xxi) Chat Breweries Ltd, Lusaka*
(xxii) Nitrogen Chemicals of Zambia, Kafue*
(xxiii) Chilanga Cement Plc, Chilanga*
(xxiv) Supa Oil Industries, Kabwe
(xxv) Mulungushi Textiles Limited, Kabwe
(xxvi) Mukuba Textiles Limited, Kabwe
(xxvii) Zambezi Paper Mills, Ndola*

(xxviii) Swarp Spinning Ltd, Ndola
(xxix) Gamma Pharmaceuticals Limited, Ndola
(xxx) Copper Harvest Limited, Ndola
(xxxi) Northern Breweries Plc, Ndola
(xxxii) Lever Brothers Plc, Ndola
(xxxiii) Ndola Knitting Mills, Ndola
(xxxiv) Lyons Zambia Limited, Ndola
(xxxv) Indeco Milling Limited, Ndola*
(xxxvi) Indeni Petroleum Refinery, Ndola*
(xxxvii) TAZAMA Pipelines Ltd, Ndola*
(xxxviii) Zambia National Oil Company, Ndola*
(xxxix) Sakiza Spinning Mills, Kitwe*
(xl) Pigott Maskew, Kitwe
(xli) Towels Textiles Limited, Kitwe
(xlii) National Breweries Limited, Kitwe
(xliii) Konkola Copper Mines Plc – Nkana Smelter, Kitwe
(xliv) Copperbelt Bottling Company, Kitwe
(xlv) Copperfields Brewing Ltd, Kitwe*
(xlvi) Speciality Foods Ltd, Kitwe*
(xlvii) Kankoyo Breweries Limited, Mufulira

Out of this list, twenty-five (25), marked with an asterisk, accepted to participate, and thus were sent questionnaires.

1.2.2 Dialogue with Stakeholders

Interaction with stakeholders was achieved through holding of two workshops in the Ndola town of the Copperbelt Province. Further, personal contacts though emails, phones and visits were made.

1.2.2.1 Inception Meeting, March 9, 2001

The inception workshop was held on 9th March 2001 at Mukuba Hotel, Ndola, in the Copperbelt Province. The list of attendees is given in Appendix B. During the workshop, the following topics/issues were covered:

(i) Overview of Climate Change issues

- UNFCCC, the Kyoto Protocol and Clean Development Mechanism (CDM) (E. Matsika)
- Status of Negotiations (Peter Pembleton)

(ii) Background and Overview of the Project

- Background studies (1999) (Peter Pembleton)
- Preparatory assistance (2001 Activities) (Peter Pembleton)
- Implementation (Capacity Building 2002+) (Pim Kieskamp)

(iii) National Activities and Current Potential CDM Projects

- National Activities and Results of Phase I (F. D. Yamba)
- Opportunities and Benefits to Accrue through participation of Zambian Based Industries UNIDO Industrial CDM (F. D. Yamba)

The main concerns/concerns raised by the participants include:

- What the benefits of CDM are
- The role of Annex 1 countries in the CDM process, and their commitment to meeting the targets
- Achievement of an enabling environment for CDM
- Who the major players in the CDM process are
- Who is responsible for development of project documents
- Transfer of appropriate technologies
- Project financing under CDM
- What the role the role of governments in the CDM process is
- Baseline and additionality calculations
- How to deal with the many barriers to CDM implementation
- Bundling of projects in view of the relatively small size of projects in Africa

During the workshop methodological approach to project implementation and introduction of questionnaires for data collection were introduced. The following questionnaires/documentation were presented and discussed:

- Questionnaire on identification of barriers to the transfer of climate friendly technologies
- Questionnaire on identification of potential CDM Projects
- Manual on methodological approach for implementation of energy management and conservation programmes in industry

During the inception, it was agreed that stakeholders be given sufficient time to study the questionnaire, and submit comments by mid April 2001.

1.2.2.2 Second Workshop, July 27, 2001

The second and final workshop was held on Friday, 27th July 2001 at Mukuba Hotel in the Ndola city of the Copperbelt Province. Appendix C shows the list of attendees. The objectives of the workshop were as follows:

- To discuss the results of the questionnaires and surveys
- To identify and finalise barriers to the transfer of climate-friendly industrial technologies
- To contribute to the formulation of the strategy to remove barriers to the transfer of climate-friendly industrial technologies
- To identify industrial CDM projects for further elaboration

The following issues were considered during the workshop:

- Overview of the presentations of the Inception report
- The questionnaires, elaborated in Section 2.2, on:

- Group Assessment & Consensus on Barriers to the Transfer of Climate-friendly Industrial Technologies and Recommended Strategy for Removal
- Group Assessment and Consensus Prioritisation on Potential CDM Projects

- Company Database for Identification of Potential CDM Projects

- Examples of CDM Projects

During the workshop, the stakeholders were randomly divided into three groups. This was aimed at achieving:

- Group assessment and consensus on barriers to the transfer of climate-friendly industrial technologies and recommended strategy for removal
- Group assessment and consensus on prioritisation of potential industrial CDM projects

The composition of each group is given in Appendix D.

1.2.2.3 Development of a Stakeholder Database

An internet based database was compiled for stakeholders with email addresses were given IDs and passwords for the web board. It was however found that most of them do not have much access to the Internet, and thus have not effectively utilised the web board. Nevertheless, a general local database constituting all the stakeholder exists.

1.2.3 Current Projects Related to UNIDO Africa Phase II

There are currently three projects in progress in Zambia namely,

- CDM SUSAC (Start Up Clean Development Mechanism in ACP Countries)
- AREED (African Rural Energy Enterprise Development) Initiative, and
- EU Synergy (CDM Capacity Building Amongst the Private Sector in Southern Africa)

which have a synergy with CDM UNIDO Africa Phase II.

1.2.3.1 CDM SUSAC

The overall objective of the CDM SUSAC is that of CDM preparedness and capacity building in three countries namely, Senegal, Uganda and Zambia. The specific objective that has a bearing on the UNIDO Phase II project is:

- Establishing a CDM institutional framework as part of the requirements of UNFCCC Conference of Parties. The institutional framework has now been established in Zambia. Given in below is the framework, composition and terms of reference.

Present Institutional Set-up

A national institutional framework for CDM has been set up and comprises of CDM sub-committee of the National Climate Change Steering Committee (NCCSC), and a secretariat. The proposed institutional set up is presented in Figure 1.

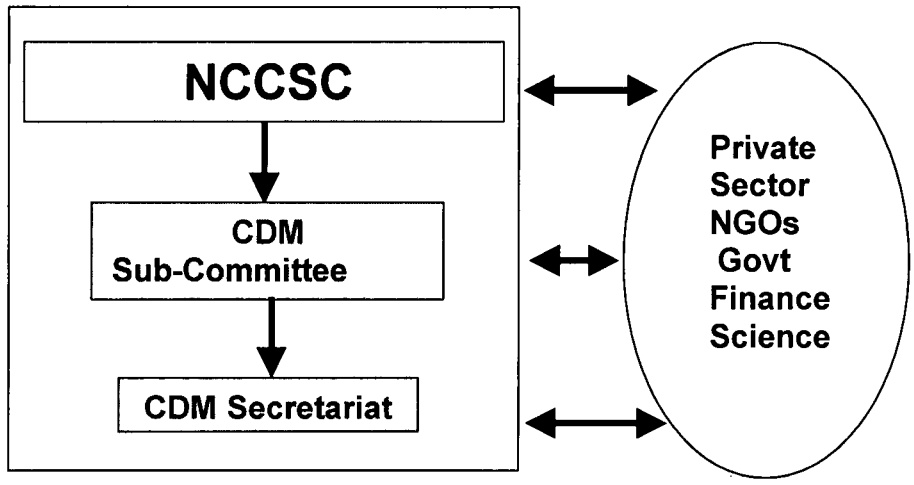

Figure 1: Proposed CDM Institutional Framework in Zambia

The NCCSC is responsible for all issues relating to climate change including the CDM and will issue communications to the UNFCCC. The NCCSC will be supported by a **CDM sub-committee** that has responsibilities for:

- Developing national Climate Change (CC) policy and defining national CDM goals within the context of other national/regional policy processes;
- Integrating CDM policy with other environmental, economic, industrial and social policies in the country;
- Formulating national CDM negotiating position and contributing to efforts to finalise the rules and guidelines to implement the Kyoto Protocol;
- Overseeing and spearheading the implementation of CDM projects;
- Attracting and mobilising financial resources for implementation of promising CDM projects;
- Defining guidelines for the approval of CDM projects; and
- Approving CDM projects based on given guidelines.

Under the sub-committee is the **CDM Secretariat** that is jointly responsible for the co-ordination of CDM project activities and will provide technical expertise to both the sub-committee and the NCCSC. The members of the secretariat comprise personnel from:

- Centre for Energy, Environment and Engineering Zambia (CEEEZ);
- Zambia Association of Chambers of Commerce and Industry (ZACCI);
- Ministry of Environment and Natural Resources (MENR).

The main activities of the secretariat include:

- Provide secretarial and technical services to the CDM sub-committee
- Raise awareness and identify and provide capacity building/training requirements for CDM project identification, design and implementation;
- Identify promising CDM projects;
- Provide technical advice and promote projects to outside investors;
- Disseminate CDM information; and
- Provide technical assistance to project promoters when need arises on baseline development, assessment of sustainable development and preparation of bankable proposals.

Whilst waiting for Government approval and formalisation of this national institutional framework described above, it was agreed that the CDM sub-committee should be established prior to formal government approval in order to operate as a project steering committee for CDM – SUSAC and CDM – UNIDO projects. It is anticipated that this group will be approved as the official sub-committee in the near future. The sub-committee has had three meetings on 3rd October 2000, 2nd February 2001 and 27th April 2001. At the first meeting held on 27th April 2001, the CDM UNIDO Africa Phase II was incorporated under the institutional set up. From that date onwards, activities and progress made presented to the CDM Sub committee for comments and advice. The UNIDO national programme is also passing through this committee for its approval.

The CDM UNIDO Africa Phase II is complementary to this project and will focus on CDM industry based projects in energy efficiency and co – generation.

1.2.3.2 The AREED Initiative

The United Nations Environmental Programme (UNEP), with financial support from United Nations Foundation, has initiated AREED. The AREED initiative being implemented by E & Co seeks to develop new sustainable enterprises that use clean, efficient, and renewable energy technologies to meet the development needs of rural areas.

The main objectives of AREED are as follows:

- To create rural energy enterprise and to build the capacity of NGOs and institutions to facilitate enterprise development
- To provide early stage funding and enterprise development services to entrepreneurs; builds capacity in African NGOs to work with clean energy enterprises and works with financial institutions to assess the rural energy business sector and integrate enterprise investments into their portfolios

To achieve the above objectives, AREED has the following components in its portfolio:

- Training and tools to help entrepreneurs start and develop energy businesses
- Enterprise start-up support in areas such as business planning, structuring and financing
- Seed capital for early stage enterprise development (US$25, 000–US$250, 000)
- Assistance in sourcing second stage financing
- Partnerships with banks and NGOs involved in rural energy development

Potential business opportunities include:

- Provision of energy to households, community, commercial/industrial applications using renewable energy (e.g. PV, Wind energy, mini and micro hydro and biomass based electric generation entities)
- Use of renewable energy in business in areas where there is no national grid for irrigation, manufacturing, processing etc.

AREED is a developmental initiative with innovative funding mechanism. When appropriate, some AREED projects may qualify for CDM leverage funding.

1.2.3.3 EU Synergy - CDM Capacity Building Amongst the Private Sector in Southern Africa

This is a project that has just been approved by the EU Synergy, and CEEEZ is one of the African partners. It is due to start at the beginning of 2002. Through the development of a practical step by step guide illustrating how to develop energy efficiency, co-generation and renewable energy investments projects under the Clean Development Mechanism (CDM) in S. Africa, Botswana Zambia, Mozambique, Swaziland, and Zimbabwe, this project aims to:

- Strengthen the security of electricity supply in the countries connected to the Southern African Power Pool (SAPP) by utilising the CDM to support energy efficiency, clean technology, renewable technology and co-generation.
- Develop CDM implementation capacity amongst public utilities and the private sector in Southern Africa.
- Develop consensus amongst countries in Southern Africa on how to access the new investment flows from north to south created under the CDM.
- Strengthen existing co-operative links and information exchange between countries connected to the SAPP and the region.

1.2.3.4 PCF Linkage

Prof. F. D. Yamba and the Director for Planning and Information, Ministry of Environment and Natural Resources, Mr. L. Aongola, attended a Prototype Carbon Fund (PCF) – World Bank Institute workshop in Kampala, Uganda from 6 – 8 June 2001. The objective of the workshop was to build capacity of the sub-Saharan African countries to implement PCF projects and to better understand the emerging carbon market. The World Bank's CDM ASSIST Program was also introduced at the workshop.

Mr. Cheikh Sylla of Senegal also attended the Workshop. The contact made with PCT will be useful in future through which industrial CDM Projects to be identified can be channels through for possible investment.

Chapter 2

Barrier Review

2.0 INTRODUCTION

This chapter considers a review of barriers. It begins with explaining the methodology employed in order to determine the barriers to industrial CDM implementation. The presentation and analysis of the results from the questionnaires then follows.

2.1 METHODOLOGY

Questionnaires were used to collect data which was analysed to come up with recommendations on barrier removal strategies.

In order to assist collect data and information required for barriers identification, and formulation of barriers removal strategy on one hand, and identification of potential industrial CDM projects, on the other, the following questionnaires were devised and introduced at the inception workshop in March 2001.

- Questionnaire on identification of barriers to the transfer of climate-friendly industrial technologies
- Questionnaires on identification of potential industrial CDM projects which included:
    - Questionnaires on methodological approach leading to identification of barriers through surveys and observations
    - Questionnaires on fuel consumption and related data

For the Lusaka area, preliminary visits were undertaken to distribute and discuss the questionnaires related to data collection and surveys. For those industries in Kabwe and the Copperbelt, the questionnaires were sent by post.

The July 2001 workshop, elaborated in Chapter 1, was used to complete discussions on the project in general and questionnaires in particular. All outstanding questionnaires were submitted during the workshop.

2.2 RESULTS AND ANALYSIS OF THE QUESTIONNAIRES

A database that contains results on the barriers to the transfer of climate-friendly industrial technologies received from individual companies is being compiled in a separate file. Table 1 shows the analysis of the results based on the submissions received from the companies.

Table 1: Analysis of Results from Submissions

A. Policy

Nature of The Barrier	Number for Yes (Positive)	Number for No (Negative)	% Yes	% No
Awareness on the need for energy efficiency from commercial/financial considerations at the following levels:				
• Management level	7	5	58.3	41.7
• Middle management level	5	6	45.5	54.5
• Operators Level	1	10	9.1	90.9
Awareness on CDM in general and its relation to business	4	8	33.3	66.7
Awareness on benefits to accrue from CDM in relation to energy efficiency	3	9	25	75
Existence of energy efficiency and conservation policy at company level	3	8	27.3	72.7
Awareness of the existence of government energy policy on energy efficiency	2	9	18.2	81.8
Expectations on benefits/incentives from government based on its energy efficiency policy	3	9	25	75
Existence of energy management department in your company	2	10	16.7	83.3
Existence of overall environmental policy in your company	7	5	58.3	41.7
Existence of cleaner production policy in your company	6	6	50	50
*Duty and VAT on Imported Energy Efficiency Equipment	1	6	14.3	85.7
Environmental Regulatory Structures	3	3	50	50
Codes and Guides on Energy Efficiency	1	5	16.7	83.3

* - means that companies are charged, and thus this is a barrier (hence negative)

B. Technological

Nature of The Barrier	Number for Yes (Positive)	Number for No (Negative)	% Yes	% No
Awareness and knowledge on availability of information on climate - friendly industrial technologies	3	8	27.3	72.7
Knowledge on selection of appropriate climate – friendly industrial technologies	2	9	18.2	81.8
Existence of a regular energy monitoring systems (energy audits) at company level.	4	7	36.4	63.6
Existence of skilled manpower to undertake energy audits	5	6	45.5	54.5
Existence of skilled manpower to undertake baseline calculations and assessment of sustainable development under CDM, and Financial Analysis.	2	9	18.2	81.8
Existence of manpower to implement projects identified under energy audits	5	7	41.7	58.3
Existence of instrumentation to undertake energy audits	3	7	30	70
Existence of regular surveys and observations for the following: • Combustion efficiency and optimisation • Steam and heat losses, compressed air and flue gas losses from steam distribution piping and uninsulated surfaces • Integration of regular maintenance related to energy activities	 1 1 3	 10 9 8	 9.1 10 27.3	 90.9 90 72.7
Existence of metering and/or flue gas analysis to improve combustion efficiency	0	11	0	100

Existence of flue gas analysis for CO, CO_2 and O_2 to determine combustion efficiency and air fuel ratio.	1	10	9.1	90.9
Existence of insulation of steam/heat distributing piping aimed at reducing heat losses	3	6	33.3	66.7
Existence of water treatment facilities and test equipment for determining boiler and feed water quality	2	3	40	60
Existence of steam condensate recovery system	1	4	20	80
Existence of pre-heating of combustion air	0	5	0	100
Existence of heat recovery systems	1	4	20	80
Availability of waste/wastewater from factory processes	3	3	50	50
Existence of automatic process control	3	3	50	50
Availability of planned and preventive maintenance – for boiler systems	3	3	50	50

C. Institutional/Financial

Nature of The Barrier	Number for Yes (Positive)	Number for No (Negative)	% Yes	% No
Does the need arise in your company to have support services for:				
• **Energy audits and analysis	4	7	36.4	63.6
• **Cleaning and services, and test equipment and water treatment facilities	6	5	54.5	45.5
• **Baseline calculations and assessment of sustainable development under CDM, and Financial Analysis	1	10	9.1	90.9
Availability of internal financial resources to implement energy efficiency measures	3	7	30	70
Availability of external financial resources to implement energy efficiency measures	0	10	0	100
Availability of financial resources/time to obtain information on energy efficiency	3	8	27.3	72.7
Are the prices of the fuel you use subsidised?	0	11	0	100

** - means that companies need assistance, and thus this is a barrier (hence negative)

Results of the group assessment and consensus on barriers to the transfer of climate-friendly technologies and recommended strategy for removal from the three groups at the workshop are given in Appendix E and F. Based on these results, a consolidated assessment on the same is given in Table 2.

Table 2: Consolidated group assessment on Barriers to the Transfer of Climate-friendly Industrial Technologies and Recommended Strategy Removal

Note: Priority (H - High, M - Medium, L - Low)

A. Policy

Nature of The Barrier	Group Assessment	Strategy	Priority
Awareness on the need for energy efficiency from commercial/financial considerations at the following levels: • Management level • Middle management level • Operators Level	Awareness generally existed Little awareness Does not exist	Awareness raising	H
Awareness on CDM in general and its relation to business	Mostly Non-existent	Awareness raising	H
Awareness on benefits to accrue from CDM in relation to energy efficiency	Mostly Non-existent	Awareness raising	H
Existence of energy efficiency and conservation policy at company level	Mostly no formalised policy existed	Awareness and introduction of policies	H
Awareness of the existence of government energy policy on energy efficiency	Low awareness	Awareness raising and also government intervention	H
Expectations on benefits/incentives from government based on its energy efficiency policy	Not aware	Awareness raising and also government intervention	H
Existence of energy management department in your company	Mostly not existent	Awareness raising, introduction and implementation	H
Existence of overall environmental policy in your company	Fairly existed	Awareness raising, introduction and implementation	H
Existence of cleaner production policy in your company	Fairly existed	Awareness raising, introduction and implementation	H
Duty and VAT on Imported Energy Efficiency Equipment	Duty and VAT existed	Lobby to govt. and government intervention	M

Environmental Regulatory Structures	Structures existed but enforcement weak	Enforcement	M
Codes and Guides on Energy Efficiency	Not existent	Formulation and implementation of energy efficiency codes and standards	M

B. Technological

Nature of The Barrier	Group Assessment	Strategy	Priority
Awareness and knowledge on availability of information on climate - friendly industrial technologies	Mostly not aware	• Information through creation of web-site (s) • Capacity building and knowledge base	M
Knowledge on selection of appropriate climate – friendly industrial technologies	Mostly non – existent	Capacity building	M
Existence of a regular energy monitoring systems (energy audits) at company level.	Mostly non – existent	Capacity building in energy audits, surveys and observations	H
Existence of skilled manpower to undertake energy audits	Potential exists	Requires capacity building	M
Existence of skilled manpower to undertake baseline calculations and assessment of sustainable development under CDM, and Financial Analysis.	Non – existent	Capacity building through 'learning-by-doing'	H
Existence of manpower to implement projects identified under energy audits	Little existed	Capacity building	H
Existence of instrumentation to undertake energy audits	Mostly non-existent	Acquisition of instrumentation equipment	H
Existence of regular surveys and observations for the following: • Combustion efficiency and optimisation • Steam and heat losses, compressed air and flue gas losses from steam distribution piping and un-insulated surfaces • Integration of regular maintenance related to energy activities	Mostly non existent	Capacity building and in-plant conduction of surveys and observations	H
Existence of metering and/or flue gas analysis to improve combustion efficiency	Mostly non existent	Capacity building, acquisition and installation	H

Existence of flue gas analysis for CO, CO_2 and O_2 to determine combustion efficiency and air fuel ratio.	Mostly non existent	Capacity building, acquisition of instrumentation and monitoring equipment	H
Existence of insulation of steam/heat distributing piping aimed at reducing heat losses	Fairly existed	Implementation	H
Existence of water treatment facilities and test equipment for determining boiler and feed water quality	Fairly existed	Implementation	M
Existence of steam condensate recovery system	Mostly non-existent	Implementation	H
Existence of pre-heating of combustion air	Non-existent	Implementation	H
Existence of heat recovery systems	Non-existent	Implementation	H
Availability of waste/wastewater from factory processes	Existed in most cases	Recover and produce methane (biogas), and use solid waste in advanced combustion equipment and steam based ICE	H
Existence of automatic process control	Fairly existed	Implementation	M
Availability of planned and preventive maintenance – for boiler systems	Fairly existed	Implementation	M

C. Institutional/Financial

Nature of The Barrier	**Group Assessment**	**Strategy**	**Priority**
Does the need arise in your company to have support services for: • Energy audits and analysis • Cleaning and services, and test equipment and water treatment facilities • Baseline calculations and assessment of sustainable development under CDM, and Financial Analysis	• Yes • No • Yes	Capacity building through 'learning-by-doing'	H
Availability of internal financial resources to implement energy efficiency measures	Not available	Source through CDM investment	H

Availability of external financial resources to implement energy efficiency measures	Not available	Source through CDM investment	H
Availability of financial resources/time to obtain information on energy efficiency	• Not available • But in most cases no internet facilities	• Creation of web-site • Acquisition of internet facilities and associated equipment and manpower	H
Are the prices of the fuel you use economic or subsidised?	Economic	Awareness on need for energy efficiency for the companies to be competitive	M

A database that contains the results for fuel consumption and related data leading to the identification of potential CDM projects received from individual companies is being compiled in a separate file. Based on these results, the analysis related to the type of fuels and fuel consumed per boiler/furnace/engine type and amount of waste emanating from the industry is given in Table 3.

Table 3: Type of Fuel and Fuel Consumed, Type of Waste and Amount of Waste

Category/Company	Type of Fuel	Units	Average Annual Fuel Consumption	Type of Waste	Unit	Monthly disposal
A. Food and Beverages						
Zambia Pork Products	Diesel	Tonnes	5	Animal Fat	Tonnes	3.33
Chat Breweries Ltd	Coal	Tonnes		Sludge		
				Waste Water		
Supa Oil	Coal	Tonnes	760	Seed husks	Tonnes	
Amanita Premier Oils Ltd	Coal	Tonnes	7133	Vegetable Oil Fats	Tonnes	
Nakambala Sugar	Baggase	Tonnes	270, 000	Baggasse	Tonnes	270, 000
	Coal	Tonnes				
Citizen Breweries	Coal	Tonnes		Malt Sludge		
				Maize Bran		
High Protein Foods	Coal	Tonnes	1200	Clinker Ash		
				Waste Water		
B. Leather and Textiles						
Mulungushi Textiles (Kabwe)	LFO	Tonnes	3000	Cotton Waste		
Sakiza Spinning Mills	LFO	Tonnes	11.4	Acrylic Fibre Waste	Tonnes	22.5
				Dust sweepings	Tonnes	
Mukuba Textiles Ltd						

C. Mining						
Nkana Smelter	Coal	Tonnes	53, 000			
	HFO		42, 000			
	Diesel		350			
	Paraffin		8500			
D. Cement						
Chilanga Cement	Coal	Tonnes				
E. Chemical/Processing						
Indeni Petroleum	LFO	Tonnes	9431	Oily Water (dry season)	m^3	150
				Oily Water (rainy season)	m^3	300
				Petroleum Solid Waste	Tonnes	16.67
TAZAMA Pipelines	Co-mingled Oil	Tonnes				
Nitrogen Chemicals	Coal	Tonnes				
Lever Brothers	Coal	Tonnes	3200	Waste Water		
	LFO	Tonnes	720			
Zambezi Paper Mills	LFO	Tonnes	176			
Central Cigarettes	Coal	Tonnes		Tobacco Waste		

Questionnaires on methodological approach leading to quantitative identification of barriers through surveys and observations and of plants aimed at determining

- Combustion efficiency optimisation
- Heat losses from un-insulated surfaces
- Heat recovery systems

were not possible. This was due to lack of monitoring and instrumentation equipment in most industries to measure various parameters required to determine the above identified factors.

Equally data on capital costs, and operations and maintenance (O + M) related to boiler/furnace infrastructure and overall plant and machinery and volume of products and their prices was also not made available. The reasons for this are valid. In some cases, this information was treated as confidential, whereas in others this information was either not available, but if available required more time and resources to identify, generate, and categorise in the required format.

A similar approach was made to the results for the group assessment and consensus on prioritisation of potential CDM projects. For this case, the results from the three groups are shown in Appendix D and the analysis is in Table 4.

Table 4: Consolidated Group Assessment on Prioritisation of Potential CDM Projects

Nature of Potential CDM Project	Selection of Potential CDM Project	Priority
(i) House Keeping • Observation of preventive maintenance measures to include combustion efficiency optimisation, and reduction of steam and heat losses from boilers and furnaces	Boiler/furnace improvements (energy efficiency)	H
(ii) Low Cost Measures • Combustion efficiency optimisation through institution of monitoring instrumentation to determine combustion efficiency • Use of heat recovery for pre-heating of combustion air • Boiler operation/process optimisation and control	Boiler/furnace improvements and retrofits	H
(iii) Retrofit/Capital Based Measures • Application of potential heat recovery systems for steam generation for different applications (electricity, process steam etc) • Use of waste material such as waste water/sludge from food and beverages industries to produce biogas (methane) for generation of power and heat. • Use of waste material such as bagasse, industrial/forestry waste in advanced state-of-the-art technologies (CEST) and biomass electric generating plants to produce heat and power • Use of LGP from flared gas at Indeni • Use of biomass resources in high pressure boilers • Use of hydro based electricity to produce steam in electric boilers • Recovery of CO_2 from cement processing operations	❑ Boiler/furnace improvements and retrofits ❑ Generation of biogas from waste water for combustion in boilers ❑ Use of solid and gaseous waste in advanced combustion equipment and steam based ICE ❑ Use of LPG for combustion in boilers to substitute hydrocarbons/coal fuels ❑ Co-generation for power and heat based on biomass resources ❑ Conversion of hydrocarbon/coal fuels boilers into electrical ❑ CO_2 recovery from cement processing	H

Note: Priority (H - High, M - Medium, L - Low)

Chapter 3
Barrier Removal Strategy

3.0 INTRODUCTION

The main objective of the barrier removal strategy is to formulate strategies/outputs, and activities needed for the removal of barriers to the transfer of environmentally friendly technologies. The strategy being recommended is based on the barriers that have been identified in the preceding sections.

As a result of findings of the preceding sections, the main strategies being recommended include:

- Awareness programme for industrial stakeholders and financial institutions
- Capacity building for industrial stakeholders through 'learning by doing' in energy audits, surveys and observations leading to elaboration of industrial CDM projects.
- Capacity building for industrial stakeholders in the preparation of bankable CDM projects
- Information creation on the availability of environmentally friendly technologies
- Enabling environment for the implementation of CDM projects

3.1 AWARENESS PROGRAMME

Institute an awareness programme to industrial stakeholders aimed at inculcating to all levels of management, and financial institutions on the need for energy efficiency policies, programmes and practices, and economic/financial and environmental benefits to accrue through implementation of CDM projects. The strategy is aimed at facilitating the following:

- Awareness on the need for energy efficiency from commercial/business considerations
- Awareness on CDM in general and its relationship to business
- Awareness on benefits to accrue from CDM in relation to energy efficiency
- Awareness on the need for energy efficiency and conservation policy at company level
- Awareness raising on the existence of government energy policy on energy efficiency
- Awareness raising on expectations, benefits/incentives from government based on its energy efficiency
- Awareness raising on the need for energy management department at company level

3.2 CAPACITY BUILDING

3.2.1 Capacity Building to Middle Management in Energy Audits, Surveys and Observations

This strategy involves institution of capacity building to middle management of identified companies through 'learning-by-doing' in energy audits, surveys and observations leading to elaboration of CDM projects. The strategy is aimed at facilitating the following:

- Existence of regular monitoring systems at company level
- Training opportunities for existing skilled manpower to undertake energy audits
- Availability of monitoring equipment and instrumentation to undertake energy audits, surveys and observations for the following:

- Combustion efficiency and optimisation
- Steam and heat losses and flue gas losses from steam distribution piping and un-insulated piping
- Integration of regular maintenance related to energy activities
- Data collection for design of heat recovery systems and identified potential CDM projects

3.2.2 Capacity Building to Industrial Stakeholders on Preparation of Bankable CDM Projects

This strategy involves developing capacity for middle managers of industrial stakeholders in the preparation of CDM bankable projects. Though 'learning-by-doing', the project will assist facilitate the following:

- Collection of data required to undertake techno-economic feasibility and baseline assessment
- Baseline additionality and industrial sustainable development calculations and assessment of identified potential projects
- Preparation of bankable projects

3.3 INFORMATION CREATION

The strategy involves creation of an information base on availability and technology characteristics of environmentally friendly technologies. The strategy aims at facilitating the following:

- provision of information on climate friendly technologies
- Provision of opportunities to access, select, input and adapt appropriate climate friendly technologies.

3.4 ENABLING ENVIRONMENT

The strategy involves creation of an enabling environment for implementation of the CDM project cycle and CDM investment. The strategy aims at facilitating the following:

- Formalisation of the current CDM project base institutional set up and designation as a national CDM Authority
- Policy intervention to facilitate CDM investment in the following:
  - Advocacy on harmonisation of policy on eligibility of energy efficiency projects under the OPPPI arrangements for incentives and waiver on duty and VAT on imported energy efficiency equipment
  - Advocacy on enforcement of exiting environmental regulatory laws
  - Contribution to formulation of codes and guides on energy efficiency
  - Advocacy on improvement of macro-economic conditions currently characterised by large inflation and interest rates

3.5 SUMMARY OF BARRIERS, BARRIER REMOVAL STRATEGY, IMPLEMENTING ACTORS AND PRIORITY

The following table gives the summary of the findings on barriers barrier removal strategy, implementing actors and priorities.

Table 5: Barriers, Barrier Removal Strategy, Implementing Actors And Priority

A. Policy

Nature of The Barrier	Removal Strategy	Implementing Actor	Priority	Complexity	Likelihood of Implementation	Expected Speed of Implementation
Awareness on the need for energy efficiency from commercial/financial considerations at the following levels: • No formalised awareness at management level • Little awareness at middle management level • Lack of awareness at operators Level	Awareness raising	❑ Industrial stakeholders ❑ CDM Secretariat	H	H	M	Slow
Lack of awareness on CDM in general and its relation to business	Awareness raising	❑ Industrial stakeholders ❑ CDM Secretariat	H	H	M	Slow
Lack of awareness on benefits to accrue from CDM in relation to energy efficiency	Awareness raising	❑ Industrial stakeholders ❑ CDM Secretariat	H	H	M	Slow
Lack of existence of energy efficiency and conservation policy at company level	Awareness and introduction of policies	Industrial stakeholders	H	H	M	Slow
Lack of awareness of the existence of government energy policy on energy efficiency	Awareness raising and also government intervention	❑ Government (Department of Energy) ❑ Industrial stakeholders	H	M	M	Slow

Lack of awareness on expectations on benefits/incentives from government based on its energy efficiency policy	Awareness raising and also government intervention	❑ Government (finance, commerce and energy) ❑ Industrial stakeholders	H	M	M	Medium slow
Lack of existence of energy management department in your company	Awareness raising, introduction and implementation	❑ Industrial stakeholders	H	M	M	Medium slow
Fair existence of overall environmental policy in your company	Awareness raising, introduction and implementation	❑ Industrial stakeholders ❑ Environmental Council of Zambia (ECZ)	H	M	M	Medium slow
Fair existence of cleaner production policy in your company	Awareness raising, introduction and implementation	❑ Industrial stakeholders ❑ ZACCI	H	M	M	Medium slow
Existence of Duty and VAT on Imported Energy Efficiency Equipment	Lobby to govt. and government intervention	❑ Government (finance and energy) ❑ Industrial stakeholders	H	H	M	Slow
Weak Environmental Regulatory Structures	Enforcement	❑ ECZ ❑ Industrial stakeholders	H	M	M	Medium slow
Lack of Codes and Guides on Energy Efficiency	Formulation and implementation of energy efficiency codes and standards	❑ ERB ❑ Bureau of Standards ❑ Industrial stakeholders	H	H	M	Slow

No Clear policy on eligibility of energy efficiency projects under the OPPPI arrangement	Inclusion of incentives on energy efficiency	❑ Ministry of Energy and Water Development ❑ ZACCI ❑ Industrial stakeholders	M	M	M	Slow
Poor macro economic conditions characterised by high inflation and interest rates	Overall improvement of the economy	❑ Government	M	M	M	Slow

B. Technological

Nature of The Barrier	Removal Strategy	Implementing Actor	Priority	Complexity	Likelihood of Implementation	Expected Speed of Implementation
Lack of awareness and knowledge on availability of information on climate - friendly industrial technologies	• Information through creation of web-site (s) • Capacity building and knowledge base	• Industrial stakeholders • CDM secretariat	M	M	M	Medium slow
Lack of knowledge to access, select, import and adapt appropriate climate – friendly industrial technologies	Capacity building	• Industrial stakeholders • CDM secretariat	M	M	M	Medium slow
High transaction costs to obtain information	• Creation of website • Creation of technology information desk at CDM secretariat	• Industrial stakeholders • CDM secretariat				
Lack of existence of a regular energy monitoring systems (energy audits) at company level.	Capacity building in energy audits, surveys and observations	• Industrial stakeholders • CDM secretariat	H	M	M	Medium slow
Fair existence of skilled manpower to undertake energy audits	Capacity building	• Industrial stakeholders • CDM secretariat	M	M	M	Medium slow

Lack of existence of skilled manpower to undertake baseline calculations and assessment of sustainable development under CDM, and Financial Analysis.	Capacity building through 'learning-by-doing'	• Industrial stakeholders • CDM secretariat	H	M	M	Medium slow
Little existence of manpower to implement projects identified under energy audits	Capacity building	• Industrial stakeholders • CDM secretariat	H	M	M	Medium slow
Lack of existence of instrumentation to undertake energy audits	Acquisition of instrumentation equipment	• Industrial stakeholders • CDM secretariat	H	M	M	Medium slow
Non-existence of regular surveys and observations for the following: • Combustion efficiency and optimisation • Steam and heat losses, compressed air and flue gas losses from steam distribution piping and un-insulated surfaces • Integration of regular maintenance related to energy activities	Capacity building and in-plant conduction of surveys and observations	• Industrial stakeholders • CDM secretariat	H	M	M	Medium slow
Lack of existence of metering and/or flue gas analysis to improve combustion efficiency	Capacity building, acquisition and installation	• Industrial stakeholders • CDM secretariat	H	M	M	Medium slow
Lack of existence of flue gas analysis for CO, CO_2 and O_2 to determine combustion efficiency and air fuel ratio.	Capacity building, acquisition and installation	• Industrial stakeholders	H	M	M	Medium slow
Lack of existence of insulation of steam/heat distributing piping aimed at reducing heat losses	Implementation	• Industrial stakeholders	H	M	M	Medium slow
Fair existence of water treatment facilities and test equipment for determining boiler and feed water quality	Implementation	• Industrial stakeholders	M	M	M	Medium slow

Lack of existence of steam condensate recovery system	Implementation	• Industrial stakeholders	H	M	M	Medium slow
Lack of existence of pre-heating of combustion air	Implementation	• Industrial stakeholders	H	M	M	Medium slow
Lack of existence of heat recovery systems	Implementation	• Industrial stakeholders	H	M	M	Medium slow
Non – consideration of use of waste/wastewater from factory processes	Recover and produce methane (biogas), and use solid waste in advanced combustion equipment	• Industrial stakeholders	H	M	M	Medium slow
Lack of existence of automatic process control	Implementation	• Industrial stakeholders	M	M	M	Medium slow
Lack of planned and preventive maintenance – for boiler systems	Implementation	• Industrial stakeholders	M	M	M	Medium slow

C. Institutional/Financial

Nature of The Barrier	Removal Strategy	Implementing Actor	Priority	Complexity	Likelihood of Implementation	Expected Speed of Implementation
Does the need arise in your company to have support services for: • Energy audits and analysis – Yes • Cleaning and services, and test equipment and water treatment facilities - No • Baseline calculations and assessment of sustainable development under CDM, and Financial Analysis – Yes	Capacity building through 'learning-by-doing'	• Industrial stakeholders • CDM secretariat	H	M	M	Medium Slow
Lack of availability of internal financial resources to implement energy efficiency measures	Source through CDM investment	• Industrial stakeholders • CDM secretariat	H	H	M	Medium Slow

Lack of availability of external financial resources to implement energy efficiency measures	Source through CDM investment	• Industrial stakeholders • CDM secretariat	H	H	M	Slow
Lack of availability of financial resources/time to obtain information on energy efficiency	• Creation of web-site • Acquisition of internet facilities and associated equipment and manpower	• Industrial stakeholders • CDM secretariat	H	H	M	Slow
Are the prices of the fuel you use economic or subsidised? – Economic	Awareness on need for energy efficiency for the companies to be competitive	• Industrial stakeholders • CDM secretariat	M	H	M	Slow
Lack of sustainable CDM institutional set up.	Formalisation of institutional set up into a national authority	• Ministry of Environment and Natural Resources • Cabinet Office	H	H	H	Slow

Chapter 4

National Programme

4.0 INTRODUCTION

This chapter presents the four themes: their objectives, expected outputs and activities.

4.1 THEMES

The main themes under the national programme component include:

- Awareness
- Capacity building
- Information creation
- Enabling environment

4.2 AWARENESS

4.2.1 Objective

The objective of the component is to develop a process for stakeholders awareness to enable them realise the opportunities and benefits through implementation of the CDM regime.

4.2.2 Outputs

- Website on climate change/CDM and industry
- Newsletter
- Workshops for sensitisation
- Well informed stakeholders

4.2.3 Activities

The activities under the strategy would encompass the following:

- Develop training packages on energy efficiency and its linkage to CDM
- Conduct two awareness workshops (one in Lusaka and the other in the Copperbelt) to senior management of identified companies on energy efficiency and its linkage to CDM.
- Conduct one workshop for middle managers of identified companies
- Conduct two workshops to traditional banks on CDM and its linkage to energy efficiency
- Creation of website and infrastructure sharing
- Periodic publication of news letters

4.3 CAPACITY BUILDING

4.3.1 Objectives

The objectives of capacity building under this component are twofold:

(i) To develop capacity for identified stakeholders for elaboration of identified CDM projects through energy audits, surveys and observations
(ii) To develop capacity for identified stakeholders in the preparation of CDM bankable projects

4.3.2 Outputs

4.3.2.1 Outputs for Objective (i)

- Training package
- Portable gas analysis and monitoring equipment
- Data required for baseline assessment
- Data for design of heat recovery and condensate systems and identified CDM projects
- Data on current levels of investment requirement, and O + M
- Baseline methodology
- Well informed stakeholders on elaboration of CDM projects

4.3.2.2 Outputs for Objective (ii)

- Techno-economic/financial study/package
- Baseline and additionality study/package
- Sustainable development study/package
- CDM Project design document

4.3.3 Activities

4.3.3.1 Activities for Objective (i)

- Training package on energy audits, surveys and observations.
- Acquisition of two sets of portable gas analysis equipment (for CO, CO_2, O_2 and NO_x) and monitoring equipment (for surface and in-situ temperature, flow rate of air, fuel and flue gas measurements). One set would be for the Midlands (Lusaka) region while the other would be for the Copperbelt region.
- Conduction of training at plant level leading to the elaboration of the following:
  - Combustion efficiency and optimisation
  - Steam and heat losses and flue gases from piping and un-insulated surfaces
  - Integration of maintenance that is related to energy activities.
  - Use of heat recovery systems for heat and power generation
  - Recovery of steam condensate
  - Determination of water/waste water
- Collection of related data (e.g. fuel consumption) needed in the elaboration of baseline calculations
- Determination of current levels of investment requirements, and O + M related to the baseline situation
- Workshops and discussions at plant level
- Two workshops for industrial stakeholders

Technology assessment and selection for identified CDM projects

4.3.3.2 Activities for Objective (ii)

- Training package on preparation of bankable proposals
- Acquisition of UNIDO Identify and COMFAR tools
- Identification of technology suppliers
- Determination of investment and O + M requirements
- Baseline and environmental calculations
- Techno-financial analysis
- Assessment of sustainable industrial development indicators
- Formulation of monitoring and verification protocol
- Preparation of CDM bankable proposals
- Validation of identified CDM projects
- Undertake carbon market negotiation capacity
- Identify and establish contacts with CDM investors

Computer packages available include MESAP, Identify, COMFAR and GACMO.

4.4 INFORMATION CREATION

4.4.1 Objective

The objective of this component is to create an information base on availability and technology characteristics of environmentally friendly measures and technologies.

4.4.2 Outputs

- Website
- Information desk at CDM Secretariat
- Newsletter

4.4.3 Activities

- Website creation
- Creation of Information Desk at the CDM Secretariat
- Publication of Quarterly News Letter

4.5 ENABLING ENVIRONMENT

4.5.1 Objective

The objective is to create an enabling environment for implementation of CDM cycle and CDM investment.

4.5.2 Outputs

- Harmonised policy and incentives for energy efficiency projects under OPPPI
- Enforcement of conventional environmental and regulatory national laws.
- Code and guide under energy efficiency

4.5.3 Activities

- Provision of support for the functioning of both the CDM sub-committee and CDM secretariat for approval of CDM projects and technical assistance to project promoters on CDM project cycle, respectively.
- Approval of CDM projects
- Determination of criteria for project eligibility
- Approval of rules and guidelines for the CDM project cycle and industrial sustainable development indicators
- Undertake policy intervention by CDM sub-committee on harmonisation of policy and incentives for energy efficiency under OPPPI regime
- Formulation of code and guide for energy efficiency by the Energy Regulation Board (ERB)
- Enforcement of environmental and regulatory national laws by Environmental Council of Zambia (ECZ)

5.1 IDENTIFICATION OF POTENTIAL CDM PROJECTS

Given in Table 7 is a portfolio of potential industrial CDM project which have been identified with active participation from stakeholders.

Table 7: Identification of CDM Projects

Category/Company	Projects							Others
	Boiler/ furnace improvements and retrofits	Generation of biogas from waste water for combustion in boilers	Use of solid and gaseous waste in advanced combustion equipment	Use of LPG for combustion in boilers to substitute hydrocarbons/ coal fuels	Co-generation for power and heat based on biomass resources	Conversion of hydrocarbon/ coal fuels boilers into electrical	CO_2 recovery from cement processing	
A. Food and Beverages								
Zambia Pork Products	X	X		X		X		
Chat Breweries Ltd	X	X		X		X		
Supa Oil	X			X		X		
Amanita Premier Oils Ltd	X	X		X		X		
Nakambala Sugar	X				X	X		
Citizen Breweries	X	X		X		X		
High Protein Foods	X	X		X		X		
B. Leather and Textiles								
Mulungushi Textiles (Kabwe)	X		X	X		X		
Sakiza Spinning Mills	X		X	X		X		
Mukuba Textiles	X		X	X		X		
C. Mining								
Nkana Smelter	X			X		X		

D. Cement								
Chilanga Cement Plc	X						X	
E. Chemical/Processing								
Indeni Petroleum	X	X		X		X		
TAZAMA Pipelines	X			X		X		
Nitrogen Chemicals	X	X		X				
Lever Brothers	X	X		X		X		
Zambezi Paper Mills	X		X	X		X		
Central Cigarettes	X		X	X		X		

From the table, it is clear that the range of companies can be divided into four categories namely:

- Food and Beverages encompassing a good number of medium small-scale companies and a relatively large one (Nakambala Sugar Plc).
- Leather and Textiles
- Mining, particularly concentrating on processing (Nkana Smelter)
- Cement Manufacture (Chilanga Cement)
- Chemical/processing

5.2 DESCRIPTION OF POTENTIAL CDM PROJECTS

5.2.1 Boiler/furnace improvements and retrofits

Boiler/furnace improvements and retrofits involve implementation of housekeeping and medium cost measures.

5.2.1.1 House Keeping

House keeping measures include investment in combustion efficiency optimisation of boiler/furnace systems and reduction of steam and heat losses from the same. These measures include installation of fuel and air monitoring equipment and/or gas analysis equipment to ensure that combustion efficiency is optimised. The measures will also include installation of insulation to un-insulated surfaces of steam distribution systems and furnaces. These measures are likely to result in fuel savings of between 20% and 30%.

5.2.1.2 Medium Cost Measures

Medium cost measures involve installation of automatic control systems between the steam supply and process operations, heat exchangers using recovered heat for pre-heating combustion air and economisers, all aimed at reducing fuel consumption and improving on combustion efficiency. Other measures include upgrading/installation of improved burner systems and recovery of condensate.

5.2.2 Generation Of Biogas From Waste Water For Use In Boilers

The process involves use of waste water, mainly from food and beverage industry, through the processes of slurry formation followed by fermentation from which methane is generated which can be used in boilers for combustion to produce steam. During the same process, effluent is also recovered which can be used as fertiliser. Detailed description of the process is given in Appendix G.

5.2.3 Use Of Waste In Advanced Combustion Equipment Related To Steam Generation

Waste (solid or gaseous) generated from industries, especially the textile industry can be used in specially designed burner heads to produce heat to generate steam through the combustion process. The burner heads and associated equipment can be connected to either new or existing installations. Given in Appendix H is the detailed process. The same steam produced can also be used in steam based internal combustion engines (ICE) as shown in Appendix I.

5.2.4 Use Of LPG For Combustion In Boilers

Liquefied Petroleum Gas (LPG) is a good fuel substitute for hydrocarbon/coal fuels in boilers. Indeni, a petroleum refinery in Zambia, has a capacity of processing up to one million tonnes of crude oil into fuel constituents namely gasoline, diesel, fuel oil and kerosene. During this process, the remaining constituent of the original feedstock is flared into the atmosphere. The flared gas can be compressed into LPG and used as a fuel in boilers and other applications. It is estimated that between 5 to 10% of the original feedstock is flared, and this constitutes a significant output from the refinery if it can be recovered.

5.2.5 Co-Generation Based On Biomass Resources

Biomass resources such as baggasse from the sugar industry can be used in the state-of-the-art technologies called the Condensing Extraction Steam Turbines (CEST) to produce more steam and electricity to meet not only the needs of the factory but with surplus electricity which can be exported to the national grid. These systems operate at high pressures, and significantly increase electricity production at sugar factories. A typical CEST operates at 4.0 – 6.0 MPa as compared to 1.2 to 2.5 MPa for traditional boilers. Given in Appendix J is the detailed description of the system.

5.2.6 Conversion Of Hydrocarbon/Coal Fuel Boilers To Hydro Based

Since Zambia is 95% hydro electricity based, most liquid hydrocarbons/coal fuels boilers can be converted into electric ones. Success of this conversion will depend on the economics of conversion and policy intervention for the same in as far as tariffs and taxes are concerned.

5.3 PRELIMINARY BASELINE ISSSUES AND CALCULATIONS

5.3.1 Preliminary Baseline Issues

5.3.1.1 Project Identification Process

The choice of identified potential industrial CDM Projects was mainly considered at two levels: At national level and industrial/company level.

At the national level, and taking note of the potential benefits from CDM, the choice was largely influenced by national development aspirations through the economic need to bring back on track most of the industrial companies, which have been struggling as a result of globalisation. As a result of adoption of the free market and liberalised economy by the government on one hand, and removal of protection from outside competition on the other, a majority of industrial companies have either closed or are struggling to survive. One of the reasons identified for this scenario is their being uncompetitive to imported goods and services. The other factor influencing the choice of potential CDM projects is that Zambia is 95% hydro electricity based.

At industrial company level, the approach adopted in an attempt to benefit from CDM was that of bottom up approach through involvement of industrial stakeholders to identify potential industrial CDM projects. The choice at this level was largely influenced by financial considerations through the need to reduce production costs related to energy use, in this case, hydrocarbon and coal, whose prices are charged at economic levels. Technical considerations for choice of the projects were largely influenced by technical status of production infrastructure related to energy use, use of waste water/solid waste to generate internally substitute fuels, and also take advantage of other fuel substitutions like LPG from domestic external source.

5.3.1.2 Project Appraisal Criteria

As part of the phase II activities, it was also found essential to identify key criteria against which identified projects should be appraised, to ensure that the objectives of CDM, in particular those related to attainment of sustainable development and environmental integrity are realised. These criteria and guidelines include:

- Sustainable industrial development
- Project emission boundaries
- Environmental additionality and baselines
- The effects of CERs on project economics

However, due to limited resources and time under this phase, treatment of the criteria and guidelines identified above could not be sufficiently covered, and will be elaborated further under Phase III. Given in the following sections, however, are preliminary thoughts and suggestions.

Sustainable Industrial Development

According to Article 12 of the Kyoto Protocol, the purpose of CDM is, inter lia, to assist Non-Annex Countries to achieve their sustainable development objectives. Although sustainable development remains a rather complex concept, and open to many interpretations, UNIDO's definition of sustainable industrial development which encompasses;

- Competitive economy
- Productive employment
- Protection of the environment

is relevant to the country's and private sectors' aspirations and requires elaboration under Phase III.

The main objective of Phase III would be to study various ranking approaches for assessment of sustainable industrial development, which include among others:

- Multi-criteria Analysis (MCA), which in turn include preferential, normal, ordinal and rating ranking
- Pair wise ranking
- Decision hierarchy

and allow us to understand and clarify the main economic, environmental and social benefits associated with the identified projects.

As part of preliminary assessment of the identified projects, some of the common form of benefits identified included:

- Contributing to competitiveness at micro level (Industry level)
- Positive effects on the trade balance
- Improved local economy (effects on GDP)
- Reduction of Energy intensity at micro level
- Local air quality improvements
- Transfer of technology
- Employment gains
- Capacity building (e.g. transfer of technical skills)

Project Emissions Boundaries

Project Emissions Boundaries involves consideration of direct and indirect emission sources, and their effect on baselines. During formulation of the identified projects, an attempt was made to define some aspects of the definition of appropriate emissions boundaries..

Environmental Additionality and Baselines

Environmental additionality is a key requirement for CDM projects under article 12 of the Kyoto Protocol. Under this article, projects are required to realise real, reasonable and long-term reductions in GHG that are additional to any that would have occurred in the absence of the project.

This is the most difficult conditionality to define, particularly to answer the justification of why a CDM project is additional.

One of the possible options to assist assess environmental additionality if the use of the "barrier approach". The barriers that could be used for distinction are:

(i) Financial,
(ii) Technological,
(iii) Knowledge related,
(iv) Institutional and
(v) Cultural

In order to determine what would have occurred in the absence of the identified project, a baseline has to be established upon which basis emissions reductions are then considered additional when projects emissions are lower than those estimated for the baseline case. Once a baseline has been established and the volume of emission credits determined, the next stage is that of checking their accuracy. Whilst there is currently no approved calculations the following approaches have to be considered when finally defining the baseline of identified projects during phase III:

- Project specific to include investment analysis, control groups method and scenario analysis.
- Multi-Project standardised approaches to include benchmarking and technology mix.
- Hybrid

Use of any of these approaches require a lot of data needs which can not fully be obtained under phase II and therefore they have to be accomplished in phase III.

The Effects of Emissions on Project Economics

Most investors particularly those in private sector will be attracted to invest in CDM projects because of the extra income that will arise form sale of credits. Sale of credits could also assist financially unviable projects become viable through improvement of financial performance indicators such as IRR and NPV.

Therefore the principal factors that will determine the effects of credits on the economics of the projects are:

- Quantity of credits generated,
- Transaction costs associated with generating credits under the CDM requirements, and
- The sale price over time

To determine the effects of project economics equally require a lot of data such as,

- Capital investment cost under the baseline and mitigation scenarios
- O + M for both baseline and mitigation situations

to arrive at determining IRR and NPV for identified projects. Therefore, the effects of credits on project economics through incorporation of net revenue from emissions reductions into the project discounted cash flow and the impact on NPV and IRR can only be fully undertaken in phase III.

Given in Appendix I are some aspects of preliminary assessments of each of the identified projects against the project approval criteria outlined in this section. Detailed assessment can only occur in phase III once all the data requirements have been fulfilled.

5.3.2 Preliminary Baseline Calculations

From the surveys undertaken, two types of fuels (liquid (diesel, HFO, LFO) and solid (coal, biomass) fuels) have been identified to be in use in boilers and furnaces for combustion to produce steam, and heat generation, respectively. CO_2 emissions from these sources and identified industries have been calculated using the IPCC methodology given below:

In accordance with IPCC methodology (1996 guidelines), CO_2 emissions are calculated using the following equation:

CO_2 (tonnes) = [(Fuel consumed – carbon stored) x (energy conversion factor) x (carbon factor) x (% carbon oxidised)] x $^{44}/_{12}$

Fuel consumed – tonnes
Energy conversion – GJ/tonne
Emission factor – Kg C/GJ

It is assumed that carbon stored in this case is zero.

Based on this equation, baseline CO_2 calculations are provided in the table below.

Table 8: Preliminary Calculations for CO_2 Emissions

Category	Company	Type of Fuel	Annual Fuel Consumption (Tonnes)	Annual CO_2 Emissions (Tonnes)
Food and Beverages	Chat Breweries Ltd	Coal		
	Citizen Breweries Ltd	Coal		
	High Protein Ltd	Coal	1200	3027.10
	Amanita Premium Oils Ltd	Coal	7133	17993.60
	Indeco Milling Ltd			
	Supa Oil Industries Ltd			
	Zambia Pork Products Ltd	Diesel	5	15.7
		Gas Oil		
Leather and Textiles	Mulungushi Textiles Ltd	LFO	3000	9409.45
	Sakiza Spinning Ltd	LFO	11.4	35.76
	Mukuba Textiles Ltd			
Mining / processing	Nkana Smelter	Coal	53000	133696.99
		HFO	42000	131314.1
		Diesel	350	1097.7
		Kerosene	8500	26210.2
	British American Tobacco (Z) Ltd	Coal		
	Indeni Petroleum Refinery	LFO	9431	29580.17
	Nitrogen Chemicals Ltd	Coal		
Cement	Chilanga Cement Plc	Coal		
Chemical/Processing	Nakambala Sugar Plc			
	Lever Brothers	Coal	3200	8072.27
		LFO	720	2258.27
	Zambezi Paper Mills	176	552.02	
	TAZAMA Pipelines Ltd	LFO		
Others				

APPENDIX A

SCOPE OF ACTIVITIES AND WORK PLAN

Table A.1: Scope of Activities and Work Plan

ACTIVITY	MONTH (2001)								
	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1. Finalisation of questionnaires									
2. Data collection through surveys on identification of barriers to the transfer of climate friendly technologies based on provided questionnaires									
3. Surveys to collect data on fuel consumption and related data based on provided questionnaire									
4. Surveys and observations based on provided manual leading to identification of potential CDM Projects									
5. Field visits to discuss progress and related problems and collect questionnaire									
6. Stakeholders' workshop to discuss results of surveys and determine way forward on barrier removal strategy and identification of potential CDM projects									
7. Finalisation of barrier removal strategy									
8. Technology identification including investment requirements for identified potential CDM projects and opportunities									
9. Preliminary baseline calculations for identified potential CDM projects									
10. Prepare and review draft of national programme									
11. Participate in regional workshop									
12. Finalisation of national integrated programmes									
13. Participate in side event at CoP7									
14. Project conclusion and debriefing									

APPENDIX B

LIST OF PARTICIPANTS OF THE FIRST CDM UNIDO PHASE II AFRICA WORKSHOP HELD ON 9TH MARCH 2001 IN ZAMBIA AT MUKUBA HOTEL IN NDOLA, COPPERBELT PROVINCE

NAME	ORGANISATION	TITLE	CONTACT INFORMATION
Mr. Ernest C. Sailande	Citizen Brewery Limited	Accountant	P. O. Box 31165, Lusaka Tel : 260 – 1 – 286669 Fax: 260 – 1 - 292973 Cell: 260 - 97 - 778541
Mr. Newton C. Samangwe	Central Cigarette Manufacturers Ltd	Factory Manager	P. O. Box 31062, Lusaka Tel: 260 – 1 – 242809 Fax: 260 – 1 – 241602 Cell: 260 – 97 – 798068
Mr. Kennedy K. Mwenya	Chilanga Cement Plc	Works Technical Manger	P. O. Box 32639, Lusaka Chilanga Tel: 260 – 1 279029/41 Cell: 260 – 96 – 758281 Fax: 260 – 1 – 278440/278134 Email: kmwenya@chilanga.zm
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Mr. Elias Musonda	Chat Breweries Ltd	Chief Engineer	P. O. Box 31924, Chinika, Lusaka Tel: 260 – 1 – 287768 Cell: 260 – 96 434546
Mr. Derrick D. Mwanza	Zambezi Paper Mills Ltd	Human Resources Manager	P. O. Box 71400, Ndola Tel: 260 – 2 – 650210/650318 Fax: 260 – 2 650401/650137 Email: zpm@zamnet.zm
Mr. Angel Lungu	Indeco Milling Limited	General Manager	P. O. Box 70406, Ndola Tel: 260 – 2 – 610273 Fax: 260 – 2 - 651912/620630
Mr. Cecil Chamululu	Mines Safety Department	Chief Inspector of Mines	P. O. Box 21006, Kitwe Tel: 260 – 2 – 227160 Fax: 260 – 2 – 220503 Email: msd@zamnet.zm
Mr. Evans Mauta	Indeni Petroleum Refinery	Manager – Processing and Control	P. O. Box 71869, Ndola Tel: 260 – 2 – 655421 Fax: 260 – 2 – 655177 Email: emauta@hotmail.com

Mr. David S. Lungu	Zambia National Oil Company	Assistant Terminal Manager	P. O. Box 71588, Ndola Tel: 260 – 1 – 655117 Fax: 260 – 1 – 655780 Email: znocft@zamnet.zm
Mr. Patrick Musenyesa	Tazama Pipelines Limited	Regional Manager	P. O. Box 71651, Ndola Tel: 260 – 2 – 655134 Cell: 260 – 96 – 784319 Email Tamamamd@zamnet.zm
Mr. Daniel M. Mukonde	Institute of Waste Management – Zambia Chapter	Projects Manager	21st Floor, Findeco House, Cairo Road, P. O. Box 33057, Lusaka. Tel: 260 – 1 – 220460 Cell: 260 – 95 – 708522 Fax: 260 – 1 – 220460 Email: Morgan.Mukonde@undp.zm
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Mr. Mumba Sydney	Copperfields Brewing Co. Ltd	Head of Engineering	Plot No. 6357, Kafulafuta Road, Industrial Area, P. O. Box 22878, Kitwe Tel: 260 – 2 – 216881 Fax: 260 – 2 – 216881 Email: greytown@yahoo.com
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Mr. Charles Mulenga	Department of Energy	Energy Economist	P. O. Box 36079, Lusaka Tel: 260 – 1 – 251337 Fax: 260 – 1 – 254491/252339 Email: doe@zamnet.zm (official) colives@yahoo.com (official)
Mr. Reuben Mulenga	Nitrogen Chemicals of Zambia Ltd	General Manager	P. O. Box 360226, Kafue. Tel: 260 – 1 – 312279 Fax: 260 – 1 – 312061

CDM UNIDO AFRICA PHASE II VISITING TEAM

Mr. Peter Pembleton (UNIDO - Austria)
Dr. Pim Kieskamp (ETC – The Netherlands)

CDM UNIDO AFRICA PHASE II NATIONAL TEAM - ZAMBIA

Prof. Francis D. Yamba (CEEEZ)
Mr. D. J. Mbewe (CEEEZ)
Mr. A. A. Phiri (CEEEZ)
Mr. Emmanuel Matsika (CEEEZ)

APPENDIX C

LIST OF PARTICIPANTS OF THE SECOND CDM UNIDO PHASE II AFRICA WORKSHOP HELD ON 27TH JULY 2001 IN ZAMBIA AT MUKUBA HOTEL IN NDOLA, COPPERBELT PROVINCE

NAME	ORGANISATION	TITLE	CONTACT INFORMATION
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Mr. Newton C. Samangwe	British American Tobacco (Former Central Cigarettes)	Factory Manager	BAT, P. O. Box 31062, Lusaka Tel: 260 – 1 – 242809 Fax: 260 – 1 – 241602 Cell: 260 – 97 – 798068
Mr. Steven B. Mhango	Zambia Pork Products Ltd	Maintenance Manager	P. O. Box 31405, Lusaka Cell: 260 – 96 – 756074
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Mr. Reuben Mulenga	Nitrogen Chemicals of Zambia Ltd	General Manager	P. O. Box 360226, Kafue. Tel: 260 – 1 – 312279 Fax: 260 – 1 – 312061/311706 Cell: 260 – 95 – 703254/ or 260-97-784698 Email:reubenmulenga@hotmail.com
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CDM UNIDO AFRICA PHASE II NATIONAL TEAM - ZAMBIA

Prof. Francis D. Yamba (CEEEZ)
Mr. D. J. Mbewe (CEEEZ)
Mr. A. A. Phiri (CEEEZ)
Mr. Emmanuel Matsika (CEEEZ)

APPENDIX D

DISCUSSION GROUPS

Group No.	Name	Institution/Organisation
1	Mr. J. J. Kanyembo (Chairman)	CBU
	Mr. R. Mulenga	NCZ
	Mr. A. Lungu	Indeco Milling
	Mr. N. G. Malunga	Sakiza Spinning
	Mr. W. Mulenga	Indeni Oil Petroleum
	Mr. K. Siame (Repertoire)	Copperbelt University
2	Ms. G. Zulu (Chairperson)	Ministry of Environment and Natural Resources ENR
	Mr. S. Mtambo (Repetoire)	Ministry of Commerce Trade and Industry
	Mr. E. Mauta	Indeni Oil Petroleum
	Mr. P. Zulu	ZACCI
	Mr. E. S. Chibuye	Citizen Breweries
	Mr. Mukonde	Institute for Waste Management
3	Mr. P. Chola (Chairman)	High Protein
	Mr. N. S. Samangwe (Repetoire)	Central Cigarettes
	Mr. C. Chamululu	Mines Safely Dept. Ministry of Mines and Minerals Development.
	Mr. David S. Lungu	Zambia National Oil Company
	Mr. Mhango	Zambia Pork Products
	Mr. J. Bwalya	Amanita Oils

APPENDIX E

QUESTIONNAIRE FOR THE GROUP ASSESSMENT ON BARRIERS

UNIDO PROJECT **GROUP 1**

DEVELOPING NATIONAL CAPACITY TO IMPLEMENT INDUSTRIAL CLEAN DEVELOPMENT MECHANISM PROJECTS IN AFRICA; PREPARATORY ASSISTANCE PHASE II

Group Assessment and Consensus on Barriers to the Transfer of Climate-friendly Industrial Technologies and Recommended Strategy for Removal

Note: Priority (High, Medium, Low)

A. Policy

Nature of The Barrier	Group Assessment	Strategy	Priority
Awareness on the need for energy efficiency from commercial/financial considerations at the following levels:			
• Management level	Awareness exist	❑ Enforce compliance	H
• Middle management level	Awareness exists	❑ Re-training (specialised in-house training)	H
• Operators Level	Awareness		
Awareness on CDM in general and its relation to business	None	Supply information on CDM	H
Awareness on benefits to accrue from CDM in relation to energy efficiency	None	Supply information	H
Existence of energy efficiency and conservation policy at company level	Exists	Compliance to strategy and policy	H
Awareness of the existence of government energy policy on energy efficiency	Low awareness	Disseminate information	H
Expectations on benefits/incentives from government based on its energy efficiency policy	Not aware	Enlightenment on benefits/incentives from policy by ministry (Dept. of Energy)	H

Existence of energy management department in your company	Exists	Incentives to personnel	H
Existence of overall environmental policy in your company	Exists	Compliance to strategy	H
Existence of cleaner production policy in your company	Exists	Compliance to policy	H
Duty and VAT on Imported Energy Efficiency Equipment	Exists	Lobby to govt. to have/remove duty and VAT	H
Environmental Regulatory Structures	Exists	Enforcement	H
Codes and Guides on Energy Efficiency	Not aware	Consult relevant ministry (if not available facilitate)	H

B. Technological

Nature of The Barrier	Group Assessment	Strategy	Priority
Awareness and knowledge on availability of information on climate - friendly industrial technologies	Aware	More information	M
Knowledge on selection of appropriate climate – friendly industrial technologies	Available	Acquisition of more basic and advanced information on available technology	M
Existence of a regular energy monitoring systems (energy audits) at company level.	Exists	Compliance	H
Existence of skilled manpower to undertake energy audits	Exists	Compliance and continuous training of personnel	H
Existence of skilled manpower to undertake baseline calculations and assessment of sustainable development under CDM, and Financial Analysis.	Not available	Training/recruitment	H
Existence of manpower to implement projects identified under energy audits	Exists	Compliance	H
Existence of instrumentation to undertake energy audits	Exists	Monitoring, compliance and purchase of current equipment	H

Existence of regular surveys and observations for the following: • Combustion efficiency and optimisation • Steam and heat losses, compressed air and flue gas losses from steam distribution piping and un-insulated surfaces • Integration of regular maintenance related to energy activities	• Not existence • Exists Exists	• Implement regular surveys and observation • Enforce regular surveys • Enforce and compliance	H H H
Existence of metering and/or flue gas analysis to improve combustion efficiency	Does not exist	Install meters	H
Existence of flue gas analysis for CO, CO_2 and O_2 to determine combustion efficiency and air fuel ratio.	Exists	Enforcement	H
Existence of insulation of steam/heat distributing piping aimed at reducing heat losses	Exits	Enforcement of maintenance and surveys	H
Existence of water treatment facilities and test equipment for determining boiler and feed water quality	Exists	Enforce compliance of maintenance	H
Existence of steam condensate recovery system	Exists	Maintenance	H
Existence of pre-heating of combustion air	Exists	Maintenance of equipment	H
Existence of heat recovery systems	Exists	Maintenance of existing systems	H
Availability of waste/wastewater from factory processes	Exists	Treat and re-circulate or recycle	H
Existence of automatic process control	Exists	Maintenance and improve existing system	H
Availability of planned and preventive maintenance – for boiler systems	Exists	Maintenance and improve existing system	H

C. Institutional/Financial

Nature of The Barrier	Group Assessment	Strategy	Priority
Does the need arise in your company to have support services for:			
• Energy audits and analysis	• Yes	• Hire consultant	M
• Cleaning and services, and test equipment and water treatment facilities	• No	• Maintain and improve existing system	M
• Baseline calculations and assessment of sustainable development under CDM, and Financial Analysis	• No	• Hire consultant	M
Availability of internal financial resources to implement energy efficiency measures	Not available	Source for grants/aid	H
Availability of external financial resources to implement energy efficiency measures	Not aware	Source for information on funder/donors	H
Availability of financial resources/time to obtain information on energy efficiency	• Financial resources are not available • Time is available	Source for funds (AID, Grants)	H
Are the prices of the fuel you use economic or subsidised?	Economic	Lobby government for subsides	H

UNIDO PROJECT

GROUP 2

DEVELOPING NATIONAL CAPACITY TO IMPLEMENT INDUSTRIAL CLEAN DEVELOPMENT MECHANISM PROJECTS IN AFRICA; PREPARATORY ASSISTANCE PHASE II

Group Assessment and Consensus on Barriers to the Transfer of Climate-friendly Industrial Technologies and Recommended Strategy for Removal

Note: Priority (High, Medium, Low)

A. Policy

Nature of The Barrier	Group Assessment	Strategy	Priority
Awareness on the need for energy efficiency from commercial/financial considerations at the following levels: • Management level • Middle management level • Operators Level	1. Inadequate information flow between different levels 2. Inadequate interaction between government and private sector [Public sector, private sector participation] 3. Use of unskilled manpower	1. Awareness creation on the need for efficiency at all levels 2. Public sector, private sector participation 3. Use of skilled personnel at lower levels	H M L
Awareness on CDM in general and its relation to business	Very little awareness on CDM, and also its relationship to business	Vigorous awareness campaign	H
Awareness on benefits to accrue from CDM in relation to energy efficiency	Little awareness on benefits	Evaluation of benefits to accrue	H
Existence of energy efficiency and conservation policy at company level	No policy on energy efficiency and energy conservation	Create awareness on the benefits of policy directed at top management	H
Awareness of the existence of government energy policy on energy efficiency	❑ Companies not aware ❑ It seems emphasis is only on one form of energy, electricity	❑ Awareness campaign ❑ Encourage use of alternative sources of energy	H M
Expectations on benefits/incentives from government based on its energy efficiency policy	No expectations since there is no awareness	Government to create: ❑ Awareness ❑ Incentives	 H M
Existence of energy management department in your company	Non existent	Create awareness to management	H

Existence of overall environmental policy in your company	Some do have, others do not have	Participation in environmental mgt courses offered by ZACCI	H
Existence of cleaner production policy in your company	Some do not have, but some companies do not have	Training at ZACCI	H
Duty and VAT on Imported Energy Efficiency Equipment	Tax rates are quite high	Exempt tax on environmentally friendly equipment	H
Environmental Regulatory Structures	They are not active	Strengthen the regulatory institution capacity	H
Codes and Guides on Energy Efficiency	For electricity through ZESCO but nothing on other forms of energy	Develop natural guides on energy efficiency	H

B. Technological

Nature of The Barrier	Group Assessment	Strategy	Priority
Awareness and knowledge on availability of information on climate - friendly industrial technologies	Awareness exists on climate-friendly industrial technologies , others are not aware	Create awareness on climate-friendly technologies	H
Knowledge on selection of appropriate climate – friendly industrial technologies	Some industries know which a few do not know	Custom the incremental cost that accrue with selection of such technologies	H
Existence of a regular energy monitoring systems (energy audits) at company level.	Its non-existent	Publicise the benefits that accrue with	H
Existence of skilled manpower to undertake energy audits	Very few auditors	Training of manpower to understand audits	H
Existence of skilled manpower to undertake baseline calculations and assessment of sustainable development under CDM, and Financial Analysis.	Manpower to do baseline is there, but they require specialisation	Undertake specialised training in CDM	M
Existence of manpower to implement projects identified under energy audits	Availability of manpower	To form a task force to co-ordinate	H
Existence of instrumentation to undertake energy audits	Others have, while others do not	To install and upgrade the existing instrumentation	H
Existence of regular surveys and observations for the following:		❑ In companies where they have not installed should put them into place	H

• Combustion efficiency and optimisation • Steam and heat losses, compressed air and flue gas losses from steam distribution piping and uninsulated surfaces • Integration of regular maintenance related to energy activities	It's there in some companies It's there in some companies It's there in some companies	❑ Factory inspectors in the Ministry of labour should enforce	H H
Existence of metering and/or flue gas analysis to improve combustion efficiency	None existent	Inspectorate from ECZ should enforce	H
Existence of flue gas analysis for CO, CO_2 and O_2 to determine combustion efficiency and air fuel ratio.	Partial existence	Monitoring by ECZ	H
Existence of insulation of steam/heat distributing piping aimed at reducing heat losses	Not there in some companies	Ensure that all pipes are insulated	H
Existence of water treatment facilities and test equipment for determining boiler and feed water quality	Readily available in some companies	Enforcement should continue and should be quality	L
Existence of steam condensate recovery system	There in some companies	To install where they are lacking	H
Existence of pre-heating of combustion air	Existent in some companies	Installed	L
Existence of heat recovery systems	Limited	Install where necessary	L
Availability of waste/wastewater from factory processes	Available in most companies	Enforcement should continue	H
Existence of automatic process control	Non-existent in most companies	Companies to install	H
Availability of planned and preventive maintenance – for boiler systems	Partially available partial	Put in place some preventive maintenance	L

C. Institutional/Financial

Nature of The Barrier	Group Assessment	Strategy	Priority
Does the need arise in your company to have support services for: • Energy audits and analysis • Cleaning and services, and test equipment and water treatment facilities • Baseline calculations and assessment of sustainable development under CDM, and Financial Analysis	Yes Yes Yes	Need to support this	H
Availability of internal financial resources to implement energy efficiency measures	Non-existent	Mobilise resources	H
Availability of external financial resources to implement energy efficiency measures	Not available	Prepare bankable projects	M
Availability of financial resources/time to obtain information on energy efficiency	Time is there, but no financial resources	Solicit for funding	M
Are the prices of the fuel you use economic or subsidised?	Economic prices	Use of alternative fuels	L

GROUP 3

UNIDO PROJECT

DEVELOPING NATIONAL CAPACITY TO IMPLEMENT INDUSTRIAL CLEAN DEVELOPMENT MECHANISM PROJECTS IN AFRICA; PREPARATORY ASSISTANCE PHASE II

Group Assessment and Consensus on Barriers to the Transfer of Climate-friendly Industrial Technologies and Recommended Strategy for Removal

Note: Priority (High, Medium, Low)

A. Policy

Nature of The Barrier	Group Assessment	Strategy	Priority
Awareness on the need for energy efficiency from commercial/financial considerations at the following levels: • Management level • Middle management level • Operators Level	 Aware Not aware Not aware	❑ Rolling out energy efficiency recognition/support ❑ Managers to be responsible for energy issues ❑ Training	 H
Awareness on CDM in general and its relation to business	Not aware	Initiate awareness	H
Awareness on benefits to accrue from CDM in relation to energy efficiency	Not aware	Create awareness	
Existence of energy efficiency and conservation policy at company level	Not formal Not available	To define policy	
Awareness of the existence of government energy policy on energy efficiency	Not aware	Government to disseminate	H
Expectations on benefits/incentives from government based on its energy efficiency policy	Not aware	"	

Existence of energy management department in your company	Not formalised	To put in place	
Existence of overall environmental policy in your company	Available		
Existence of cleaner production policy in your company	Generally none	Define policy on enforcement	H
Duty and VAT on Imported Energy Efficiency Equipment	Government to	Government to disseminate information and policy	H
Environmental Regulatory Structures	Available through ECZ	To enforce regulator structure	H
Codes and Guides on Energy Efficiency	Not available	To develop and enforce	H

B. Technological

Nature of The Barrier	Group Assessment	Strategy	Priority
Awareness and knowledge on availability of information on climate - friendly industrial technologies	None	Sensitise on benefits	H
Knowledge on selection of appropriate climate – friendly industrial technologies	Very little	As above	H
Existence of a regular energy monitoring systems (energy audits) at company level.	None	Make available the monitoring equipment	H
Existence of skilled manpower to undertake energy audits	Available	Utilisation of skilled labour	H
Existence of skilled manpower to undertake baseline calculations and assessment of sustainable development under CDM, and Financial Analysis.	Non existent, but potential is there	Training and development	H
Existence of manpower to implement projects identified under energy audits	Available	Utilisation	H
Existence of instrumentation to undertake energy audits	Not available	Procurement of instruments	H

Existence of regular surveys and observations for the following: • Combustion efficiency and optimisation • Steam and heat losses, compressed air and flue gas losses from steam distribution piping and un-insulated surfaces • Integration of regular maintenance related to energy activities	No Done Inadequate (not fully integrated)	Each company should have its own Continue Reinforcement	H H
Existence of metering and/or flue gas analysis to improve combustion efficiency	Reluctant to install		H
Existence of flue gas analysis for CO, CO_2 and O_2 to determine combustion efficiency and air fuel ratio.	Not available		H
Existence of insulation of steam/heat distributing piping aimed at reducing heat losses	Yes available		H
Existence of water treatment facilities and test equipment for determining boiler and feed water quality	Yes, available	Enhance	H
Existence of steam condensate recovery system	Yes, available		H
Existence of pre-heating of combustion air	Some have, others do not have	All boilers should have	H
Existence of heat recovery systems	Not available	Economisers to be used	H
Availability of waste/wastewater from factory processes	Available	Treat and recycle waste	H
Existence of automatic process control	No	Install auto - control	H
Availability of planned and preventive maintenance – for boiler systems	Available	Should be enhanced	H

C. Institutional/Financial

Nature of The Barrier	Group Assessment	Strategy	Priority
Does the need arise in your company to have support services for: • Energy audits and analysis • Cleaning and services, and test equipment and water treatment facilities • Baseline calculations and assessment of sustainable development under CDM, and Financial Analysis	Yes No Yes	Engaging Consultants Consultancy	H
Availability of internal financial resources to implement energy efficiency measures	Inadequate	Source funding	H
Availability of external financial resources to implement energy efficiency measures	Not available	Invite CDM investors	H
Availability of financial resources/time to obtain information on energy efficiency	Financial - No Time - Yes	Source funds	H
Are the prices of the fuel you use economic or subsidised?	Economic	Energy conservation optimisation	H

APPENDIX F

QUESTIONNAIRE FOR THE GROUP ASSESSMENT ON PRIORITISATION OF CDM PROJECTS

UNIDO PROJECT

GROUP 1

DEVELOPING NATIONAL CAPACITY TO IMPLEMENT INDUSTRIAL CLEAN DEVELOPMENT MECHANISM PROJECTS IN AFRICA; PREPARATORY ASSISTANCE PHASE II

Table 2: Group Assessment and Consensus Prioritisation on Potential CDM Projects

Nature of Potential CDM Project	Selection of Potential CDM Project	Priority
(i) House Keeping • Observation of preventive maintenance measures to include combustion efficiency optimisation, and reduction of steam and heat losses from boilers and furnaces	Boiler based on municipal waste to produce steam/electricity	H
(ii) Low Cost Measures • Combustion efficiency optimisation through institution of monitoring instrumentation to determine combustion efficiency • Use of heat recovery for pre-heating of combustion air • Boiler operation/process optimisation and control	As above. All would be incorporated in the plant	H
(iii) Retrofit/Capital Based Measures • Application of potential heat recovery systems for steam generation for different applications (electricity, process steam etc) • Use of waste material such as waste water/sludge from food and beverages industries to produce biogas (methane) for generation of power and heat. • Use of waste material such as bagasse, industrial/forestry waste in advanced state-of-the-art technologies (CEST) and biomass electric generating plants to produce heat and power	As above. But designed boiler must take various types of waste for heat generation	H
(iv) Others ❑ Recovery of CO_2 ❑ Recovery of heat ❑ Cleaning of flue gases	Inclusion of recovery plant for heat recovery from flue gases, clean flue gases. Pre-heating air to the boiler. Reduce CO2 emissions by recovery in liquid form for sell and also solid ice.	H

Note: Priority (H - High, M - Medium, L - Low)

UNIDO PROJECT

GROUP 2

DEVELOPING NATIONAL CAPACITY TO IMPLEMENT INDUSTRIAL CLEAN DEVELOPMENT MECHANISM PROJECTS IN AFRICA; PREPARATORY ASSISTANCE PHASE II

Table 2: Group Assessment and Consensus Prioritisation on Potential CDM Projects

Nature of Potential CDM Project	Selection of Potential CDM Project	Priority
(i) House Keeping • Observation of preventive maintenance measures to include combustion efficiency optimisation, and reduction of steam and heat losses from boilers and furnaces	Insulation of naked pipes to improve efficiency	H
(ii) Low Cost Measures • Combustion efficiency optimisation through institution of monitoring instrumentation to determine combustion efficiency • Use of heat recovery for pre-heating of combustion air • Boiler operation/process optimisation and control	Recovery of condensate	M
(iii) Retrofit/Capital Based Measures • Application of potential heat recovery systems for steam generation for different applications (electricity, process steam etc) • Use of waste material such as waste water/sludge from food and beverages industries to produce biogas (methane) for generation of power and heat. • Use of waste material such as bagasse, industrial/forestry waste in advanced state-of-the-art technologies (CEST) and biomass electric generating plants to produce heat and power	Co-generation from solid waste	H
(iv) Others Intensify use of bicycles		L

Note: Priority (H - High, M - Medium, L - Low)

UNIDO PROJECT

GROUP 3

DEVELOPING NATIONAL CAPACITY TO IMPLEMENT INDUSTRIAL CLEAN DEVELOPMENT MECHANISM PROJECTS IN AFRICA; PREPARATORY ASSISTANCE PHASE II

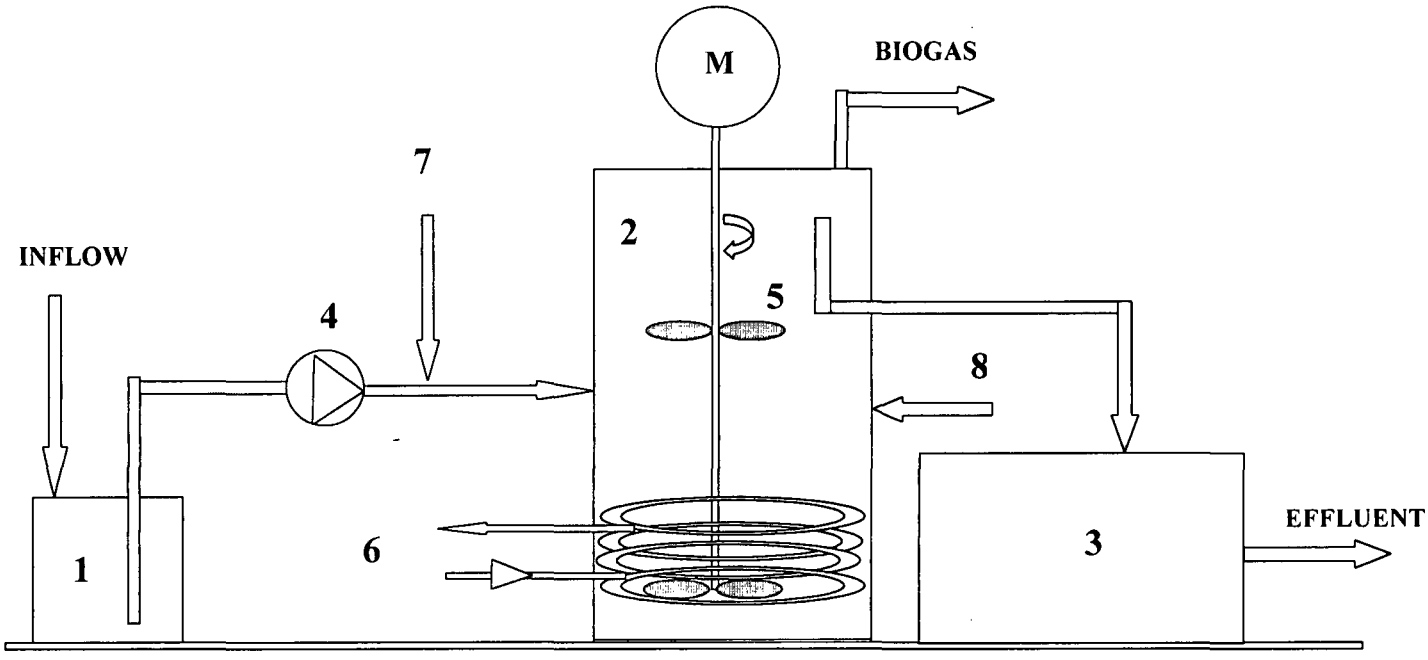
Table 2: Group Assessment and Consensus Prioritisation on Potential CDM Projects

Nature of Potential CDM Project	Selection of Potential CDM Project	Priority
(i) House Keeping • Observation of preventive maintenance measures to include combustion efficiency optimisation, and reduction of steam and heat losses from boilers and furnaces	1. Insulation/lagging of steam piping (big companies) to reduce heat losses through radiation	H
(ii) Low Cost Measures • Combustion efficiency optimisation through institution of monitoring instrumentation to determine combustion efficiency • Use of heat recovery for pre-heating of combustion air • Boiler operation/process optimisation and control	1. Installation of instrumentation to monitor combustion efficiency treads 2. Fitting economisers on boilers to reduce on coal waste by up to 40% 3. Boiler maintenance and operations procedure	H H M
(iii) Retrofit/Capital Based Measures • Application of potential heat recovery systems for steam generation for different applications (electricity, process steam etc) • Use of waste material such as waste water/sludge from food and beverages industries to produce biogas (methane) for generation of power and heat. • Use of waste material such as bagasse, industrial/forestry waste in advanced state-of-the-art technologies (CEST) and biomass electric generating plants to produce heat and power	1. Restoration of waste from boilers to other uses (e.g. geysers, turbines known as co-generation) 2. Ethanol blending Plant. Blending ethanol and petrol to cut down on the petrol importation. Mean time, the sugar plantation (the source of ethanol) acts as carbon sink 3. Use of forestry waste to produce paper and electricity by burning (combustion). Plantation acts was a carbon sink.	H
(iv) Others Solar water heaters Wind mills	1. To be used in the pre-heating of water to about 60°C before going to the boiler 2. To pump water	M L

Note: Priority (High, Medium, Low)

APPENDIX G
GENERATION OF BIOGAS FROM WASTE WATER FOR USE IN BOILERS

PROCESS SCHEME



1. Pre-treatment
2. Entec-CSTR Digester
3. Effluent Buffer
4. Feed Pump
5. Low Speed Mixer
6. Heating Tubes
7. Nutrient addition
8. Ph Adjustment

Figure G.1: Generation of Biogas From Waste Water For Use In Boilers

APPENDIX H

USE OF WASTE IN ADVANCED COMBUSTION EQUIPMENT RELATED TO STEAM GENERATION

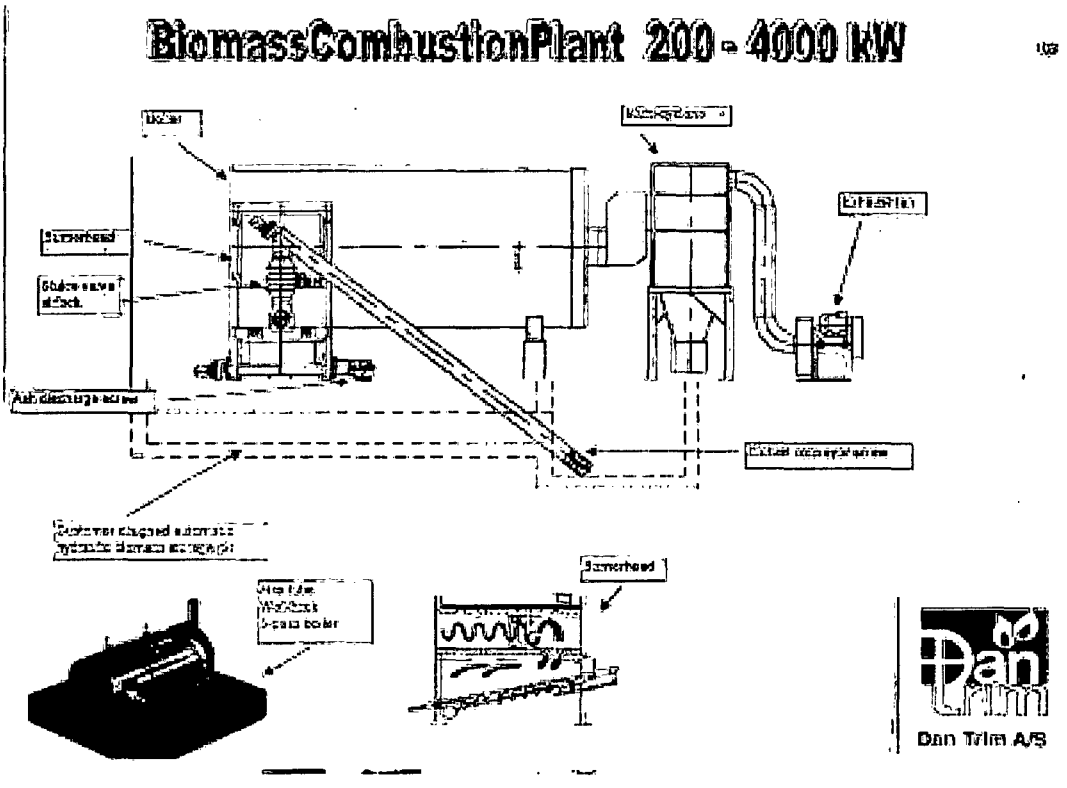


Figure H.1: Use of Waste in Advanced Combustion Equipment

Figure H.2: Use of Waste in Advanced Combustion Equipment

APPENDIX I

STEAM BASED INTERNAL COMBUSTION ENGINES

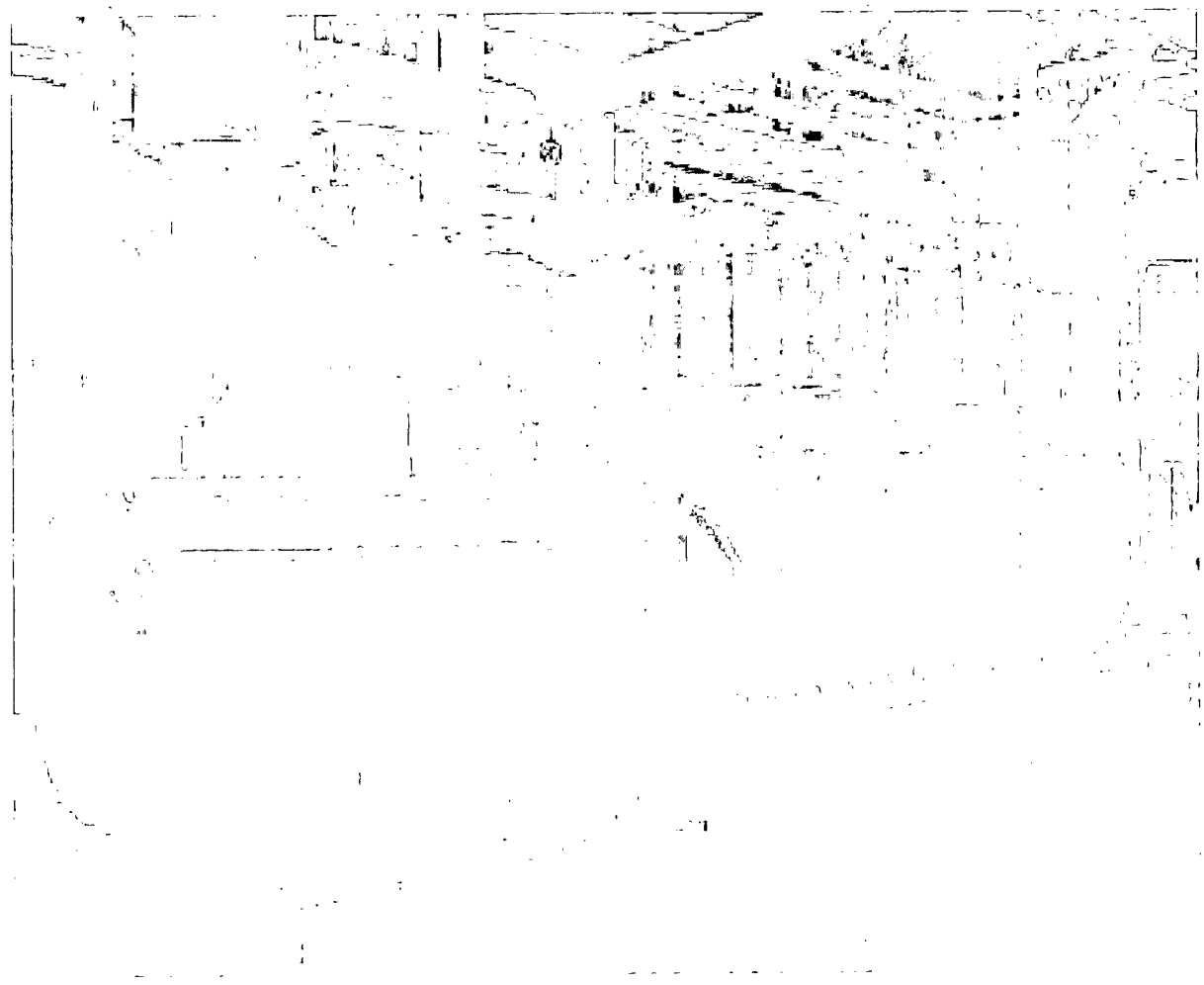


Figure I.1: Co-generation Based on Biomass Resources

APPENDIX J

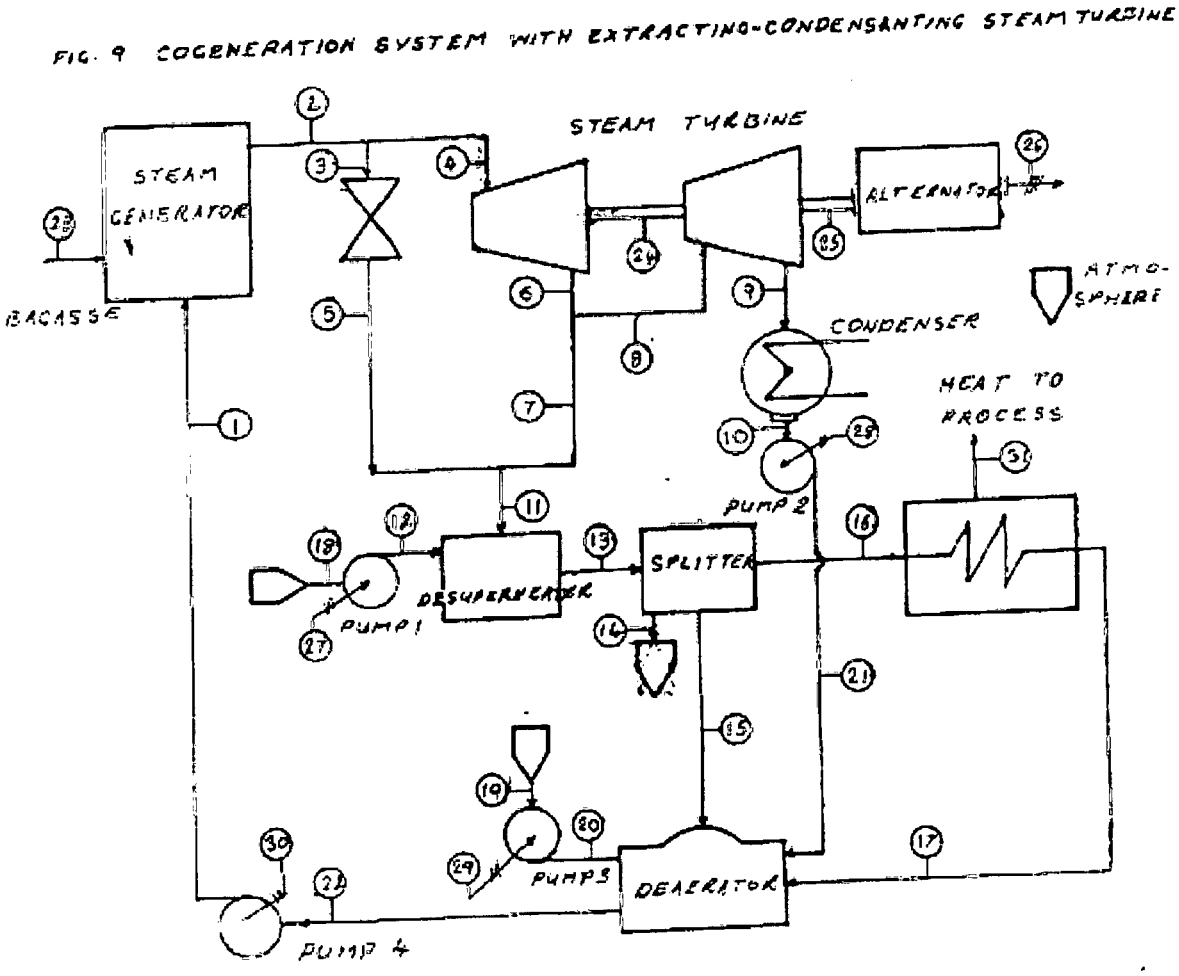


Figure J.1: Schematic Diagram of a Co-generation Plant

APPENDIX K

SOME ASPECTS OF PRELIMINARY ASSESSMENTS OF EACH OF THE IDENTIFIED PROJECTS

Project 1: Boiler Improvements and Retrofits	
Project Description	This project involves implementation of housekeeping and medium cost measures in virtually most of the industries identified (Food and Beverages, Textiles, Mining, and Chemical & Processing) through installation of the following: • Fuel and air monitoring equipment and /or gas analysis equipment • Insulation of un-insulated surfaces of steam distribution surfaces, and furnaces • Automatic control systems between the steam supply and process operations • Heat exchangers for pre-heating combustion air and feed water into boilers • Improved burner systems and recovery of condensate
Sustainable Development	The main sustainability benefits include: • Contributing to attainment of competitiveness at company level • Reduction of energy intensity per product • Transfer of technology and skills • Reduction of local air pollution (e.g. particulates, SO_2, CO)
Project Boundaries	The project boundaries are predominantly internal and direct sources of CO_2 from the companies identified.
Choice of Baseline/ Additionality	• In the absence of the project, the industries identified will continue using hydrocarbon fuel/coal inefficiently, thus leading to unnecessary increased release of CO_2 into the atmosphere • Additionality benefits of this project are reduced CO_2 emissions from improved combustion systems and use of retrofits
Estimated emissions savings	• Preliminary baseline emissions of identified companies are shown in Table 6 • Detailed emissions savings to be calculated in Phase III once relevant data has been collected
Effects on economics	Depending on the market value of CO_2 credits, the effects of sale of carbon credits on revenue base, profit and loss, IRR and NPV will be calculated in Phase III, once all the parameters/data have been collected (such as investment capital, O + M of existing and identified technologies and infrastructure)

Project 2: Generation of Methane (Biogas) from Wastes and slurries	
Project Description	This project involves generation of methane (biogas), mainly from food and beverages industries based on anaerobic treatment technologies through use of organic wastewater, organic sludges and organic solids. Examples of such include: • Organic waste from food and beverages industry • Slaughter house waste • Sewerage sludge The methane produced is used in boilers for combustion purposes to produce steam
Sustainable Development	The main sustainability benefits include: • Contributing to attainment of competitiveness at company level • Reduction of energy intensity per product • Transfer of technology and skills • Reduction of local air pollutants (e.g. particulates, SO_2, CO) • Reduction of organic effluents and pollutants • Production of fertilizer for agriculture industry, and hence contribute to reduction of imported fertilizers, and also save foreign currency
Project Boundaries	The project boundaries are predominantly internal and direct sources of CO_2 from the companies identified.
Choice of Baseline/ Additionality	• In the absence of the project, the industries identified will continue using liquid hydrocarbon fuel/carbon in boilers and furnaces, and consequently continue releasing CO_2 into the atmosphere • Use of methane or biogas, which is a more environmentally friendly gas in view of its lower carbon intensity, will go a long way towards reduction of use of liquid hydrocarbon fuels/coal for the purposes identified • Additionality benefits of this project are avoided CO_2 through either complete or partial substitution of hydrocarbon fuel/coal with methane, a more environmentally friendly gas
Estimated emissions savings	• Preliminary baseline emissions of identified companies are shown in Table 6 • Detailed emissions savings to be calculated in Phase III once relevant data has been collected
Effects on economics	Depending on the market value of CO_2 credits, the effects of sale of carbon credits on revenue base, profit and loss, IRR and NPV will be calculated in Phase III, once all the parameters/data have been collected (such as investment capital, O + M of existing and identified technologies and infrastructure)

Project 3: Use of Waste in Advanced Combustion Equipment and Steam Based Internal Combustion Engines	
Project Description	This project involves two technologies: • The first technology involves the use of waste (solid and gaseous), especially from the textile industries in specially designed burner heads to produce heat, which in turn produces steam through the combustion process. The burner heads and associated equipment can be connected to either new or existing boiler installations. • The second technology involves the use of the steam produced in the same manner as above in steam based internal combustion engines to produce electricity. The electricity produced can be used in electric boilers which can substitute liquid hydrocarbon and coal fired boilers and furnaces)
Sustainable Development	The main sustainability benefits include: • Contributing to attainment of competitiveness at company level • Reduction of energy intensity per product • Transfer of technology and skills • Reduction of local air pollution (e.g. particulates, SO_2, CO) • Reduction of waste, which is a nuisance and pollutant
Project Boundaries	The project boundaries are predominantly internal and direct sources of CO_2 from the companies identified.
Choice of Baseline/ Additionality	• In the absence of the project, the industries identified will continue using liquid hydrocarbon/coal in boilers and furnaces, and consequently continue releasing CO_2 into the atmosphere. • Use of wastes from each industry identified will contribute towards reduction of the liquid hydrocarbon/coal fuels. Equally, use of steam to produce electricity from steam based ICE will encourage use of electric boilers, which in turn will completely substitute liquid hydrocarbon/coal fired boilers and furnaces • Additionality benefits include avoidance of CO_2 through use of waste in the combustion system, and or replacement of hydrocarbon/coal fuels with electric boilers
Estimated emissions savings	• Preliminary baseline emissions of identified companies are shown in Table 6 • Detailed emissions savings to be calculated in Phase III once relevant data has been collected
Effects on economics	Depending on the market value of CO_2 credits, the effects of sale of carbon credits on revenue base, profit and loss, IRR and NPV will be calculated in Phase III, once all the parameters/data have been collected (such as investment capital, O + M of existing and identified technologies and infrastructure)

Project 4: Use of LPG for Steam Generation in Boilers	
Project Description	This project involves use of LPG to substitute liquid hydrocarbon/coal fuels used in boilers and furnaces for process steam generation. LPG will be produced from Indeni Petroleum Refinery from flared gases
Sustainable Development	The main sustainability benefits include: • Contributing to attainment of competitiveness at company level • Reduction of energy intensity per product • Reduction of local air pollutants from Indeni to surrounding areas
Project Boundaries	The project boundaries are both direct and indirect. Direct sources include emission production at company level through use of liquid hydrocarbons/coal fuels in boilers and furnaces. Indirect source involves production of CO_2 from flared gases at Indeni.
Choice of Baseline/ Additionality	• In the absence of the project, the identified industries will continue using liquid hydrocarbon/coal fuels in boilers and furnaces and hence contribute to release of CO_2 into the atmosphere. Equally, Indeni will continue releasing CO_2 into the atmosphere from flared gases. • Additionality benefits of this project are the avoided CO_2 emissions from substituting liquid hydrocarbon/coal fuels used in boilers and furnaces with LPG, which is an environmentally friendly gas, in view of its low carbon intensity. Other benefits include avoided CO_2 from flared gases at Indeni.
Estimated emissions savings	• Preliminary baseline emissions of identified companies are shown in Table 6 • Detailed emissions savings to be calculated in Phase II once relevant data has been collected
Effects on economics	• Depending on the market value of CO_2 credits, the effects of sale of carbon credits on revenue base, profit and loss, IRR and NPV will be calculated in Phase III, once all the parameters/data have been collected (such as investment capital, O + M of existing and identified technologies and infrastructure)

Project 5: Co-generation Based on Biomass Resources	
Project Description	This project involves use of bagasse from Nakambala Sugar Company Plc in the state-of-the-art technologies called Condensing Extraction Steam Turbines (CEST) to produce more steam and surplus electricity for own use and export to the national grid (ZESCO)
Sustainable Development	The main sustainability benefits include: • Contributing to attainment of competitiveness at company level • Reduction of energy intensity of the product, sugar • Transfer of technology and skills • Reduction of local air pollution from coal combustion during the off season
Project Boundaries	The project will displace CO_2 emissions from internal use of coal, which is currently used to supplement bagasse during the off season, due to the inefficient manner of the use of bagasse in traditional boilers
Choice of Baseline/ Additionality	• In the absence of the project, Nakambala will continue using coal to supplement bagasse during the 'off season' to produce electricity due to the inefficient manner of the use of bagasse in traditional boilers. CEST uses high pressure boilers and efficient combustion systems to ensure available bagasse lasts throughout the year. • Additionality benefits includes avoidance of coal and hence CO_2 during 'off season' when bagasse is exhausted
Estimated emissions savings	• Preliminary baseline emissions of identified companies are shown in Table • Detailed emissions savings to be calculated in Phase II once relevant data has been collected
Effects on economics	• Depending on the market value of CO_2 credits, the effects of sale of carbon credits on revenue base, profit and loss, IRR and NPV will be calculated in Phase III, once all the parameters/data have been collected (such as investment capital, O + M) of existing and identified technologies and infrastructure

Project 6: Conversion of liquid hydrocarbon/coal fired boilers into hydro based electric boilers	
Project Description	The project involves conversion of liquid hydrocarbon/coal fired boilers into hydro based electric boilers in most of the identified companies
Sustainable Development	The main sustainability benefits include: • Reduction of local air pollution (e.g. particulates, SO_2, CO)
Project Boundaries	The project involves single point sources of direct emissions from identified companies
Choice of Baseline/ Additionality	• In the absence of the project, the identified companies will continue using liquid hydrocarbon/coal fuels in boilers and furnaces. Since Zambia is 95% hydro based, conversion to hydro based electric boilers will substitute this scenario. • Additionality benefits include avoidance of CO_2 from combustion of liquid hydrocarbon/coal fuels in boilers and furnaces.
Estimated emissions savings	• Preliminary baseline emissions of identified companies are shown in Table 6 • Detailed emissions savings to be calculated in Phase II once relevant data has been collected
Effects on economics	• Depending on the market value of CO_2 credits, the effects of sale of carbon credits on revenue base, profit and loss, IRR and NPV will be calculated in Phase III, once all the parameters/data have been collected (such as investment capital, O + M) of existing and identified technologies and infrastructure